

MONTCLAIR BOARD OF EDUCATION

District-Wide Energy Savings Plan

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Honeywell

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MONTCLAIR BOARD OF EDUCATION

District-Wide Energy Savings Plan

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SECTION A EXECUTIVE SUMMARY

Honeywell is pleased to submit this Energy Savings Plan for the Montclair Board of Education (Montclair BOE). During the development of the Energy Savings Plan, Honeywell has completed a thorough investment grade energy audit of the Montclair BOE's buildings and grounds. Based on the audit findings and Honeywell's extensive experience in working with school districts, we can confidently state that we can deliver a financially viable, comprehensive solution to address Montclair BOE's facility concerns and goals. Our Energy Savings Plan includes projects that achieve energy and operational efficiencies, create a more comfortable and productive environment and are actionable via the New Jersey Energy Savings Improvement Program (NJ ESIP) in accordance with NJ PL2012, c.55.

The Energy Savings Plan is the core of the NJ ESIP process. It describes the energy conservation measures that are planned and the cost calculations that support how the plan will pay for itself through the resulting energy savings. Under the law, the Energy Savings Plan must address the following elements:

- The results of the energy audit;
- A description of the energy conservation measures (ECMs) that will comprise the program;
- An estimate of greenhouse gas reductions resulting from those energy savings;
- Identification of all design and compliance issues and identification of who will provide these services;
- An assessment of risks involved in the successful implementation of the plan;
- Identify the eligibility for, and costs and revenues associated with, the PJM Independent System Operator for demand response and curtail-able service activities;
- Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings;
- Maintenance requirements necessary to ensure continued energy savings, and describe how they will be provided; and
- If developed by an ESCO, a description of, and cost estimates of a proposed energy savings guarantee.

The purpose of this document is to provide all the information required for the Montclair BOE to determine the best path forward in the implementation of a District-Wide NJ ESIP Project. It is important to note that the Energy Savings Plan provides a comprehensive evaluation of ALL potential ECMs within the Montclair BOE. This is not meant to infer that all the ECMs identified can be implemented. However, if the ECM is part of this plan, it may be implemented later as additional funding becomes available or technology changes to provide for an improved financial return.

Our Energy Savings Plan is structured to clearly demonstrate compliance with the NJ ESIP law, while also presenting the information in an organized manner which allows for informed decisions to be made. The information is divided into the following sections:

A. Executive Summary (This Section)

B. Preliminary Utility Analysis – The Preliminary Utility Analysis (PUA) defines the utility baseline for the Montclair BOE buildings included in the Energy Savings Plan. It provides an overview of the current usage and a cost per square foot by building of utility expenses. The report also compares the Montclair BOE's utility consumption to that of other districts in the same region on a per square foot basis.

C. Energy Conservation Measures – This section includes a detailed description of the ECMs we have selected and identified for your School District. It is specific to your facilities in scope, savings methodology and environmental impact. It is intended to provide a basis of design for each measure in narrative form. It is not intended to be a detailed specification for construction. ALL potential ECMs for the Montclair BOE are identified for the purposes of potential inclusion in the program. Final selected ECMs are to be determined by the Montclair BOE in conjunction with Honeywell during the project development phase of the NJ ESIP process.

D. Technical and Financial Summary – This section includes an accounting of all technical and financial outcomes associated with the ECMs as presented on the New Jersey Board of Public Utilities Forms II through IV. Information detailed on the forms includes projected implementation hard costs, projected energy savings, projected operational savings and projected environmental impact. Form VI: Annual Cash Flow Analysis provides a “rolled-up” view of the overall project financials, inclusive of financing costs, on an annual basis as well as over the entire 15 or 20-year term of the agreement.

E. Measurement & Verification and Maintenance Plan – This section identifies the intended methods of verification and measurement for calculating energy savings. These methods are compliant with the International Measurement and Verification Protocols (IMVP), as well as other protocols previously approved by the Board of Public Utilities (BPU) in New Jersey. This section also includes the recommended maintenance requirements for each type of equipment. Consistent maintenance is essential to achieving the energy savings projected in this plan.

F. Design Approach – This section includes a summary of Honeywell’s best practices for the successful implementation of a NJ ESIP project. It includes a project specific Safety Management Plan and provides an overview of our project management procedure, construction management and a sample schedule for the overall completion of the project. Within the schedule, we clearly define the tasks directed towards compliance with architectural, engineering and bidding procedures in accordance with New Jersey Public Contracts Law.

G. Independent Energy Audit – This section includes, for reference, the independent energy audits as previously received by the Montclair BOE through the Local Government Energy Audit (LGEA) program. The audits provided by TRC have been included on a USB drive as Appendix 1. A comparison can be made between the ECMs outlined in this Independent Energy Audit and the additional ECMs described in the overall Energy Savings Plan.

H. Energy Calculations and Greenhouse Gas Reduction Summary – This section titled Appendix 2: ECM Calculations includes all the energy calculations required to ensure compliance with the law and to confirm the energy savings can, and will, be achieved. These calculations are subject to an independent 3rd party engineering firm review for verification.

I. **Equipment Cut-sheets –** This section titled Appendix 3: Equipment Cut-sheets includes specification data for the equipment which shall be utilized as the basis of design for plans and specifications during the subsequent project development and NJ public bid phase.

J. **Safety Management Plan –** This section titled Appendix 4: Safety Management Plan establishes a plan for the implementation of Honeywell's Safe Operations Management (SOM) program. The document includes procedures and requirements specific to the Montclair BOE necessary to support a safe workplace for all stake holders. The Safety Management Plan is a living document, which will be updated and modified to maintain its relevance throughout the project as site conditions and circumstances change.

Benefits

The measures investigated in this Energy Savings Plan could result in an annual utility savings of 2,052,491 kWh of electricity and save 291,481 therms of natural gas. Additionally, these energy savings will result in a net reduction of greenhouse gases and will reduce the school district's carbon footprint by 2627 MTE of CO_2 annually. This is equivalent to removing 554 cars from the road annually and /or 2488 forested acres per year. All these savings are achieved while improving the classroom environment and renewing many items that have been in service beyond useful life expectancy.

In accordance with the NJ ESIP process, the next step in the project development phase is for Honeywell to provide our recommendations and for the Montclair BOE to select the desired content of the project based upon the Montclair BOE's unique goals and objectives. The selections will consider the projected costs, projected energy and operational savings, available financing options at the time of the agreement, interest rates, length of term and Montclair BOE priorities, which will all play a part in the final selection and cash flow of ECMs. The definitive requirement under NJ PL2012, c.55 is that the project is self-funding within the 15 or 20-year term as outlined in the legislation.

Overall, it is evident that the Montclair BOE is well positioned to implement a program that will upgrade your facilities, while funding itself within the requirements of the law and with zero impact on your taxpayer base. We welcome this opportunity to partner with the Montclair BOE to improve the comfort and efficiency of your facilities through the successful implementation of this Energy Savings Plan.

Sincerely,



Joseph Coscia
Sr. Business Consultant

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SECTION B PRELIMINARY UTILITY ANALYSIS

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Honeywell

Preliminary Utility Analysis

Montclair Township Board of Education
Montclair, NJ



Helping customers manage energy resources to improve financial performance

Executive Summary

Honeywell would like to thank you for the opportunity of providing you with this Preliminary Utility Analysis. A one year detailed billing analysis was completed for all utility data provided by your staff. The facility's electric and gas consumption were compared to a benchmark of typical facilities of similar use and location. It should be noted however, that some of Buildings which make up the benchmarking standards are not equipped with mechanical cooling (air conditioning). Therefore, these buildings may unjustly appear to be less efficient in comparison.

Through our Energy Services offerings, Honeywell's goal is to form a long term partnership for the purpose of meeting your current infrastructure needs by focusing to:

- Improve Operational Cost Structures
- Ensure Satisfaction
- Upgrade Infrastructure While Reducing Costs
- Meet Strategic Initiatives
- Leverage Teamwork
- Pursue Mutual Interests
- Provide Financing Options

How does it work?

Under an energy retrofit solution, Honeywell installs new, energy efficient equipment and optimizes your facility, as part of a multi-year service contract. Most of these improvements are cost-justified by energy and operational savings. Some of the energy conservation measures provide for a quick payback, and as such, would help offset other capital intensive energy conservation measures such as, boilers, package rooftop units, domestic hot water heaters, etc. The objective is to provide you with reduced operating costs, increased equipment reliability, optimized equipment use, and improved occupant comfort.

After review of the utility analysis, you can authorize Honeywell to proceed with the development of a detailed engineering report. The report development phase allows Honeywell to prepare an acceptable list of proposed energy conservation measures, which are specific to the selected facility. Some examples of typical Energy Conservation Measures include:

- Lighting
- Control Systems
- Boilers
- AC Units/Condensers
- Building Enevelope
- Package Rooftop Units
- Domestic Hot Water Heaters
- Plug Load Management

Why Honeywell?

- Honeywell is one of the world leaders in providing infrastructure improvements
- With Honeywell as your building partner, you gain the advantage of more than 115 years of leadership in building services
- Honeywell has the infrastructure and manpower in place to manage and successfully implement your project
- Honeywell has over 30 years experience in the energy retrofit marketplace with over $5 Billion in customer energy savings
- Honeywell provides you with "Single Source Responsibility" - from Engineering to Implementation, Servicing and Financing (if desired)

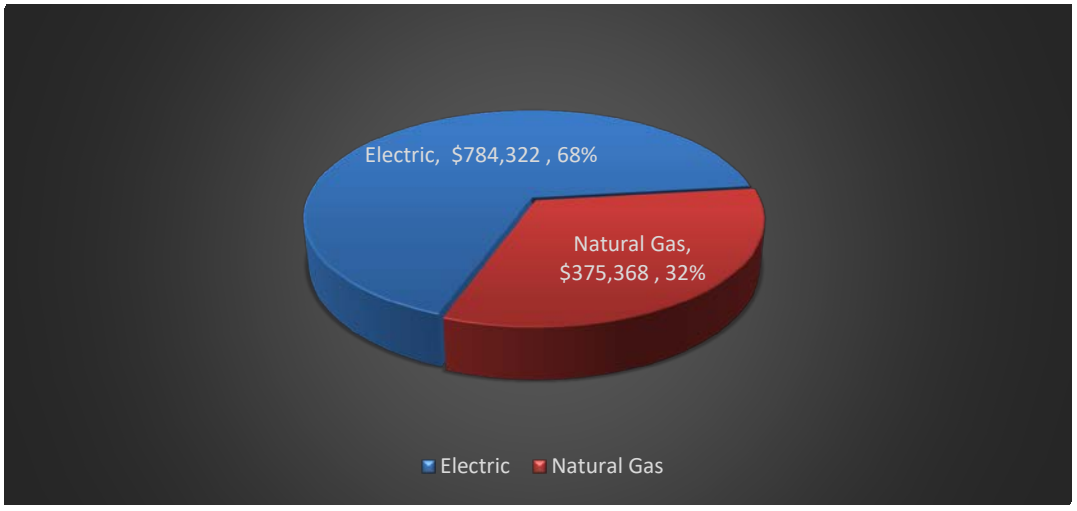
Historical Summary

Utility Analysis Period:
March 2019 through February 2020

	Electric	Natural Gas
Utility Costs*	$784,322	$375,368
Utility Usage (kWh, Therms)	5,536,584	477,378
$ Cost/Unit (kWh, Therms)	$0.14166	$0.786
Annual Electric Demand (kW)	22,045	

* Costs include energy and demand components, as well as taxes, surcharges, etc.

Actual Cost by Utility
March 2019 through February 2020



Total Cost
$1,159,690

Energy Benchmarking

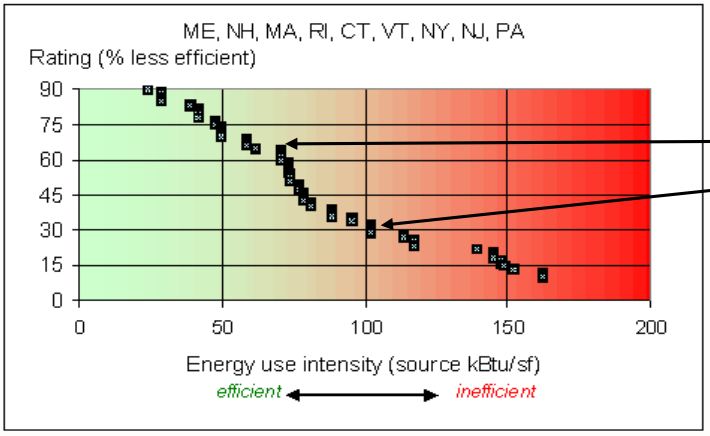
The calculation of EUI (Energy Use Intensity) is shown below. EUI, expressed in kBtu/sf, is normalized for floor area, the most dominant influence on energy use in most buildings. Its use usually provides a good approximation of how your building's energy performance compares to others. Site EUI indicates the rate at which energy is used at your building (the point of use). Source EUI indicates the rate at which energy is used at the generation sources serving your building (the point of source) and indicates the societal energy penalty due to your building The lower the EUI, the higher the rating, indicating that the building is more efficient than other buildings. The greater the EUI, the lower the rating, indicating that there is an opportunity for higher potential benefits from operational improvements.

The Source EUI below has been applied to a Department of Energy statistical model from the Oak Ridge National Laboratory web site, http://eber.ed.ornl.gov/benchmark. The Department of Energy has estimated energy use and cost reductions for building source EUI ratings (percentiles) in the table below. Please see the DOE Regional Source EUI Comparison graph below to rate your building in relation to the regional distribution of similar type buildings. (Note: The Source EUI includes the inefficiencies of electrical generation and transmission. A reduction in 'electrical' source EUI includes a benefit in terms of reduction of air pollution emissions and green house gases, and is thus an indicator of societal benefit.)

Source EUI Rating for your Building	Energy use and cost reduction potential (%)	Walk-thru energy assessment recommended?
above 60%	below 25%	No
40 to 60%	20 to 35%	Maybe
20 to 40%	35 to 50%	Yes
Below 20%	above 50%	Definitely

Site EUI Rank		Annual Total Electrical Use (kWh)	Annual Total Non-Electrical Fuel Use (Therms)	Building Gross Floor Area (sq-ft)	Site EUI Rating	Source EUI: Annual Total Source Energy Use per Sq-Ft (kBtu/sf)	Rating (Regional Source EUI Comparison)
1	Bradford Elementary School	316,377	25,827	58,129	**63**	**101**	**50%**
2	Bullock Elementary School	478,514	0	84,017	**19**	**59**	**29%**
3	Buzz Aldrin Middle School	620,172	59,576	58,128	**139**	**213**	**100%**
4	Edgemont Elementary School	94,680	25,462	34,638	**83**	**102**	**51%**
5	Glenfield Middle School	787,484	41,873	125,281	**55**	**98**	**49%**
6	Valley Road Complex	657,410	73,682	172,102	**56**	**82**	**41%**
7	Montclair High School	948,990	75,388	262,855	**41**	**66**	**33%**
8	George Inness Annex (HS-9th), Athletics	552,617	44,390	89,261	**71**	**114**	**57%**
9	Nishuane K-2	221,790	39,290	87,440	**54**	**71**	**36%**
10	Northeast Elementary School	267,450	22,259	56,549	**55**	**88**	**44%**
11	Renaissance Middle School	154,890	19,369	37,167	**66**	**95**	**48%**
12	Watchung Elementary School	219,090	28,783	52,109	**70**	**99**	**49%**
13	Woodman Field	217,120	21,480	13,184	**219**	**333**	**100%**

School Facilities



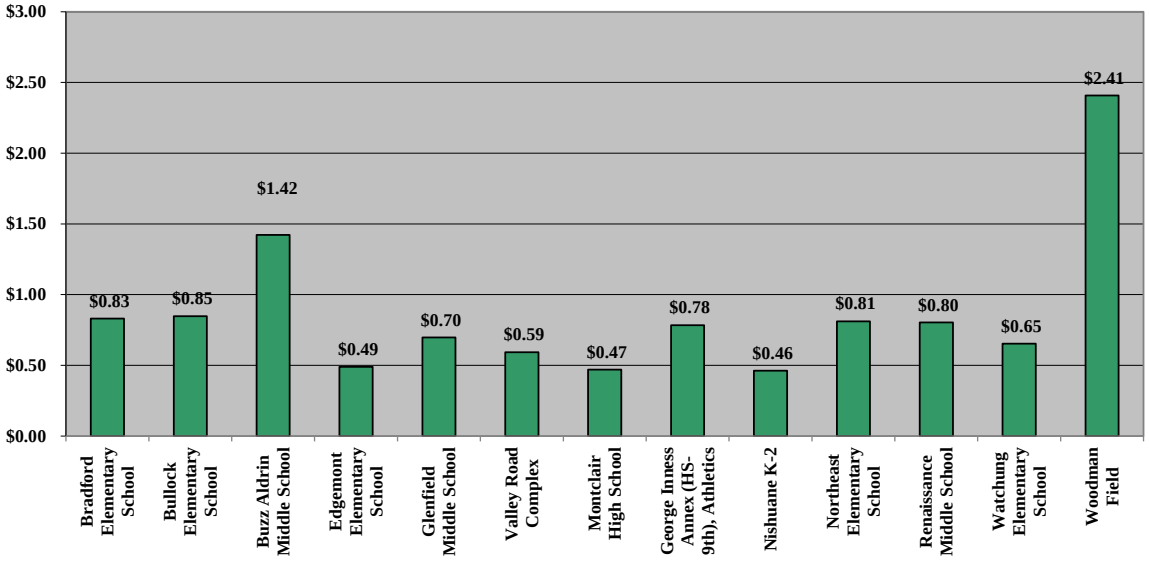
*Note that the Valley Road Complex represents the Board of Education Offices, Community Pre-K, Central Heating Plant, and Hillside Elementary School, due to their shared/district steam heating system.

Source EUI	Est Regional Rating	Building
101	50%	Bradford Elementary School
59	29%	Bullock Elementary School
213	100%	Buzz Aldrin Middle School
102	51%	Edgemont Elementary School
98	49%	Glenfield Middle School
82	41%	Valley Road Complex
66	33%	Montclair High School
114	57%	George Inness Annex (HS-9th), Athletics
71	36%	Nishuane K-2
88	44%	Northeast Elementary School
95	48%	Renaissance Middle School
99	49%	Watchung Elementary School
333	100%	Woodman Field

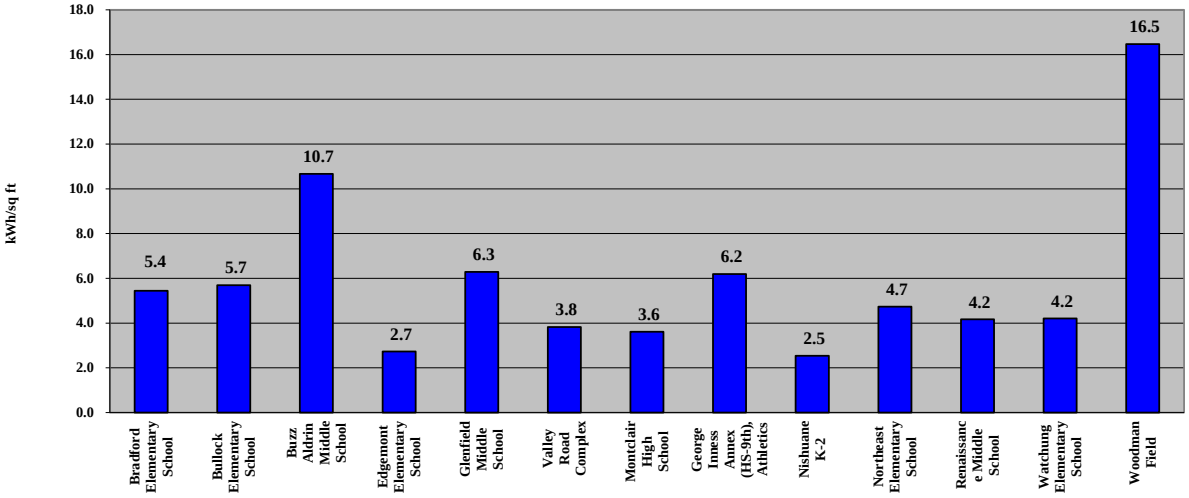
Utility Analysis
Electric

Square Footage Analysis

Cost per Sq. Ft.

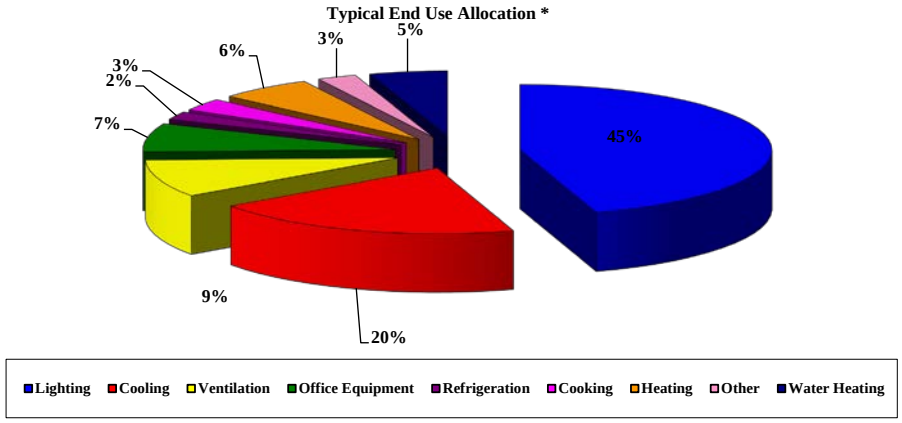


Usage (kWh per Sq. Ft.)



Utility Analysis

Sources of Electric Consumption



**This allocation is generic and is not a representation of the actual end use in your buildings included in this report.

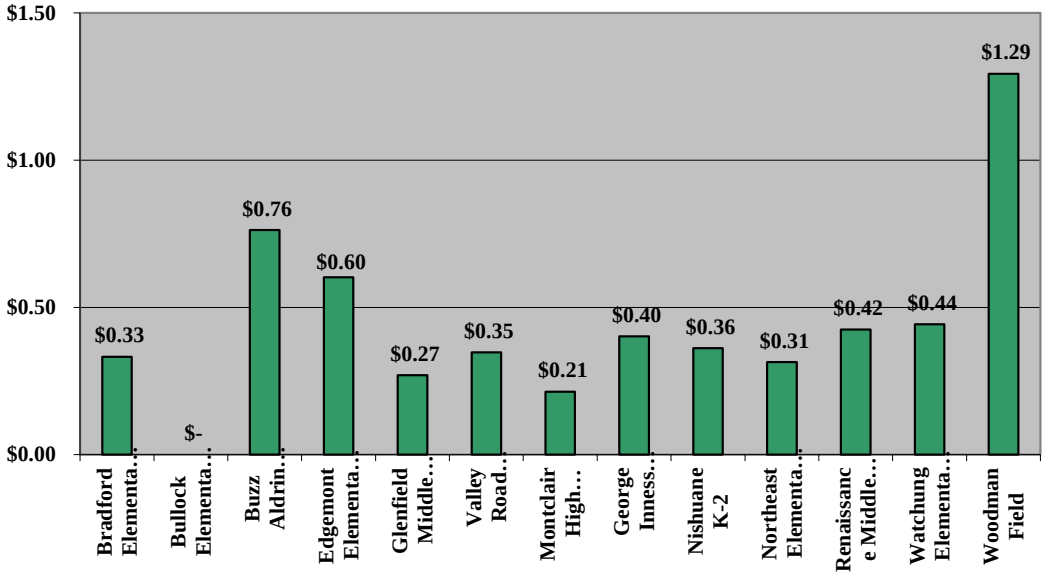
Typical Allocation Applied to Your Electric Cost**

	Lighting	$352,945
	Cooling	$156,864
	Ventilation	$72,158
	Office Equipment	$54,903
	Refrigeration	$15,686
	Cooking	$23,530
	Heating	$47,059
	Other	$19,608
	Water Heating	$39,216
Your Total Cost	**March 2019 through February 2020**	**$784,322**

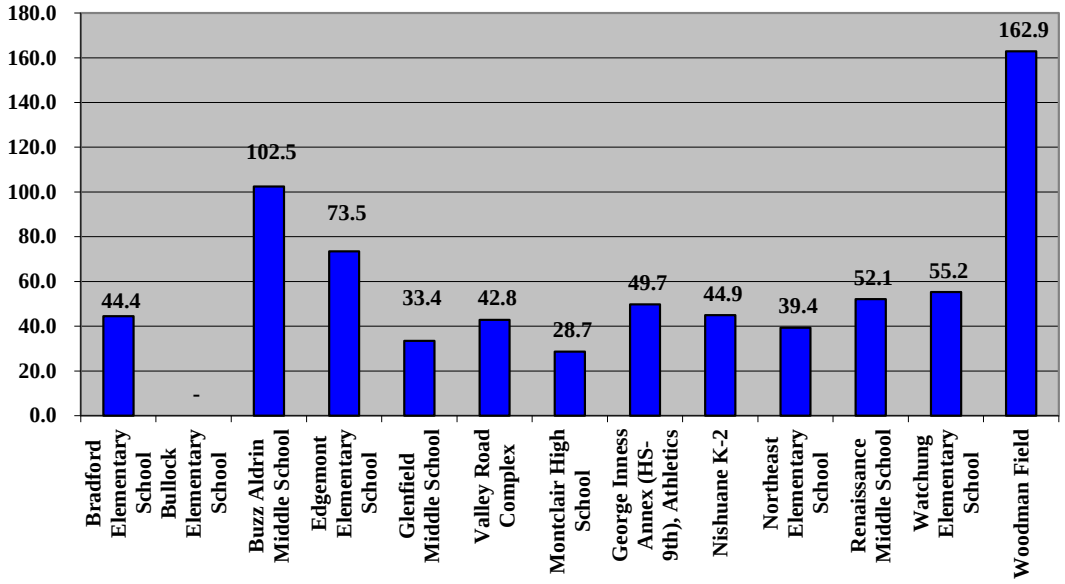
Utility Analysis

Natural Gas

Square Footage Analysis
Cost per Sq. Ft.



Usage (kBtu per Sq. Ft.)

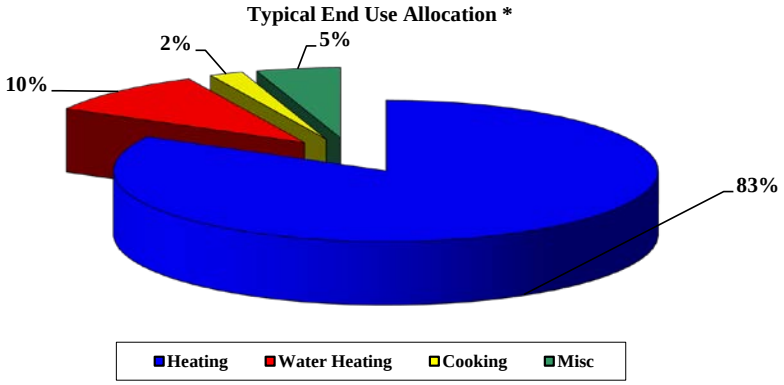


There is a fairly direct correlation between your gas usage and heating degree days, indicating that the vast majority of your natural gas usage is for space heating.

Utility Analysis

Natural Gas

Sources of Usage
Natural Gas



**This allocation is generic and is not a representation of the actual end use in your buildings included in this report.

Typical Allocation Applied to Your Cost**
Natural Gas

	Heating	$311,556
	Water Heating	$37,537
	Cooking	$7,507
	Misc	$18,768
Your Total Cost	**March 2019 through February 2**	**$375,368**

Annual Emissions & Environmental Impact

Montclair Township Board of Education

Calendar Year March 2019 through February 2020

The following energy usage, cost and pollution have been quantified:

Total Annual Electric usage	5,536,584	kWh
Annual Natural Gas usage	477,378	Therms

Annual Greenhouse Gas Emissions

CO2	13,381,400	pounds
SO2	25,524	pounds
NOx	17,440	pounds

This is equivalent to one of the following:

300	No. of passenger vehicles - annual greenhouse gas emissions
176,715	Gallons of gasoline consumed - CO_2 emissions
3,653	Barrels of oil consumed - CO_2 emissions
134	No. of homes energy use for one year - CO_2 emissions
40,282	No. of tree seedlings grown for 10 years - carbon sequestered
335	No. of acres of pine or fir forests - carbon sequestered annually
65,458	No. of propane cylinders used for home barbeques - CO_2 emissions
8	No. of railcars' worth of coal burned - CO_2 emissions

Based on the US Environmental Protection Agency -
Clean Energy Power Profiler



Potential Retrofits

Retrofit Description	Utility/Fuel Type	Symptomatic Issues	Common Recommendations for Action
Lighting Retrofit and Motion Sensors	Electric/Natural Gas	Elevated EUI	Lighting and Controls UpGrade
De-Stratification Fans	Electric/Natural Gas	Elevated EUI	Redistribution of Conditioned Air
DHW Boiler Replacements	Electric/Natural Gas	Elevated EUI	Higher Efficiency Units
Classroom Unit Replacments	Electric	Elevated EUI	Higher Efficiency Units
RTU Replacements	Electric/Natural Gas	Elevated EUI	Higher Efficiency Units
Boiler Replacements	Natural Gas	Elevated EUI	Higher Efficiency Units
Burner Replacements	Natural Gas	Elevated EUI	Decrease Thermal Losses
Building Envelope Improvements	Electric/Natural Gas	Elevated EUI	Reduce Building In leakage
Roof Top Unit Replacements	Electric	Elevated EUI	Lower Energy Consumption
Computer Controllers	Electric	Elevated EUI	Lower Energy Consumption
Install Premium Efficient Motors	Electric	Elevated EUI	Lower Energy Consumption
CHP	Electric/Natural Gas	Elevated EUI	Lower Energy Consumption
Load Reduction	Electric	Elevated EUI	Lower Energy Supply Side Consumption

SECTION C ENERGY CONSERVATION MEASURES

INTRODUCTION

The information used to develop this Section was obtained through the independent energy audit building surveys to collect equipment information, interviews with operators and end users, and an understanding of the components to the systems at the sites. The information obtained includes nameplate data, equipment age, condition, the system's design and actual load, operational practices and schedules, and operations and maintenance history.

Honeywell has done a review of the ECMs which would provide energy and cost savings to the Montclair Township BOE. This report aims to be an assessment of the feasibility and cost effectiveness of such measures, and an indication of the potential for their implementation. The ECMs listed below have been reviewed throughout your facilities for consideration within a complete Energy Savings Plan. What follows is a general description of the energy auditing process and the detailed descriptions of the available ECMs for your facilities.

ENERGY CONSERVATION MEASURES

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1A LED Lighting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
1B Lighting Controls		●					●			●						
1C Vending Misers		●			●					●						
1D De-Stratification Fans	●		●	●	●		●			●	●	●	●	●	●	
1E Plug Load Management via Wi-Fi	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
2A Boiler Upgrade		●	●							●	●			●	●	
2A.1 Vacuum Tank Replacements	●		●	●				●		●	●	●		●	●	
2B Boiler Burner Replacement & Controls	●			●				●				●	●	●	●	
2C Domestic Hot Water Replacement		●		●			●				●	●	●			
2D Rooftop Unit Replacement (DI)	●									●	●		●			●
2E Kitchen Hood Controls	●	●		●	●		●			●	●	●	●			●
2F Walk-In Compressor Controls		●								●	●					
2G Premium Efficiency Motors and VFDs								●		●	●					
2H Piping Insulation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2I Split System Replacement					●		●			●	●		●			
2J Steam Trap Replacement	●		●	●		●	●	●	●	●	●	●	●	●	●	●
2K Air Handling Unit Refurbishment					●											

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
3A Building Management Control System	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
3B Demand Control Ventilation (in BMS scope)					●		●						●	●		
3C Exhaust Fan Controls (in BMS scope)	●	●	●		●	●				●			●		●	●
4A Building Envelope Improvements	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
5A Computer Power Management	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
6A Permanent Load Reduction	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
7A Transformer Replacement	●										●					
8A Cogeneration					●											
9A Roof Re-sealing	●		●	●	●	●	●			●	●	●	●	●	●	●
10A Kitchen Equipment Conversion	●		●	●	●		●					●	●			
11A Solar Power Purchase Agreement	●		●	●	●	●	●		●	●	●	●	●	●	●	●
12A Water Conservation (DI)	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
13A Window Film	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

ECMs Included in Recommended Project ●
ECMs Analyzed for Alternate Projects ●

OVERVIEW

Honeywell has closely evaluated and audited the District to develop the optimum mix of energy saving measures. These site-specific measures have been selected and developed using the following process:

- Review Site Audits
- Engineering Team Site Visits
- Develop Measures
- Review Measures with Team

Reject and Accept Measures Based On

- Alignment with Critical Success Factors (CSF)
- Value to the School
- Economic Financial Payback
- Equipment Service Life
- Effect on Current Space Conditions

In developing the proposed measures, the following considerations were critical:

- Reduction of space heating and cooling loads by performing systems review, with complete consideration of current indoor environmental quality standards.
- Review and redesign lighting systems noting reductions in the internal heat gain in the affected spaces.
- Load reduction measures always precede optimization measures.

Bin weather data was used from a 15-year average reported from Newark, NJ. Ventilation rates, taken from ASHRAE published standard, were predicted by using the building's population multiplied by cfm/person during occupied hours.

Reasonable infiltration rates were assumed based on the building's fenestration conditions and expected values for typical buildings. A reduced infiltration rate was assumed for the unoccupied hours. Envelope heat loss calculations assumed a reasonable heat transmission rate (U value) based on the construction of the buildings. Wall area and glass area were estimated by supplied drawings and field photographs.

Current efficiencies were derived from assumed and later to be measured boiler efficiencies, and assumed system losses due to thermal losses, distribution losses and loose operational control. The current assumed boiler system efficiencies were then applied to the calculated load and calibrated to last year's actual fuel consumption.

Demand Sensitive Operation

Review existing and proposed thermal loads. For example, the review process will facilitate the application of:

1. Optimized flow rates (steam, water, and air).
2. Optimized operation of equipment, matching current occupancy use profiles, and considering both outside and indoor space temperatures.

Benefits of Mechanical Improvements

Listed below are some of the benefits that the District would reap from the mechanical portion of the measures:

1. Avoid costly repairs and replace equipment that would have to be replaced in the next five years.
2. Improved compliance with ASHRAE Ventilation Standards.
3. Ability to trend ventilation rates; thus, insuring compliance through documentation.
4. Operating a more weather sensitive facility.
5. Allowing for a greater capability of central monitoring and troubleshooting via remote.
6. Greater operating flexibility to reduce costs and optimize staff efficiency.

Indoor Air Quality

Implementation of new energy-related standards and practices has contributed to a degradation of indoor air quality. In fact, the quality of indoor air has been found to exceed the Environmental Protection Agency (EPA) standards for outdoor air in many homes, businesses, and factories.

The American Council of Governmental Industrial Hygienists (ACGIH) in their booklet “Threshold Limit Values,” has published air quality standards for the industrial environment. No such standards currently exist for the residential, commercial, and institutional environments, although the ACGIH standards are typically and perhaps inappropriately used. The EPA has been working to develop residential and commercial standards for quite some time.

Recent studies indicate that for even the healthiest students, indoor air pollution can reduce the ability to learn. As an example, if you were to place several students in a room where it is hot, there is little, or no air circulation and other children are coughing and sneezing, exposing the student body to airborne related illnesses such as the cold or flu. Honeywell has addressed this issue by focusing on the proper operation and replacement of the unit ventilators and air handler equipment which will assure IAQ standards are met.

ECM 1A LED LIGHTING

The key benefits of this ECM include:

- **Energy Savings** from reducing total energy consumption with more efficient, state of the art technology. Today's most efficient way of illumination and lighting has an estimated energy efficiency of 80%-90% when compared to traditional lighting and conventional light bulbs.
- **Improved teacher and student performance** from enhanced lighting quality that translates to an enhanced working and learning environment.
- **Improved equipment longevity** by reducing amount of light usage and extending the useful life of your lighting system. LED bulbs and diodes have an outstanding operational life time expectation of up to 100,000 hours. This is 11 years of continuous operation, or 22 years of 50% operation. Operational savings in terms of bulb and ballast replacement are significant based on this technology.
- **Reduced maintenance and operational costs** by modernizing your lighting system and providing for longer lasting and technologically advanced lights, without the need to address deficient or bad ballasts.
- **Ecologically Friendly** - LED lights are free of toxic chemicals. Most conventional fluorescent lighting bulbs contain a multitude of materials like mercury that are dangerous for the environment. LED lights contain no toxic materials and are 100% recyclable and will help to reduce carbon footprint by up to a third. The long operational life time span mentioned above means also that one LED light bulb can save material and production of 25 incandescent light bulbs. A big step towards a greener future!

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1A LED Lighting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Existing Conditions

Indoor lighting predominantly consists of T-12s and T-8s, some CFLs, and some incandescent bulbs. In general, lighting is operated on switches.

Scope of Work

The proposed lighting system is based on the recent investment grade lighting system audit where existing lighting systems were analyzed and inventoried. Honeywell proposes to retrofit all existing T-8 and T-12 fixtures with high efficiency Light Emitting Diode (LED) lamps.

The District will receive many benefits from the lighting system upgrade.



Existing Lighting at High School



Existing Lighting at Pre-K/DLC

LED Parking Lot Lighting Upgrades

Existing Conditions

The District parking lots consist of various types of HID light fixtures, which are not as efficient as modern LED types. Parking lot exterior lights consist of pole mounted shoe-box type and wall pack HID fixtures.

Scope of Work

Outdoor Lighting

The exterior wall-packs and pole-mounted shoebox fixtures are currently high wattage HID lamps. These will be replaced with lower wattage LED fixtures. The LED technologies offer significant advantages such as extended lamp life, minimal lumen depreciation, “instant on,” and very high energy conversion efficiency. These fixtures will provide substantial maintenance savings via the new 100,000-hour LED lamp life versus the 20,000 hours of the existing metal halide lamps.

To retrofit these lights with energy efficient LEDs, the existing ballasts that are in the space behind the light will be removed. Once removed, we will replace them with LED drivers which will use approximately 24V and will not need the existing ballast. The existing lamps will be removed, and new energy efficient LED lamps are installed in their place. Replacements or maintenance is not required on these type fixtures for up to 100,000 hours or 15-20 years depending on usage time.

Changes in Infrastructure

New LED lamps will be installed as part of this ECM. Existing poles and shoe box fixtures will be utilized.

Customer Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage. A slight increase in heating energy is resultant from the reduced heat output of more efficient lamps.
Waste Production	All lamps and ballasts that are removed will be properly disposed.
Environmental Regulations	No environmental impact is expected.

ECM 1B LIGHTING CONTROLS

The key benefits of this ECM include:

- **Energy savings** from reducing total energy consumption with more efficient, state of the art technology. Lighting controls keep lighting off when no occupancy is detected, reducing electrical energy consumption.
- **Reduced maintenance and operational costs** by reducing the runtime of lighting system and components.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1B Lighting Controls		●					●			●						

Existing Conditions

Educational institutions, such as K-12 districts, are focused on providing classrooms and campuses for their teachers and students that are safe, healthy, energy-efficient, and provide the best environment for learning, and they are also chartered with reducing the costs of building operations.

Solution

Honeywell proposes the installation of occupancy-based lighting controls for interior spaces where none are currently installed. These controls will automatically control lighting systems based on occupancy.



Bullock gym to receive controls



Hillside gym to receive controls



Example of interior lighting sensor

Scope of Work

Lighting controls lower cost by adjusting light levels by occupancy, turning lights off when not needed.

Changes in Infrastructure

New lighting control devices will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage. A slight increase in heating energy is resultant from the reduced heat output lighting that is turned off.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

ECM 1C VENDING MISERS

The key benefits of this ECM include:

- **Energy savings** by better managing the power consumption of electrical equipment.
- **Longer equipment life** thanks to reduced usage.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1C Vending Misers		●			●					●						

Multiple vending machines were observed in various buildings. As such, Honeywell has investigated the use of vending machine misers for these areas.

Existing Conditions

Vending machines are located throughout multiple buildings offering soft drinks to the occupants. A typical cold drink machine consumes over 5,000 kWh annually.





Vending Machines to be retrofitted with controls

Building	Type	Location	Qty
Bullock Elementary School	Cold Beverage	Staff Room	1
Bullock Elementary School	Snack	Staff Room	1
Glenfield Middle School	Cold Beverage	Conference 237	1
Glenfield Middle School	Snack	Conference 237	1
Glenfield Middle School	Snack	Cafeteria 240	1

Building	Type	Location	Qty
Montclair High School	Cold Beverage	Cafeteria Vending	1
Montclair High School	Snack	Cafeteria Vending	1
Montclair High School	Cold Beverage	Cafeteria Vending	1
Montclair High School	Snack	Cafeteria Vending	1
Montclair High School	Cold Beverage	Faculty Lounge	2
Montclair High School	Snack	Faculty Lounge	2
Total			**13**

Proposed Vending Machines for Vending Miser Controls

Proposed Solution

During the site visit, Honeywell noted vending machines providing an opportunity for energy savings by shutting off non-critical loads during the non-occupied periods.

The VMOC also monitors electrical current used by the vending machine. This ensures that the unit will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor ensures that every time the vending machine is powered up, the cooling cycle is run to completion before again powering down the vending machine. The Coca Cola Company and Pepsi Corporation approve the proposed controller for use on their machines.

Interface with Existing Equipment

All the VMOC devices are easily installed. The vending machine controllers are installed separately from the machine, and implementation will occur during working hours. A period of three (3) weeks will be required to verify proper calibration of the sensors.

With respect to the vending machines in the various buildings, Honeywell has estimated the number and types of vending machines based on our site tour. During the implementation phase, Honeywell will check with the vendor about the type and specification of the vending machines as it relates to any internal time clocks which may exist inside the machine. Should this be the case, the savings and cost will be adjusted accordingly.

Changes in Infrastructure

New vending machine controls will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Minor coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced electric energy usage.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

ECM 1D DE-STRATIFICATION FANS

The key benefits of this ECM include:

- **Improved efficiency and energy savings** through more equal distribution of conditioned air space.
- **Equipment longevity** due to lower utilization of equipment to condition air.
- **Increased comfort** of students and teachers.

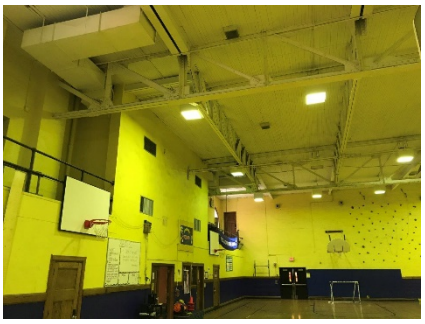
ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1D De-stratification Fans	●		●	●	●		●			●	●	●	●	●	●	

Existing Conditions

Warm air stratifies close to the ceiling in high ceiling areas such as in a gymnasium or auditorium. Elevated levels of heat transfer through the high walls and roof causes elevated heat loss.



Gym at Hillside



Gym at Buzz Aldrin

Examples of Spaces for Destratification Fans

Proposed Solution

In areas with 20+ foot ceiling heights, there is approximately a 15°F+ temperature difference between the floor and the ceiling. With higher ceilings, it is even greater. That means to generate the heat necessary to maintain a comfortable 70°F temperature at the floor level, where student activities occur, the ceiling could be 85°F or higher.

De-stratification fans even out the air temperature to a zero to 3°F differential from floor to ceiling and wall to wall. This will allow HVAC systems to run for a shorter duration because of the absence of extreme temperatures to heat or cool, thus allowing the local thermostats to be satisfied for longer periods of time.

Systems Evaluation and Selection

An energy-efficient motor drives a near-silent fan that forces a column of hotter air from the ceiling to the cooler floor below. As this column of warm air nears the floor, it begins to flare out in a circular pattern and rise again creating a torus. While doing so, it warms the cooler air and mixes with air near the floor, increasing the temperature and comfort of occupants. Through a natural law of physics, this torus will continue to re-circulate air, mixing warmer air from the ceiling with cooler air near the floor until the ceiling and air temperatures are nearly equal. As this happens, it will require less and less energy to comfortably heat the work area, allowing thermostats to be lowered and energy savings to be realized. Once started, the entire process of "thermal equalization" will take on average less than 24 hours.

Based on preliminary site investigation conducted by our staff, we propose to install the following as indicated in the table below:

School	Location	Qty	Type
Valley Road Complex	Hillside Gym	4	Air Pear S-25
Bradford Elementary School	Gym	2	Air Pear S-25
Bradford Elementary School	Stage	4	Air Pear S-25
Northeast Elementary School	Gym	2	Air Pear S-25
Northeast Elementary School	Stage	4	Air Pear S-25
Buzz Aldrin Middle School	Large Gym	6	Air Pear A-25
Buzz Aldrin Middle School	Small Gym	4	Air Pear S-25
Edgemont Elementary School	Cafetorium	4	Air Pear S-25
George Inness Annex (HS-9th), Athletics	Gym 1	4	Air Pear A-25
George Inness Annex (HS-9th), Athletics	Gym 2	4	Air Pear A-25
Glenfield Middle School	Main Gym	6	Air Pear A-25
Glenfield Middle School	Small Gym	2	Air Pear A-25
Montclair High School	Main Gym	9	Air Pear A-25
Montclair High School	Small Gym	6	Air Pear A-25
Nishuane K-2	Gym	4	Air Pear A-25
Renaissance Middle School	Gym	2	Air Pear S-25
Watchung Elementary School	Gym	4	Air Pear S-25
Total		**71**	

Proposed De-Stratification Fans

Scope of Work

Per De-Stratification Fan:

- Shut off the main electric power to the area in which the unit(s) will be installed.
- Install new de-stratification fan and wiring.
- Re-energize.
- Inspect unit operation by performing electrical and harmonics testing.

Changes in Infrastructure

New de-stratification fans will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced thermal energy usage. A slight increase in electrical energy is resultant from the increase run time of the fan motors.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

ECM 1E PLUG LOAD MANAGEMENT VIA WIFI

The key benefits of this ECM include:

- **Energy Savings** by better managing the power consumption of electrical equipment.
- **Longer equipment life** thanks to reduced usage.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
1E Plug Load Management via Wi-Fi	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

Existing Conditions

The School District is equipped with a host of equipment and devices. A byproduct of the electronic devices such as printers, projectors, televisions, and window air conditioning units are their phantom load. Phantom load refers to energy that is used when a device is off. This includes energy used by TV's and copiers when they're in standby mode (i.e. when they can be turned on with a remote), and energy used by chargers or a laptop's AC adapter. Studies estimate that phantom load now accounts for 6% of all energy use. This measure will address energy waste due to phantom loads in your buildings.

Typical electrical draws for when devices are off are as follows:





Plug Load Management Applications

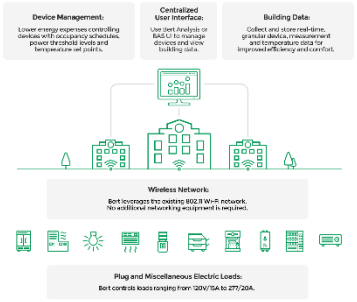
Device	Wattage
Projectors	21
Charging Cart	35
Printer/Copier	30
Smart Boards	20
Window ACs	100

Electrical Draw per Typical Device

Proposed Solution

Honeywell proposes to install plug load management devices to provide a comprehensive solution to the device control dilemma, by using an existing Wi-Fi network. This computer-based system is designed to allow you to program or control your devices with a customizable schedule. These plugs are a switch that stops all electrical power to the device, turning off equipment and eliminating phantom loads, and are a proven technology with a high degree of reliability and security.





The Plug Load Controller enables energy savings by controlling plug loads through occupancy or schedule-based on/off control of receptacles on a circuit. The device is paired with a sensor or a group of sensors in the network to enable occupancy-based control. The controller features two sets of wires to separately power controlled and uncontrolled outlets, so that energy consumption on both uncontrolled and controlled circuits are separately measured.

Energy Savings Methodology and Results

Installation of the devices will reduce the operating hours of the connected peripheral devices reducing electrical consumption.

Changes in Infrastructure

None.

Customer Support and Coordination

None.

Environmental Issues

Resource Use	Annual savings for student computers is based wattage difference between the two monitor types.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

ECM 2A BOILER UPGRADE

The key benefits of this ECM include:

- **Reduced energy usage** from improved boiler efficiency thanks to replacement of older equipment.
- **Lower operational costs** through less frequent maintenance and operational issues.

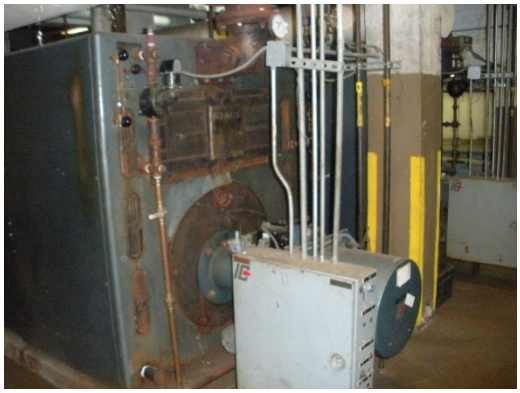
ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2A Boiler Upgrade		●	●							●	●			●	●	

Existing Conditions

Some boilers in the District are near or past the end of their useful life and are not as efficient as new boilers. Some can be replaced with high-efficiency, condensing boilers.



Boilers at Buzz Aldrin



Boilers at George Inness Annex

Existing Boilers to be Replaced

Building	Location	Manufacturer	Model	Qty	Input (MBH)	Fuel
Bullock Elementary School	Boiler Room	Lochinvar	CHN2071	2	1,739	Natural Gas
Buzz Aldrin Middle School	Boiler Room	Weil McLain	2294	2	6,100	Natural Gas
George Inness Annex (HS-9th), Athletics	Boiler Room	Weil McLain	H1994-WS	2	5,230	Natural Gas
Montclair High School	Boiler Room	Cleaver-Brooks	CB800-100	1	3,347	Natural Gas
Montclair High School	Boiler Room	Cleaver-Brooks	CB800-200	1	6,695	Natural Gas
Montclair High School	Boiler Room	Weil McLain	H-988-WS	1	2,176	Natural Gas
Renaissance Middle School	Boiler Room	HB Smith	28-14	1	3,370	Natural Gas

Building	Location	Manufacturer	Model	Qty	Input (MBH)	Fuel
Watchung Elementary School	Boiler Room	Weil McLain	H-1188-WS	1	2,724	Natural Gas

Existing Boilers to be Replaced

Proposed Solution

It is recommended that the boilers listed in the table above be replaced with boilers operating at higher efficiency listed in table below. New condensing hot water boilers have thermal efficiencies that range from 88% – 95% depending on the return hot water temperature from the heating loop. With proper design, it is typical to see thermal efficiencies of around 92%. Thermal efficiency is only one part of the equation that makes up the seasonal efficiency of a boiler. Compared to the existing boilers in these schools, the new boilers will provide an increase in boiler efficiency of anywhere between 10% to 15%. Boilers which cannot be converted from steam will be replaced with new steam boilers, which will still operate at to 10% more efficient than the existing boilers.

New boiler sizes and quantities will be based on the heat load of the building with redundancy, take into account the existing system sizing and level of redundancy.

Building	Location	Manufacturer	Model	Qty	Input (MBH)	Fuel
Bullock Elementary School	Boiler Room	AERCO	BMK 1500	3	1,500	Natural Gas
Buzz Aldrin Middle School	Boiler Room	Weil McLain	2094	2	5,520	Natural Gas
George Inness Annex (HS-9th), Athletics	Boiler Room	Weil McLain	1894	2	4,940	Natural Gas
Montclair High School	Boiler Room	Smith	28HE-S-13	1	3,304	Natural Gas
Montclair High School	Boiler Room	Weil McLain	2494	1	6,680	Natural Gas
Montclair High School	Boiler Room	Smith	28HE-S-9	1	2,249	Natural Gas
Renaissance Middle School	Boiler Room	Smith	28HE-S-14	1	3,567	Natural Gas
Watchung Elementary School	Boiler Room	Smith	28HE-S-11	1	2,776	Natural Gas

Proposed Boiler Equipment

Scope of Work

The following outlines the boiler replacement:

- Disconnect gas back to shutoff valve and electric back to source panel-board.
- Remove existing boilers.
- Install new boilers.
- Connect gas and heating hot water appurtenances to new boilers.
- Terminate and power new boiler electric circuiting.
- Start up, commissioning, and operator training.

Energy Savings Methodology and Results

In general, Honeywell uses the following approach to determine savings for this specific measure:

Existing Boiler Efficiency	= Existing Heat Production/ Existing Fuel Input
Proposed Boiler Efficiency	= Proposed Heat Production/ Proposed Fuel Input
Energy Savings $	= Heating Production (Proposed Efficiency – Existing Efficiency)

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	As part of the ECM design and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New boilers will be installed in itemized locations; in addition, training for maintenance personnel will be required, as well as on-going, annual preventive maintenance. New gas piping will need to be run from the new gas service/meter to the equipment.

O&M Impact

The new boilers will decrease the O&M cost for maintaining the boilers.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods. Continuity of service must be maintained for the customer.

Environmental Issues

Resource Use	Energy savings will result from greater combustion efficiency, reduced maintenance costs control and setback.
Waste Production	Existing boilers scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected; all regulations will be adhered to in accordance with EPA and local code requirements.

ECM 2A.1 VACUUM TANK REPLACEMENTS

The key benefits of this ECM include:

- **Reduced energy usage** from improved steam system efficiency thanks to replacement of older equipment.
- **Lower operational costs** through less frequent maintenance and operational issues.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2A.1 Vacuum Tank Replacements	●		●	●				●		●	●	●		●	●	

Existing Conditions

Some condensate vacuum tanks in the District are near or past the end of their useful life and lead to wasted energy due to heat loss from the steam condensate system. These older vacuum tanks will be replaced with new systems.





Existing Vacuum, Tanks to be Replaced

Building	Location	Qty
Bradford Elementary School	Boiler Room	1
Buzz Aldrin Middle School	Boiler Room	1
Edgemont Elementary School	Boiler Room	1
Central Heating Plant	Boiler Room	1
Montclair High School	Boiler Room	1
George Inness Annex (HS-9th), Athletics	Boiler Room	1
Nishuane K-2	Boiler Room	1

Building	Location	Qty
Renaissance Middle School	Boiler Room	1
Watchung Elementary School	Boiler Room	1

Existing Vacuum, Tanks to be Replaced

Proposed Solution

It is recommended that the vacuum tanks listed in the table above be replaced with new equipment. New vacuum tanks will reduce loss from the steam system and allow for lower operating steam pressures.

Scope of Work

The following outlines the vacuum tank replacement:

- Disconnect electrical and piping from existing vacuum tanks.
- Remove existing vacuum tanks.
- Install new vacuum tanks.
- Reconnect electrical and piping back to new vacuum tanks.
- Terminate and power new vacuum tank electric circuiting.
- Start up, commissioning, and operator training.

Energy Savings Methodology and Results

In general, Honeywell uses the following approach to determine savings for this specific measure:

Existing Heat Loss	= Annual Steam Production (lbm) * Existing Steam Enthalpy (Btu/lbm)
Proposed Heat Loss	= Annual Steam Production (lbm) * Proposed Steam Enthalpy (Btu/lbm)
Energy Savings $	= Existing Heat Loss – Proposed Heat Loss

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	As part of the ECM design and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New vacuum tanks will be installed in itemized locations; in addition, training for maintenance personnel will be required, as well as on-going, annual preventive maintenance.

O&M Impact

The new vacuum tanks will decrease the O&M cost for maintaining the vacuum tanks.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods. Continuity of service must be maintained for the customer.

Environmental Issues

Resource Use	Energy savings will result from reduced steam system heat loss, and reduced maintenance costs control.
Waste Production	Existing vacuum tanks scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected; all regulations will be adhered to in accordance with EPA and local code requirements.

ECM 2B BOILER BURNER REPLACEMENT & CONTROLS

The key benefits of this ECM include:

- **Reduced energy usage** from improved boiler efficiency thanks to replacement of older burner controls.
- **Lower operational costs** through less frequent maintenance and operational issues.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2B Boiler Burner Replacement & Controls	●			●				●				●	●	●	●	

Existing Conditions

Honeywell observed that the existing boiler burners have limited fuel / air ratio controls in place, which reduces your ability to optimize combustion efficiency and system reliability. The below table indicates which systems Honeywell recommends installation of new advanced combustion controls to decrease costs and increase efficiency. In cases where burners cannot be retrofit with controls, new burners will be installed.

Building	Manufacturer	Model	Output (MBH Each)	Type	Qty	Fuel	Replace Burner
Bradford Elementary School	Weil McLain	988	2,274	Steam	2	Natural Gas	Y
Edgemont Elementary School	Smith	28A-13	2,867	Steam	2	Natural Gas	Y
Nishuane K-2	HB Smith	M450L-20	4,720	Steam	2	Natural Gas	N
Northeast Elementary School	HB Smith	28-14	3,194	Steam	2	Natural Gas	Y
Renaissance Middle School	HB Smith	28HW-S/W-14	3,567	Steam	2	Natural Gas	Y
Central Heating Plant	Weil McLain	2394	6,390	Steam	2	Natural Gas	N
Watchung Elementary School	Weil McLain	-	2,848	Steam	1	Natural Gas	Y
Watchung Elementary School	Weil McLain	H-1188-WS	2,724	Steam	1	Natural Gas	Y

Existing Boilers for Burner Controls & Replacements




Existing Burners without Advanced Combustion Controls

Proposed Solution

Typically, boilers are sized to accommodate the coldest days (approximately 5% of the year). During these periods of maximum demand, the burner is constantly on and operating at maximum capacity. The burner cycles on and off, maintaining temperature or pressure in the boiler. It is during these periods of lesser demand, that the controller will monitor the boiler make up rate, and efficiently manage the firing of the boiler.

The length of the burner's off-cycle is the best measure of total heating demand or load. In other words, the load is directly related to the time it takes for water (or steam) in the boiler to drop from its high-limit temperature (or pressure) to its low-limit or "call" setting. When demand is high, these off-cycles are short, and the on-cycles are longer. When demand is lower, off-cycles are longer, and on-cycles are reduced.

The device, which is a microprocessor-based computer, constantly monitors the demand on the boiler by assimilating all factors affecting a building's heating requirements, including occupancy, climate, wind chill, solar gain, type of building, and many others.

Proposed Systems and Scope of Work

Honeywell will replace the burners on the boilers listed above with new, natural gas-fired burners, utilizing advanced controls.

Honeywell SLATE™



Honeywell SLATE™ will integrate to the existing Burner Management Flame Safe Guard Controller (FSG) to monitor and control the burner fuel and air ratios to maintain proper combustion. The single actuator will be replaced with separate Direct Coupled Actuators (DCA) for air and fuel(s) and will be connected to the existing burner control.

This upgrade will provide a combustion curve and light-off points including minimum/maximum firing rate points resulting in a precise firing rate control over the

entire firing rate of the burner. Combustion efficiency will be maximized throughout the combustion curve and will provide a fuel curve to achieve maximum efficiency.

Modulating Burner Control

The Modulating Burners integrates flame safeguard control, fuel-air ratio control, O_2 Trim, VFD control, and proportional integral derivative (pID) control into a single, integrated, user-friendly system.
The features integrated into the burner provide energy savings, reduced emissions, reduced installation costs and enhanced safety.

Fuel Metering

- Reduced fuel use.
- Increased burner efficiency.
- Greenhouse gas emissions reduction.

Easy Access Panels

- Totla access to components.
- Easy Maintenance.

Graphic Burner Management System

- Graphic annunciation of critical burner functions.



Scope of Work

The following outlines the boiler burner controls and replacements:

- Install new burner controls on existing burner (where applicable)
- Remove existing boiler burners (where applicable).
- Install new boiler burners (where applicable)
- Start up, commissioning and operator training.

Energy Savings Methodology and Results

In general, Honeywell uses the following approach to determine savings for this specific measure:

Existing Boiler Efficiency	= Existing Heat Production/ Existing Fuel Input
Proposed Boiler Efficiency	= Proposed Heat Production/ Proposed Fuel Input
Energy Savings $	= Heating Production (Proposed Efficiency – Existing Efficiency)

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	As part of the ECM design and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New combustion controls (and new burners, where applicable) will be installed and programmed in the locations listed above; in addition, training for maintenance personnel will be required as well as on-going, annual preventive maintenance.

O&M Impact

The new boiler controls will decrease the O&M cost for maintaining the boilers.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods. Continuity of service must be maintained for the customer.

Environmental Issues

Resource Use	Energy savings will result from greater boiler load control, reduced maintenance costs control and setback.
Waste Production	Existing boiler burners scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected; all regulations will be adhered to in accordance with EPA and local code requirements.

ECM 2C DOMESTIC HOT WATER HEATER REPLACEMENT

The key benefits of this ECM include:

- **Reduced energy usage** from improved efficiency thanks to replacement of older equipment.
- **Lower operational costs** through less frequent maintenance and operational issues.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2C DHW Heater Replacement		●		●			●				●	●	●			

Existing Conditions

The existing domestic hot water heaters are generally in good condition but are not high-efficiency units.



Water Heater at Bullock



Water Heater at Edgemont

Building	Qty	Manufacturer	Model	Capacity MBH	Storage (Gal)	Fuel
Bullock Elementary School	1	AO Smith	HW399-200	399	200	Natural Gas
Edgemont Elementary School	1	Bradford White	LG2PV75H763N	76	75	Natural Gas
George Inness Annex (HS-9th), Athletics	1	Bradford White	LG275H763N	76	75	Natural Gas
George Inness Annex (HS-9th), Athletics	1	AO Smith	-	150	100	Natural Gas
Nishuane K-2	1	Rheem	G82-156	156	82	Natural Gas
Northeast Elementary School	1	American Water Heater Co.	G62-75T75-4NOV 400	75	73	Natural Gas
Northeast Elementary School	1	AO Smith	BT 80 230	75	75	Natural Gas
Hillside Elementary School	1	AO Smith	BTR 199 118	199	81	Natural Gas

Existing Domestic Hot Water Heater Equipment

Proposed Solution

Honeywell proposes replacing the existing DHW heaters at the above locations with highly efficient condensing DHW heaters. New condensing DHW heaters have efficiencies between 97% - 98%. They provide better control with capabilities as night setback, temperature adjustments and demand control hot water.

Building	Qty	Manufacturer	Model	Capacity MBH	Storage (Gal)	Fuel
Bullock Elementary School	2	AO Smith	BTH-199(A)	199	100	Natural Gas
Edgemont Elementary School	1	AO Smith	BTH-150(A)	150	100	Natural Gas
George Inness Annex (HS-9th), Athletics	1	AO Smith	BTH-150(A)	150	100	Natural Gas
George Inness Annex (HS-9th), Athletics	1	AO Smith	BTH-150(A)	150	100	Natural Gas
Nishuane K-2	1	AO Smith	BTH-150(A)	150	100	Natural Gas
Northeast Elementary School	1	AO Smith	BTH-150(A)	150	100	Natural Gas
Northeast Elementary School	1	AO Smith	BTH-150(A)	150	100	Natural Gas
Hillside Elementary School	1	AO Smith	BTH-199(A)	199	100	Natural Gas

Proposed Domestic Hot Water Heater Equipment

Scope of Work

The following outlines the domestic hot water heater replacement:

- Demolish and remove old water heaters.
- Furnish and install condensing gas fired domestic hot water heaters as specified in the table above.
- Install all required piping, controls, and breeching as needed.
- Install mixing valve.
- Install circulators where needed for building use and kitchen supply.
- Test and commission.

Energy Savings Methodology and Results

The savings are calculated from the domestic hot water heater efficiency differences.

Existing Equipment Efficiency	= Existing Boiler Efficiency + Existing Heat Exchanger Efficiency
Proposed Equipment Efficiency	= Efficiency of the New Domestic Hot Water Heater
Energy Savings	= DHW Load x (Existing Equipment Efficiency – New Equipment Efficiency)

Changes in Infrastructure

A new controller for each DHW heater will be installed and programmed. In addition to the controllers, training for maintenance personnel will be required.

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available.
Equipment Identification	As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from improved thermal efficiency.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

Utility Interruptions

Proper phasing procedures will minimize gas interruptions.

ECM 2D ROOFTOP UNIT REPLACEMENT (DI)

The key benefits of this ECM include:

- **Reduced energy usage** from improved efficiency thanks to replacement of older equipment.
- **Lower operational costs** through less frequent maintenance and operational issues.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2D RTU Replacement (DI)	●									●	●		●			●

Existing Conditions

Some Rooftop Units (RTUs) serving the locations marked below are inefficient or past their useful lives. Replacing these units with new, high efficiency units will save energy costs over the long term while reducing repair costs that would otherwise have been necessary to keep the old RTUs in operation.



Existing Rooftop Units to be Replaced

Building	Make	Model	Location Served	Tons	Qty.
Bradford Elementary School	AAON	RK-40	New Wing	40.3	1
Bradford Elementary School	AAON	RM-13	New Wing Library	13.2	1
George Inness Annex (HS-9th), Athletics	AAON	RK-16-3	600B & 602	16.0	2
Montclair High School	TRANE	TCC018F	Science Office	1.5	1
Northeast Elementary School	Carrier	48HJE014	Media Center	12.5	1
Northeast Elementary School	Carrier	48GX024	Resource Room	2.0	1
Northeast Elementary School	Carrier	48HJF009	Hallway	8.5	1
Northeast Elementary School	Carrier	48HJF008	Hallway	7.5	1
Woodman Field	Carrier	48PGDC24	Fieldhouse	20.0	1

Existing Rooftop Units to be Replaced

Proposed Solution

Honeywell proposes replacing the existing rooftop units in the above Table. The new units will be installed in the same location as the existing units. Existing electrical power supply will be reconnected to the new motors. The new units will be equipped with factory-installed microprocessor controls that improve unit efficiency. The units will also communicate with the building management system.

Building	Make	Model	Location Served	Tons	Qty.
Bradford Elementary School	TRANE	OANG040A	New Wing	40.0	1
Bradford Elementary School	York	ZJ150C00B4 *1EAA1A	New Wing Library	12.5	1
George Inness Annex (HS-9th), Athletics	York	ZJ180N40B4 A1EAA1A	600B & 602	15	2
Montclair High School	TRANE	4YCY50241	Science Office	1.5	1
Northeast Elementary School	Carrier	48HCED14B 1A5-0*0G0	Media Center	12.5	1
Northeast Elementary School	Carrier	48VG-B2404030	Resource Room	2.0	1
Northeast Elementary School	Carrier	48HCED09B 1A5-0*0G	Hallway	8.5	1
Northeast Elementary School	Carrier	48HCED08B 1A5-0*0G	Hallway	7.5	1
Woodman Field	Carrier	48HCDD24B 1A5-0*0G0	Fieldhouse	20.0	1

Proposed Rooftop Units

Scope of Work

The following outlines the scope of work to install the rooftop units stated in the above table:

- Disconnect existing RTU electric connections.
- Disconnect piping and air ducts from the unit.
- Remove unit from the base.
- Modify base for new unit if necessary.
- Rig and set new unit at the base.
- Inspect piping and air ducts before reconnecting them to the unit.
- Reconnect piping and air ducts.
- Repair duct and piping insulation.
- Connect electric power.
- Start up and commissioning of new unit.
- Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric Energy savings	Existing unit energy consumption (kWh) – replacement unit energy consumption (kWh)

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design, and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Existing unit scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2E KITCHEN HOOD CONTROLS

The key benefits of this ECM include:

- **Reduced energy usage** from improved equipment control and reduced exhaust of conditioned air.
- **Lower operational costs** through less frequent maintenance and operational issues.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2E Kitchen Hood Controls	●	●		●	●		●			●	●	●	●			●

Existing Conditions

Honeywell observed that the kitchens utilizes a constant volume kitchen exhaust hood system. This system operates at full load, even when there is no activity in the kitchen. It also requires operating the exhaust fan at full load. This wastes both fan energy and heating energy. When the hood is not utilized, an opportunity exists to reduce airflow and conserve energy.



Kitchen Hood at High School


Kitchen Hood at Bullock

Proposed Solution

Honeywell recommends installing a microprocessor-based controls system whose sensors automatically regulate fan speed based on cooking load, time of day and hood temperature while minimizing energy usage. The system includes a temperature sensor installed in the hood exhaust collar, IP sensors on the ends of the hood that detect the presence of smoke or cooking effluent and VFD that control the speed of the fans. This will result in energy and cost savings, noise reduction, longer equipment life and reduction in cleaning costs.

Building	Kitchen Hood Area (sq. ft.)
Hillside Elementary School	60
Bradford Elementary School	16
Bullock Elementary School	96
Edgemont Elementary School	16
George Inness Annex (HS-9th), Athletics	32
Glenfield Middle School	25
Montclair High School	160
Nishuane K-2	16
Northeast Elementary School	16
Woodman Field	16

Existing Kitchen Hoods to receive Controls

Scope of Work

- Install a temperature sensor in the hood to monitor temperature of the exhaust gas
- Install a set of two photo sensors on the sides to monitor smoke density across the hood
- Install a control panel with a small point controller and a set of relays in the kitchen close to the hood
- Provide electric wiring from the new panel to the sensors, exhaust fan motor as well as to the closest electric panel for power supply
- Provide connection to the BMS system for remote monitoring, control, and alarming. This system could also be stand-alone to save on cost.
- Commission control components and sequences and calibrate control loops.

Sequence of operation will enable the exhaust fans when either temperature or smoke density in the range hoods is above a pre-set value. Time delays between start and stop will be programmed to prevent motor short cycling. Schedule programming could be implemented as well.

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of conditioned air that is being exhausted when there is no cooking taking place.

Changes in Infrastructure

There will be improvements in HVAC equipment and controls for not operating fans continuously.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced energy.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2F WALK-IN COMPRESSOR CONTROLS

The key benefits of this ECM include:

- **Energy savings** from reducing equipment runtime.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.
- **Operational savings** from less frequent need to repair or replace equipment thanks to less frequent equipment use.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2F Walk-In Compressor Controls		●								●	●					

Existing Conditions

In many refrigeration, walk-in freezers and coolers, the compressor is oversized and cycles on/off frequently. This compressor cycling results in higher energy consumption and may reduce the life of the compressor.



Walk-In at Bullock



Walk-In at High School

Building	Location	Walk-In Refrigerators	Walk-In Freezers
Bullock Elementary School	Kitchen	1	-
Bullock Elementary School	Kitchen	-	1
George Inness Annex	Kitchen	1	-
George Inness Annex	Kitchen	-	1
Montclair High School	Kitchen	1	-

Building	Location	Walk-In Refrigerators	Walk-In Freezers
Montclair High School	Kitchen	-	1

Existing Walk-In Refrigerator/Freezers to receive Controls

Proposed Solution

Honeywell will install a controller manufactured by Intellidyne at the above-mentioned buildings to reduce the compressor cycles of the kitchen walk-in coolers and freezers. The installation of this ECM will have no negative impact on system operation or freezing of food products. By reducing the cycling, the sensor will improve operating efficiency and reduce the electric consumption by 10% to 20%.

This control enhancement will save energy through the reduced compressor cycling in the kitchen walk-in coolers and freezers and will extend the operating life of the compressor. Consequently, the compressor will not have to be replaced as often.

Intellidyne Sensor Features

- Automatic restart on power failure.
- Surge protection incorporated into circuitry.
- Fully compatible with all energy management systems.
- UL listed.
- Maintenance free.

Intellidyne Sensor Benefits

- Patented process reduces air conditioning electric consumption typically 10% to 20%.
- Increased savings without replacing or upgrading costly system components.
- “State-of-the-art” microcomputer controller – LED indicators show operating modes.
- Protects compressor against momentary power outages and short cycling.
- Simple 15-minute installation by qualified installer.
- No programming or follow-up visits required.
- Maximum year-round efficiency.
- Reduces maintenance and extends compressor life.
- Fail-safe operation.
- Guaranteed to save energy.
- UL listed, “Energy Management Equipment”.

Intellidyne’s patented process determines the cooling demand and thermal characteristics of the entire air conditioning system by analyzing the compressor’s cycle pattern, and dynamically modifies that cycle pattern to provide the required amount of cooling in the most efficient manner. This is accomplished in real-time by delaying the start of the next compressor “on” cycle, by an amount determined by the cooling demand analysis. These new patterns also result in less frequent and more efficient compressor cycles.

Energy Savings Methodology and Results

The energy savings for this ECM is realized by the reduction in run time of the compressors and fan motors in the freezers/refrigerators.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from the reduced electrical consumption of the compressor.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2G PREMIUM EFFICIENCY MOTORS AND VFDS

The key benefits of this ECM include:

- **Energy savings** from reduced run hours and reduced motor speeds.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization and reduced startup wear.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2G Premium Efficiency Motors and VFDs								●		●	●					

ECM Overview

Variable Frequency Drives (VFDs) allow motors to run at specified speeds rather than just on or off while allowing systems to more accurately move heat. Honeywell recommends this ECM due to the significant savings potential given the relationship between energy consumption and motor speed.





Examples of existing motors

Existing Conditions

Honeywell has identified standard efficiency electric motors on several pumps. Energy savings can be obtained by replacing the standard efficiency motors with premium efficiency motors as well as by installing VFDs on systems that have two-way control valves.

The motors that were identified in the buildings are listed as follows:

Building	Equipment Description	Qty	Motor HP	Replace Motor Y/N	Add VFD Y/N
George Inness Annex (HS-9th), Athletics	Chilled Water Pump	2	5.0	Y	Y
George Inness Annex (HS-9th), Athletics	Chilled Water Pump	2	10.0	Y	Y
Montclair High School	Heating Hot Water Pump	3	5.0	Y	Y
Montclair High School	Boiler Feed Water Pump	2	1.5	Y	Y
Montclair High School	Heating Hot Water Pump	1	3.0	Y	Y
Central Heating Plant	Combustion Fan	2	7.5	Y	Y
Montclair High School	Combustion Fan	1	10.0	Y	Y

Existing Motors

Proposed Solution

Honeywell observed that several motors and pumps that are sized to meet peak heating or cooling conditions. However, we've learned that most operating hours occur during conditions that require less than peak loads.

Honeywell proposes replacement of all above-mentioned single speed standard efficiency motors (that do not have VFDs) with new premium efficiency motors, installing new couplings where applicable. In addition, Honeywell recommends installing VFDs on these pumps. Energy used by the motor can be reduced by varying the flow in response to varying loads in the space. Motor speed may be controlled either based on the pressure in the distribution system or based on time of day.

Honeywell recommends fitting unit ventilators with two-way valves (provided that unit ventilators located at end of piping branches are fitted with three-way valves to keep hot water moving through the distribution piping at all times).

Honeywell also recommends installing VFDs on the heating hot water pumps and chilled water pumps to better match pumping output to system requirements and reduce energy waste. Each motor will be equipped with new selector relays that will allow one drive to operate per pump with the VFD drive. Honeywell also recommends installation of new differential pressure sensors and tying them to the control system to allow you to regulate the speed of the pump per load requirements. Lastly, we recommend installation of VFDs on the cooling system pump motors that have higher horsepower. VFDs will maintain temperatures in the unit by adjusting the speed of both the motor and the pump and can be connected to your BMS.

Energy Savings Methodology and Results

The energy consumed by electric motors varies inversely with the cube of the motor speed. Variable frequency drives reduce motor speed (in response to load) thus reducing energy consumption exponentially.

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available.
Equipment Identification	Product cut sheets and specifications for generally used are available upon request. As part of the measure, design, and approval process, specific product selection will be provided for your review and approval.

Changes in Infrastructure

New motors will be installed in place of the old motors. No expansion of the facilities will be necessary.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will also be required.

Environmental Issues

Resource Use	Energy savings will result from reducing electrical usage by operating higher efficiency motors for the same horsepower output. The equipment uses no other resources.
Waste Production	This measure will produce waste byproducts. Old motors shall be disposed of in accordance with all federal, state, and local codes.
Environmental Regulations	No environmental impact is expected.

ECM 2H PIPING INSULATION

The key benefits of this ECM include:

- **Energy savings** from reducing heat losses from uninsulated pipes.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2H Piping Insulation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Existing Conditions

Heat losses result from uninsulated hot piping giving off heat to the space around it. This measure will insulate these surfaces, resulting in energy savings and improved comfort of those areas in or near occupied spaces.

During the site visits, it was noted that some hot water piping and valves were not insulated. The un-insulated piping and valves waste energy and also pose a danger of getting injured with exposed hot piping. In addition, the boiler has to work harder to make up for the wasted energy.





Examples of Uninsulated Piping

Proposed Solution

Honeywell proposes insulating these pipes and valves with appropriately sized fiberglass insulation. The following table lists the recommended insulation thickness.

Building	Pipe Size (in.)													
	12+	10	8	6	5	4	3	2.5	2	1.5	1	0.75	0.5	Traps/Fittings/Etc.
Bradford Elementary School						35.0	50.0		75.0	-	180.0			
Bullock Elementary School						-	-	-	-	-	-	-		-
Buzz Aldrin Middle School						27.0	26.0		218.0	-	80.5	75.0		
Edgemont Elementary School						48.0		133.0		80.0	298.0	249.0	-	
Glenfield Middle School						6.0			35.0	64.0	4.0			51
Valley Road Complex			1.0		145.0	96.0	498.5	152.5	149.5	1,343.0	739.0	181.5	37.0	1,056
Montclair High School	2.0	10.0	2.0	5.0		11.0	149.5	56.5	64.0	673.5	81.5	64.0	1.0	592
George Inness Annex (HS-9th), Athletics									168.0	80.0	113.5	102.0		
Nishuane K-2						3.0	42.0		83.0		65.0	27.0		
Northeast Elementary School						13.0		52.0	64.0		77.0	29.0		
Renaissance Middle School						26.0			76.0	45.0	134.0	2.0		
Watchung Elementary School						12.0	9.0			69.0	158.0	55.0		
Woodman Field								15.5		116.0	5.0	14.5		

Uninsulated Pipe Sizes

Energy Savings Methodology and Results

Energy savings results from significantly reducing the heat lost to the atmosphere from the piping and valve surfaces. In general, Honeywell uses the following approach to determine savings for this specific measure:

Energy Savings $	= ((Heat Loss Rate per foot of Uninsulated Pipe – Heat Loss Rate per foot of Insulated Pipe) x (Length of Pipe x Hours of Operation) x Cost/btu)/(Boiler Efficiency))

Reference is made to the ASHRAE 1989 Fundamentals text page 22.19, Table 9A “Heat Loss from Bare Steel Pipe to Still Air at 80 degrees F, Btu/hr-ft” for losses from un-insulated lines, and Table 11 “Recommended Thickness for Pipe and Equipment Insulation”.

Changes in Infrastructure

The insulation of hot piping can happen anytime without impact on building operation. In areas were asbestos is present; precautions will be required. Areas that are dangerously hot may require coordination with a normally occurring shutdown of that portion of the system.

Customer Support and Coordination with Utilities

The service to the specific lines may require interruption to allow for the repair or replacement. Coordination with site personnel will be required to minimize interruption to the buildings affected.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Any waste generated will be properly disposed of.
Environmental Regulations	No environmental impact is expected.

ECM 2I SPLIT SYSTEM REPLACEMENTS

The key benefits of this ECM include:

- **Energy Savings** from increased equipment efficiency.
- **Equipment Longevity** due to more efficient and less wasteful equipment utilization.
- **Operational Savings** from less frequent need to repair or replace key HVAC equipment thanks to less frequent equipment use.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2I Split System Replacements					●		●			●	●		●			

Existing Conditions

Honeywell identified some condensing units as being inefficient and having exceeded their useful service life. Replacing these units with new, high efficiency units will save energy costs over the long term, while reducing repair costs that would otherwise have been necessary to keep the old units in operation.



Split System Condensing Units

Building	Make	Model	Qty.	Tons
George Inness Annex	Mitsubishi	PU12EK	1	1.0
Glenfield Middle School	HEIL	CBA060	1	5.0
Glenfield Middle School	HEIL	CBA048	2	4.0
Glenfield Middle School	HEIL	CBA036	1	3.0
Montclair High School	ICP	AD036HD	4	3.0
Montclair High School	TRANE	2TTA3048	2	4.0
Montclair High School	TRANE	2TTA3042	2	4.0

Building	Make	Model	Qty.	Tons
Montclair High School	TRANE	2TTB2018	1	1.5
Montclair High School	Toshiba	RAV-120AH2U	2	1.0
Northeast Elementary School	Carrier	38BRC042	4	3.5
Northeast Elementary School	Carrier	38BRRC024	4	2.0
Northeast Elementary School	Carrier	38BRC036	2	3.0
Hillside Elementary School	TRANE	TTP018C100A2	1	1.5

Existing Split System Units to be Replaced

Proposed Solution

Honeywell proposes replacing the existing condensing units in the table above. The new units will be installed in the same location as the existing units. Existing electrical power supply will be reconnected to the new motors. The new units will be equipped with factory-installed microprocessor controls that improve unit efficiency. The units will also communicate with the existing or enhanced building management system.

Building	Make	Model	Qty.	Tons
George Inness Annex	Mitsubishi	PUZ-A12NKA7	1	1.0
Glenfield Middle School	TRANE	4TTR7060	1	5.0
Glenfield Middle School	TRANE	4TTR7048	2	4.0
Glenfield Middle School	TRANE	4TTR7036	1	3.0
Montclair High School	TRANE	4TTR7036	4	3.0
Montclair High School	TRANE	4TTA7048	2	4.0
Montclair High School	TRANE	4TTA4042	2	3.5
Montclair High School	TRANE	4TTR6018	1	1.5
Montclair High School	Mitsubishi	PUZ-A12NKA7	2	1.0
Northeast Elementary School	TRANE	4TTA4042	3	3.5
Northeast Elementary School	TRANE	4TTR7024	4	2.0
Northeast Elementary School	TRANE	4TTA7036	2	3.0
Hillside Elementary School	TRANE	4TTR6018	1	1.5

Proposed Split Systems

Scope of Work

The following outlines the scope of work to install the condensing units listed in the Proposed System table above.

- Disconnect existing electric connections.
- Disconnect piping from the unit.
- Remove unit from the base.
- Modify base for new unit if necessary.
- Rig and set new unit at the base.
- Inspect piping and air ducts before reconnecting them to the unit.
- Reconnect piping and air ducts.
- Repair duct and piping insulation.

- Connect electric power.
- Start up and commissioning of new unit.
- Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric Energy savings	Existing unit energy consumption (kWh) – replacement unit energy consumption (kWh)

Equipment Information

Manufacturer and Type	Several quality and cost-effective manufacturers are available. Honeywell and the customer will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design, and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency units.
Waste Production	Existing rooftop unit scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 2J STEAM TRAP RETROFITS

The key benefits of this ECM include:

- **Energy Savings** from reducing heating losses caused by old, inefficient steam traps that will be retrofitted
- **Equipment Longevity** due to more efficient and less wasteful equipment utilization.
- **Operational Savings** from less frequent need to repair or replace key heating equipment thanks to less frequent equipment use.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2J Steam Trap Retrofits	●		●	●		●	●	●	●	●	●	●	●	●	●	●

Existing Conditions

When steam heats the building and transfers heat throughout the building, it condenses back to water. The condensate must be trapped and sent back to the boiler. When steam traps fail, the steam does not condense, which reduces the heat transfer, causing unnecessary heat losses. The repair or replacement of the steam traps will reduce unnecessary losses.

Traps are designed to drain only the condensate, and prevent live steam from entering the condensate return piping.As the distribution system ages, the moving parts in the trap tend to get sluggish or fail altogether. This failure results in live steam entering the condensate return piping. The cumulative effect of this is to return the condensate above the flash point, resulting in steam and hence valuable heating energy loss at the boiler. This loss of energy can be minimized by a thorough survey to identify leaking traps by use of infrared temperature sensing instruments.



Existing Steam Traps

Building	Steam Traps
Bradford Elementary School	16
Buzz Aldrin Middle School	43
Edgemont Elementary School	15
George Inness Annex (HS-9th), Athletics	30
Valley Road Complex	59
Montclair High School	7
Nishuane K-2	29
Northeast Elementary School	16
Renaissance Middle School	11
Watchung Elementary School	22
Woodman Field	5
TOTAL	**253**

Existing Steam Traps

Proposed Solution

Honeywell recommends retrofitting the traps per the following scope of work. The steam trap retrofit includes surveying all the existing steam traps and engineering appropriate replacements. During construction, Honeywell will provide all materials, fittings, labor and supervision for the timely completion of the project. All existing strainers, isolation valves, check valves, and fittings in good repair will be reused.

Energy Savings Methodology and Results

All mechanical steam traps lose some live steam, either through normal cycling, leaking through a closed trap, or failing in the open position. Various sources have stated that the loss through a properly operational trap may exceed ten lbs./hour, while the failed steam trap population ranges between 20-50% at any given time.

We have estimated the steam losses based on a conservative figure of 20% leaking. Failure rates are based on sample testing of the steam trap population. In determining steam losses, the trap orifices and steam pressures have been grouped and averaged to create a simpler statistical basis

Equipment Information

Material and Type	Steam Trap selection will be determined in conjunction with District
Material Identification	Specific material selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the trap installation.

Environmental Issues

Resource Use	Energy savings will result the reduction of steam loss from malfunctioning traps resulting in lower fuel consumption. The equipment uses no other resources.
Waste Production	Existing steam traps scheduled for removal will be disposed of properly.
Environmental Regulations	Asbestos abatement may be required

ECM 2K AIR HANDLING UNIT REFURBISHMENTS

The key benefits of this ECM include:

- **Improved efficiency and energy savings** from better heat transfer and reduced fan operation.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.
- **Operational savings** from less frequent equipment repairs and replacements.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
2K Air Handling Unit Refurbishments					●											

Existing Conditions

Some of the existing AHUs observed are aging and no longer operating efficiently. Even with regular maintenance and repairs, the motors, fans, and coils within the units run less efficiently than when they were new, leading to higher energy usage and increased frequency of maintenance issues.



Typical Air Handling Units

Proposed Solution

Honeywell proposes to refurbish the units in the table below by replacing their internal components, namely the fans, motors, and coils. Existing electrical power supply will be reconnected to the new motors. Where possible, the units will incorporate variable speed drives (VFDs) on the motors to allow them to operate in a Variable Air Volume mode, instead Constant Volume. This will lead to reduced heating and cooling energy expended. The units will also communicate with the existing or enhanced building management system.

Building	Quantity	Area Serving
Glenfield Middle School	2	Halls
Glenfield Middle School	1	Gym

Proposed Air Handling Units to be refurbished

Scope of Work

The following outlines the scope of work to refurbish the air handling units stated in the above table:

- Disconnect existing electric connections.
- Disconnect piping from the unit.
- Replace fans, motors, and coilers, where applicable
- Inspect piping and air ducts before reconnecting them to the unit.
- Reconnect piping and air ducts.
- Repair duct and piping insulation.
- Connect electric power.
- Start up and commissioning of refurbished unit.
- Maintenance operator(s) training.

Energy Savings Methodology and Results

The savings approach is based on the energy efficiency between the existing and new units. The savings are generally calculated as:

Electric and Thermal Energy Savings	Existing unit energy consumption (kWh) and (therms) – refurbished unit energy consumption (kWh) and (therms).

Equipment Information

Manufacturer and Type	Honeywell and the Customer will determine final selections.
Equipment Identification	Product cut sheets and specifications are available upon request. As part of the measure, design, and approval process, specific product selection will be provided for your review and approval.

Customer Support and Coordination with Utilities

Coordination of the installation and electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from higher efficiency operation.
Waste Production	Existing fans, motors, and coils scheduled for removal will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 3A BUILDING MANAGEMENT CONTROL SYSTEMS

The key benefits of this ECM include:

- **Operational efficiency** thanks to better control and system wide visibility.
- **Energy savings** from reducing total energy consumption with more efficient, state of the art technology.
- **Occupancy comfort and productivity** by way of enhanced temperature and humidity control throughout your buildings.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
3A Building Management Control Systems	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Existing Condition

Honeywell assessed the existing building management systems (BMS) of Montclair School District. Upon inspection, it was noted that some of the buildings have either Automated Logic BMS, Allerton controls, Honeywell Niagara Tridium controls or no controls. The buildings without any controls use time-clock or manual breakers to turn on and turn off their equipment. Many the building's field devices such as damper actuators or valve actuators are pneumatically operated.



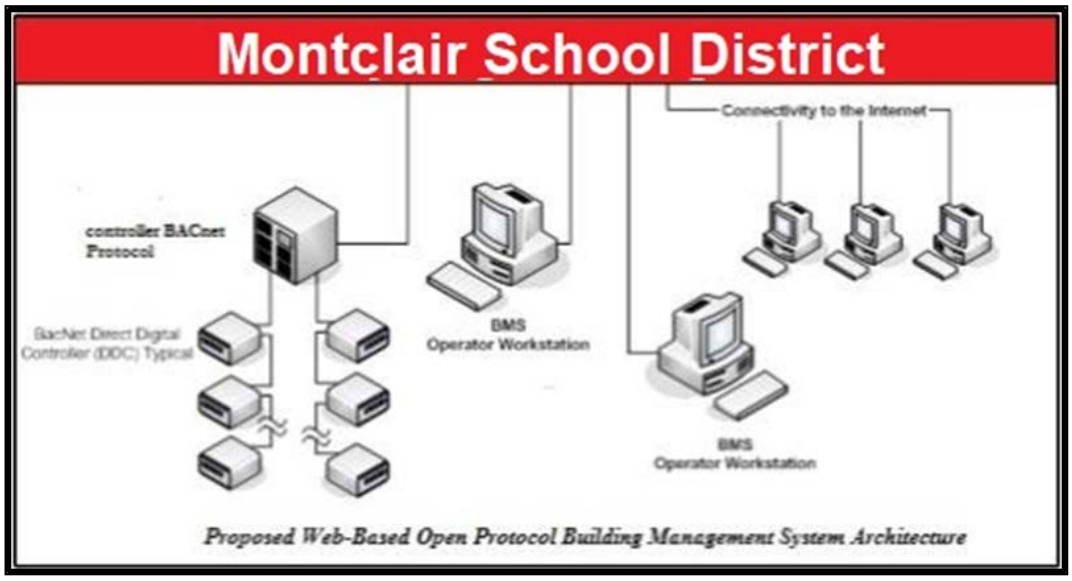
Existing Controls Components

The schools are currently equipped with approximately 40% of DDC controls. These DDC controls are remotely monitored and operated by Energy for America (EFA). The district has a steam plant that provide steam to the BOE building, Hillside school, and the Pre-K DLC building. George Inness building is the only building that uses a chilled water system. Most of the buildings have steam boilers and others

have hot water boilers. Each building has a combination of RTUs, AHUs, and split AC, Fan Coils, and exhaust fans.

Proposed Conditions

Honeywell proposes to establish a web-enabled BMS for Montclair School District that will utilize the latest technology in building automation. The BMS shall communicate over the School District local area network (LAN) via the industry standard BACnet open protocol. Existing vintage DDC and electronic HVAC controls shall be upgraded to the latest Honeywell BACnet direct digital controllers. Honeywell proposes to replace the pneumatic field devices with electro-mechanicals devices to maximize the energy savings. In addition, three dimensional (3-D) graphical representations of all connected heating, ventilating and air conditioning equipment shall be provided to allow for intuitive control, monitoring, and scheduling of all systems. Operators shall be capable of system control and/or monitoring from any local computer or smart devices via a standard internet connection. Honeywell BMS control suite provides and delivers smarter buildings and enterprise systems through the integration of things. The Result? Improved business efficiency, greater control, and faster decision making.



Typical Local BMS network Topology

Operational and Maintenance Impact

Upgrading and consolidating all HVAC controls under one system will result in the following benefits to Montclair School District.

1. Minimize time for the maintenance department to troubleshoot problems by allowing operators to investigate and resolve facility issues at any computer connected either locally or remotely (from home) to the IT network.
2. Ensure a comfortable and productive learning environment for patrons and staff by improving the HVAC controls through technology enhancements and repairs.
3. Minimize unexpected disruptions to the buildings by notifying operators of problematic and/or inefficient system operation prior to irrevocable equipment failures.

4. Eliminate unnecessary energy consumption by individually scheduling equipment operation based on real-time space occupancy status, holiday and summer schedules.
5. Reduce building heating, ventilating and air conditioning repair costs by providing operators with direct access to information used in the troubleshooting process.
6. Identify opportunities for improvement and prioritize repairs based on energy benchmarking data available through advanced reporting and trending capabilities.
7. Mobile access to approve personnel on and off campus to the systems.
8. The elimination of Operating Costs Associated with outside monitoring services required to operating the buildings.

Potential Application and Control Programs with BMS Upgrades

Outcome Based Analytics

Outcome Based Analytics is Honeywell's smart big data solution, helping you to save money through better decision making and improve the quality of life for those who learn and work inside the building. With the power to digitize the way mechanical services are carried out, Outcome Based Analytics provides facilities managers and other key stakeholders with a better view of their building health and reduces total cost of ownership through significant savings on capital expenditure and operating expenses. Outcome Based Analytics is an option that is available for the district as part of an overall BMS strategy and platform.

Night Setback & Setup

Design and implementation of a more aggressive setback and setup schedule will help to further eliminate energy waste in each of your buildings by utilizing an optimal start/stop schedule.

Set Point Optimization

Honeywell will help deliver temperature uniformity by calibrating thermostats to the same set point, thereby achieving optimum comfort for your occupants by reducing the occurrence of hot and cold spots. We will also help you to reduce energy waste caused when adjacent areas cause your systems to overcompensate due to running in different operating modes.

Heating/Cooling Mode Selection

A modern, state of the art building management system can make real time decisions about the heating and cooling needs of any of your buildings. Honeywell will help you establish optimal system configurations to ensure that your buildings are always in optimal settings to deliver a more comfortable space and reduce energy waste.

Optimal Start/Stop

Honeywell understands that equipment start times are typically set to run earlier than normal to ensure optimal comfort is maintained during hot and cold weather seasons. We will work with staff to ensure that optimal start and stop features are fully utilized to optimize occupancy comfort and eliminate energy waste.

Remote Access

Facility managers will be able to login in to their BMS system from anywhere via their smartphone or iPad/Tablet or other internet enable devices. This added granular view will allow them to verify existing

conditions and effectively manage their alarms and critical conditions and take steps to remediate the situation

Scope of Work:

1. Montclair School District Building Management System

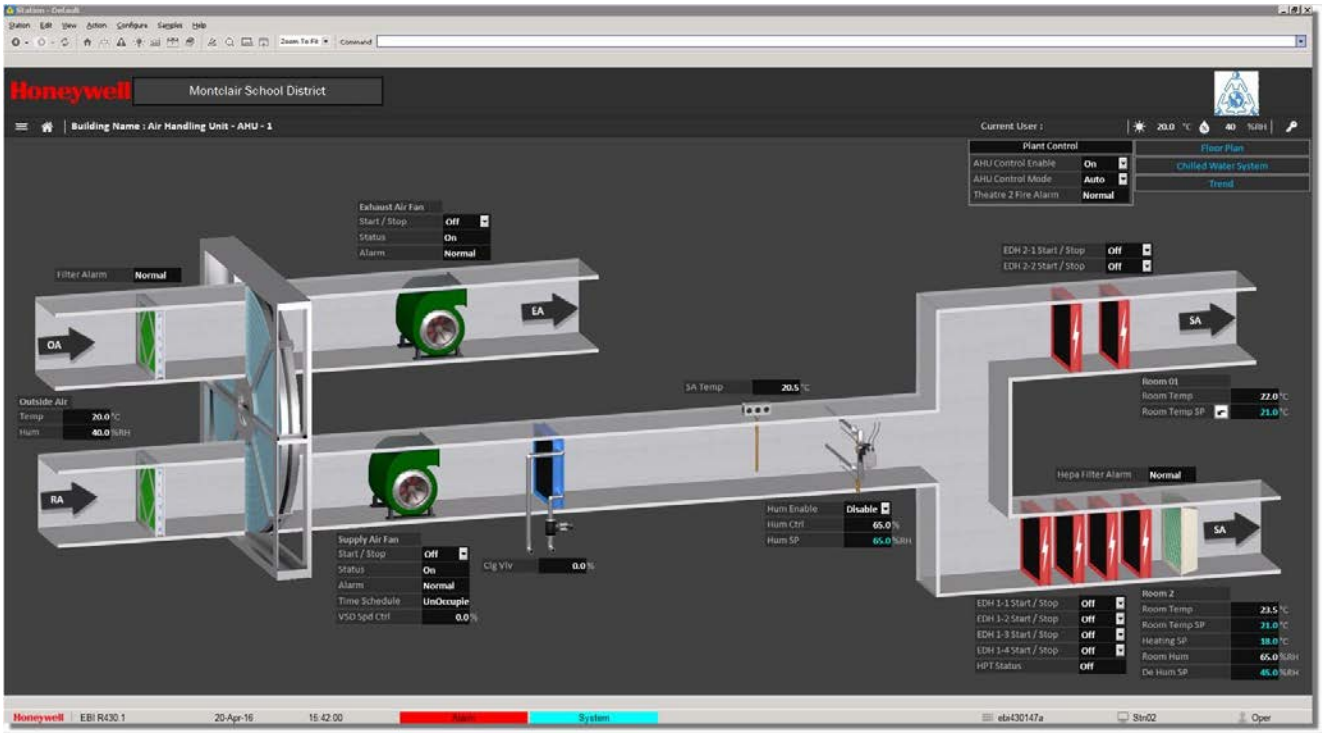
1.1 BMS

Existing State:

a. Existing Automated Logic Controls, Allerton, and Niagara Tridium.
b. Combination of vintage controllers and pneumatic systems.

Proposed State:

a. Honeywell propose to leverage Montclair School District IT infrastructure to establish a new BMS based on a BACnet open-protocol platforms. BMS operators shall be capable of real-time control and monitoring of any mechanical systems in the two buildings.
b. Remote access via computers, laptops, and mobile devices.
c. Integrate standalone equipment into the new Honeywell EBI system.
d. Establish a common communication platform throughout the entire school district.
e. Integrate existing non-defective controllers into the new systems.
f. Replace older equipment to maximize the energy savings.
g. Generate 3-dimensional graphical representation of all connected heating, cooling, ventilating, and air conditioning equipment to allow for intuitive control and monitoring of all systems.



Sample BMS Graphic

2. Montclair BOE

2.1 Heating Systems (Typical of 1).

Existing State:

a. Steam is provided from the Central plant.
b. Condensate systems pumps condensate back to Central Plant.
c. Steam radiators are used to heat the building.
d. Cooling is provided by window AC units.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the steam supply.
b. Monitor condensate pumps start/stop and status.
c. Generate 3-D graphical representation of the system to monitor and control the unit.
d. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

2.2 Steam Radiators (Typical of 25).

Existing State:

a. Steam radiators are used to heat the building.

Proposed State:

a. Install new Thermostatic Radiator Valves on the steam radiators
b. Install Sylk sensors to monitor common spaces, 1 per floor.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

2.3 Air Handling Unit (Typical of 1)

Existing State:

a. RTUs are controlled by local thermostats.

Proposed State:

a. Install new BACnet controllers to control the RTUs.
b. Establish connectivity between the BACnet thermostat and the network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3. Bradford Elementary

3.1 Air Handler Unit (Typical of 1)

Existing State:

a. AHU units are standalone and controlled by pneumatic system.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace existing pneumatic damper actuators with electronic actuators.
c. Replace existing pneumatic valves and valves actuators.
d. Install VFDs are required for demand-controlled ventilation.
e. Install Duct CO_2 sensor.
f. Replace temperature sensors with Honeywell duct temperature sensors.
g. Establish connectivity between the AHU controllers and the CPO-6A network controller.
h. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
i. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.

d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.2 Roof Top Unit (Typical of 4)

Existing State:

a. RTUs are controlled by local thermostats.

Proposed State:

a. Install new BACnet controllers to control the RTUs.
b. Establish connectivity between the RTU controllers and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.3 Classroom Fan Coils (Typical of 10).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.

c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.4 Heating Systems (Typical of 2).

Existing State:
a. Steam Boilers are controlled via JCI DX-9100 controllers.

Proposed State:
a. Install new Honeywell BACnet controller to control and monitor the two boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:
a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.5 Exhaust Fans (Typical of 10).

Existing State:
a. Exhaust fans are manually controlled via breakers.

Propose State:
a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.6 VAV Boxes (Typical of 23)

Existing State:
a. Controlled by JCI unitary controllers.

Proposed State:
a. Install new BACnet VAV-2A controller.
b. Daisy Chain BACnet Bus to and from each controller.
c. Establish connectivity between the VAV Box controllers and the CPO-6A network controller.
d. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
e. Establish an equipment run schedule based on the actual building usage.

Benefits:
a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

3.7 Radiators (Typical of 60)

Existing State:
a. Radiators are standalone.

Proposed State:
a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:
a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.

4. Bullock Elementary

4.1 Integration of Existing Controls.

Existing State:

a. The school is currently controlled by Allerton DDC system.

Proposed State:

a. Integrate the existing systems with Honeywell Front-end.
b. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
c. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

5. Buzz Aldrin

5.1 Package AC (Typical of 11)

Existing State:

a. AC units are standalone and controlled by local thermostats.

Proposed State:

a. Install new Honeywell BACnet controllers or Honeywell BACnet Controller to control the AHU.
b. Establish connectivity between the units and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

5.2 Roof Top Unit (Typical of 1)

Existing State:

a. RTU is controlled by a local thermostat.

Proposed State:

a. Install new Honeywell BACnet thermostat to control the RTU.
b. Establish connectivity between the AHU controllers and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

5.3 Classroom Fan Coils (Typical of 65).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.

d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

5.4 Exhaust Fans (Typical of 4).

Existing State:

a. Exhaust fans are manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

5.5 Radiators (Typical of 45)

Existing State:

a. Radiators are standalone.

Proposed State:

a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.

5.6 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are controlled locally.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the two boilers.
b. Control and monitor system start/stop and status of all the boilers.

c. Control and monitor the feed water pumps.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

6. Central Heating

6.1 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are controlled locally.

Proposed State:

a. Install new Honeywell BACnet controller to control the boiler and the pumps.
b. Integrate the new boiler to the new district BMS.
c. Control and monitor system start/stop and status of the boiler.
d. Install space sensor to monitor the central plant environment.
e. Open the fresh air damper whenever the boilers are in operation.
f. Generate 3-D graphical representation of the system to monitor and control the unit.
g. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
b. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

7. Edgemont Elementary

7.1 Air Handler Unit (Typical of 2)

Existing State:

a. AHU units are locally controlled by a thermostat.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace temperature sensors with Honeywell duct temperature sensors.
c. Establish connectivity between the AHU controllers and the CPO-6A network controller.
d. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
e. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

7.2 Classroom Fan Coils (Typical of 20).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

7.3 Radiators (Typical of 28)

Existing State:

a. Radiators are standalone.

Proposed State:

a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.

7.4 Heating Systems (Typical of 3).

Existing State:

a. Steam boilers are controlled by a Honeywell Tridium Jace.

Proposed State:

a. Integrate the existing Niagara Tridium controller into Montclair School District BMS.

Benefits:

c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

8. Furlong Fieldhouse

8.1 Package AC and Unit heaters in garage. (Typical of 10)

Existing State:

a. AC units are standalone and controlled by local thermostats.
b. Units are in the fieldhouse and the two garages.

Proposed State:

a. Install new Honeywell BACnet controllers or Honeywell BACnet Controller to control the AHU.
b. Establish connectivity between the units and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.

c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

8.2 Radiators (Typical of 28)

Existing State:
a. Radiators are standalone.

Proposed State:
a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:
a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.

8.3 Exhaust Fans (Typical of 2).

Existing State:
a. Exhaust fans are manually controlled via breakers.

Propose State:
a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:
a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

8.4 Heating Systems (Typical of 1).

Existing State:
a. Steam boilers are controlled by a time clock.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the two boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Generate 3-D graphical representation of the system to monitor and control the unit.
d. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

9. George Inness

9.1 Roof Top Unit (Typical of 4)

Existing State:

a. RTUs are standalone and controlled by local standalone thermostats.

Proposed State:

a. Install new Honeywell BACnet controllers or Honeywell BACnet Controller to control the RTU.
b. Establish connectivity between the AHU controller and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

9.2 Classroom Fan Coils (Typical of 52).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

9.3 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are locally controlled.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the two boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the feed water pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

9.4 Chilled Water Systems (Typical of 2).

Existing State:

a. Chillers are locally controlled.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the two chillers.
b. Control and monitor system start/stop and status of chillers.
c. Control and monitor the 2 pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

10. Glenfield Middle

10.1 Air Handler Unit (Typical of 3)

Existing State:

a. AHU units are standalone and controlled by pneumatic system.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace existing pneumatic damper actuators with electronic actuators.
c. Replace existing pneumatic valves and valves actuators.
d. Replace temperature sensors with Honeywell duct temperature sensors.
e. Establish connectivity between the AHU controllers and the CPO-6A network controller.
f. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
g. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.

c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

10.2 Split AC (Typical of 6)

Existing State:
a. Split AC units are standalone and controlled by local thermostats.

Proposed State:
a. Install new Honeywell BACnet controllers or Honeywell BACnet Controller to control the Split ACs.
b. Establish connectivity between the units and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AC units.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:
a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

10.3 Classroom Fan Coils (Typical of 53).

Existing State:
a. Fan Coils are controlled by a pneumatic system.

Proposed State:
a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

10.4 Radiators (Typical of 30)

Existing State:
a. Radiators are standalone.

Proposed State:
a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:
a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is satisfied.

10.5 Exhaust Fans (Typical of 10).

Existing State:
a. Exhaust fans are manually controlled via breakers.

Propose State:
a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:
a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

10.6 Heating Systems (Typical of 3).

Existing State:

a. Hot Water boilers are controlled locally.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the three boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the 2 pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

11. Hillside Elementary

11.1 Heating Systems

Existing State:

a. Steam is provided by the Central plant.
b. The radiators and controlled by Alerton DDC.

Proposed State:

a. Install new Niagara Tridium Jace at Hillside Elementary.
b. Integrate existing Alerton DDC to the District Wide BMS.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

12. Montclair High School

12.1 Roof Top Unit (Typical of 3)

Existing State:

a. RTUs are standalone and controlled by local standalone thermostats.

Proposed State:

a. Install new Honeywell BACnet controllers or Honeywell BACnet Controller to control the RTU.
b. Establish connectivity between the RTU controller and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the RTU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

12.2 Split AC (Typical of 7)

Existing State:

a. Split ACs (cooling only) are controlled by a local thermostat.

Proposed State:

a. Install new BACnet thermostat to control the units.
b. Establish connectivity between the Split AC controllers and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the ACs.
d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

12.3 Classroom Fan Coils (Typical of 69).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

12.4 Radiators (Typical of 37)

Existing State:

a. Radiators are standalone.

Proposed State:

a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is satisfied.

12.5 Exhaust Fans (Typical of 20).

Existing State:

a. Exhaust fans are manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.

c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

12.6 Heating Systems (Typical of 3).

Existing State:

a. Steam boilers are locally controlled via timeclock.
b. Of the 3 boilers, 2 are steam and 1 is hot water.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the 3 boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

13. Nishuane

13.1 Air Handler Unit (Typical of 1)

Existing State:

a. AHU units are standalone and controlled by pneumatic system.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace existing pneumatic damper actuators with electronic actuators.
c. Replace existing pneumatic valves and valves actuators.
d. Replace temperature sensors with Honeywell duct temperature sensors.
e. Establish connectivity between the AHU controllers and the CPO-6A network controller.
f. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
g. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

13.2 Roof Top Unit (Typical of 1)

Existing State:

a. RTU is standalone and controlled by local thermostats.

Proposed State:

a. Install new Honeywell BACnet controllers to control the RTU.
b. Establish connectivity between the units and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the RTU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

13.3 Classroom Fan Coils (Typical of 55).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

13.4 Radiators (Typical of 25)

Existing State:

a. Radiators are standalone.

Proposed State:

a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is satisfied.

13.5 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are locally controlled by Alerton DDC.

Proposed State:

a. Integrate the Alerton DDC system into the District Wide BMS.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

14. Northeast Elementary

14.1 Split AC (Typical of 10) and Roof Top Units (Typical of 4)

Existing State:

a. Split AC and RTU units are standalone and controlled by local thermostats.

Proposed State:

a. Install new Honeywell BACnet thermostats to control the Split ACs and the RTUs.
b. Establish connectivity between the new BACnet controller and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the ACs and the RTUs.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

14.2 Air Handler Unit (Typical of 1)

Existing State:

a. AHU units are standalone and controlled by pneumatic system.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace existing pneumatic damper actuators with electronic actuators.
c. Replace existing pneumatic valves and valves actuators.
d. Replace temperature sensors with Honeywell duct temperature sensors.
e. Establish connectivity between the AHU controllers and the CPO-6A network controller.

f. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
g. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

14.3 Classroom Fan Coils (Typical of 52).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

14.4 Exhaust Fans (Typical of 5).

Existing State:

a. Exhaust fans are manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system

14.5 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are locally controlled via timeclock.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the 3 boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

15. Pre-K DLC

15.1 Air Handler Unit (Typical of 5)

Existing State:

a. AHU units are standalone and controlled by a local thermostat.

b. The unit control the steam from the Central Plant by controlling the steam valve actuator.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace temperature sensors with Honeywell duct temperature sensors.
c. Monitor the condensate pumps.
d. Establish connectivity between the AHU controllers and the CPO-6A network controller.
e. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
f. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

15.2 Roof Top Unit (Typical of 3)

Existing State:

a. RTUs are controlled by local thermostats.

Proposed State:

a. Install new BACnet controllers to control the RTUs.
b. Establish connectivity between the RTU controllers and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

15.3 Radiators (Typical of 33)

Existing State:

a. Radiators are standalone.

Proposed State:

a. Install new thermostatic valves to control the steam output of the radiators.

Benefits:

a. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is satisfied.

15.4 Exhaust Fans (Typical of 3

Existing State:

a. Exhaust fans are manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the district-wide building automation system.
b. **Electrical Impact:** Reduce electrical consumption by de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

16. Renaissance Middle

16.1 Split AC (Typical of 1)

Existing State:

a. Split ACs is controlled by a local thermostat.

Proposed State:

a. Install new BACnet thermostat to control the ACs.
b. Establish connectivity between the unit and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the ACs.

d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

16.2 Air Handler Unit (Typical of 3)

Existing State:

a. AHU units are standalone and controlled by pneumatic system.

Proposed State:

a. Install new Honeywell BACnet controllers to control the AHU.
b. Replace existing pneumatic damper actuators with electronic actuators.
c. Replace existing pneumatic valves and valves actuators.
d. Replace temperature sensors with Honeywell duct temperature sensors.
e. Establish connectivity between the AHU controllers and the CPO-6A network controller.
f. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the AHU.
g. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

16.3 Classroom Fan Coils (Typical of 29).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.

d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

16.4 Ventilation Fans (Typical of 1).

Existing State:

a. Ventilation Fan is manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.
b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system

16.5 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are locally controlled via timeclock.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the 3 boilers.
b. Control and monitor system start/stop and status of all the boilers.

c. Control and monitor the pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

17. Watchung School

17.1 Split AC (Typical of 8)

Existing State:

a. Split ACs is controlled by a local thermostat.

Proposed State:

a. Install new BACnet thermostat to control the ACs.
b. Establish connectivity between the unit and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the ACs.
d. Establish an equipment run schedule based on the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

17.2 Roof Top Units (Typical of 2)

Existing State:

a. RTUs are standalone and controlled by local thermostats.

Proposed State:

a. Install new Honeywell BACnet thermostat to control the RTUs.

b. Establish connectivity between the RTU controllers and the CPO-6A network controller.
c. Generate a 3-dimensional graphical representation of the equipment allowing building operators to monitor and adjust operating parameters of the RTU.
d. Establish an equipment run schedule based upon the actual building usage.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

17.3 Classroom Fan Coils (Typical of 38).

Existing State:

a. Fan Coils are controlled by a pneumatic system.

Proposed State:

a. Replace existing pneumatic thermostat with a new wireless BACnet temperature sensor.
b. Install the new wireless BACnet controller at the Fan Coil unit.
c. Install new relays and CTs to control the fan.
d. Install new valves and valve actuators to control the heating valves.
e. Establish wireless BACnet communication with Network Controller gateway.
f. Create 3-D representation of the new systems to allow for intuitive control and monitoring.
g. Establish equipment runtime

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature set point and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature set point when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

17.4 Exhaust Fans (Typical of 5).

Existing State:

a. Ventilation Fan is manually controlled via breakers.

Propose State:

a. Install a new Honeywell BACnet controller to control the units.

b. Incorporate exhaust fan command start/stop and status into the BMS.
c. Integrate the exhaust fan control with the new CPO-6A network controller.
d. Generate 3-D graphical representation of the exhaust fan allowing building operators to schedule operating hours.
e. Schedule unit to operate only when the school is opened for business.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system

17.5 Heating Systems (Typical of 2).

Existing State:

a. Steam boilers are locally controlled via timeclock.

Proposed State:

a. Install new Honeywell BACnet controller to control and monitor the 3 boilers.
b. Control and monitor system start/stop and status of all the boilers.
c. Control and monitor the pumps and program for lead/lag operation.
d. Install new outdoor air temperature sensor.
e. Generate 3-D graphical representation of the system to monitor and control the unit.
f. Create equipment schedule based on the building's hours of operation.

Benefits:

a. **Occupancy Impact:** Improved space temperature and ventilation control ensuring a comfortable occupancy environment.
b. **Electrical Impact:** Reduce electrical consumption by increasing cooling space temperature setpoint and de-energizing the fan when the space served is unoccupied.
c. **Natural Gas Impact:** Reduce natural gas consumption by reducing heating space temperature setpoint when the space served is unoccupied.
d. **Operational Impact:** Improve maintenance response times by automatically notifying building operators of system deficiencies on a real-time basis via the Network-wide building management system.

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of energy that needs to pre-heat or cool the outside air. The savings are generally calculated as:

Existing Heating BTU & Cost per BTU	= Metered data from existing meter readings

Cost of Existing Heating	= Average site data $/CCF or $/Gallon
Reduction in Heating/Cooling BTU	= Reduction in outside air CFM x 1.08 x Delta T x Operating Hours
	= Reduced BTU x Cost per BTU
Cost of Proposed Heating/Cooling	= Existing Costs – Proposed Costs
Energy Savings $	

The baseline adjustment calculations are included with the energy calculations.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced energy.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 3B DEMAND CONTROL VENTILATION (IN BMS SCOPE)

The key benefits of this ECM include:

- **Operational efficiency** thanks to better control and reduced outside air.
- **Energy Savings** from reducing total energy consumption with more efficient, state of the art technology.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.
- **Occupancy comfort and productivity** by way of enhanced temperature and humidity control throughout your buildings.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
3B Demand Control Ventilation (in BMS scope)					●		●						●	●		

Existing Conditions

HVAC equipment serving large one-zone spaces such as gyms, auditoriums and multi-purpose rooms are often designed for peak occupancy conditions to supply outside air to the space with return air from space being exhausted. Most of the time these spaces are not fully occupied, which increase energy demand for heating and cooling of excessive amount of outside air.



Typical Units for Demand Control Ventilation

Proposed Solution

Honeywell will install CO_2 sensors at the below locations. The CO_2 sensors will provide the control signal for the HVAC equipment to optimize the quantity of fresh air required. The installation of CO_2 sensors will

read the levels of CO_2 in the space and ensure that only the required outside air is supplied and heated to meet the minimum outdoor air requirements. This control strategy will reduce the amount of outside air intake and thus reduce the heating energy used by the HVAC units and electric energy used by the motors. Based on this fact, there are reduced requirements for outside air to the spaces.

Building	Area Served	Number of Units	CFM Total (each unit) (est.)
Glenfield Middle School	Gym	1	9,912
Northeast Elementary School	Cafetorium	1	9,000
Renaissance Middle School	Gym	2	3,304
Hillside Elementary School	Gym Supply	1	5,000
Hillside Elementary School	Auditorium Supply	1	3,000

Existing Units to be installed with CO_2 sensors

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of energy that needs to pre-heat or cool the outside air. The savings are generally calculated as:

Existing Heating BTU & Cost per BTU	= Metered data from existing meter readings
Cost of Existing Heating	= Average site data $/CCF or $/Gallon
Reduction in Heating/Cooling BTU	= Reduction in outside air CFM x 1.08 x Delta T x Operating Hours
	= Reduced BTU x Cost per BTU
Cost of Proposed Heating/Cooling	= Existing Costs – Proposed Costs
Energy Savings $	

The baseline adjustment calculations are included with the energy calculations.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced energy.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 3C EXHAUST FAN CONTROLS (IN BMS SCOPE)

The key benefits of this ECM include:

- **Energy Savings** from reducing total runtime of energy consuming exhaust fans.
- **Equipment longevity** due to fewer equipment run hours per year.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
3C Exhaust Fan Controls (in BMS scope)	●	●	●		●	●				●			●		●	●

Existing Conditions

Currently, exhaust fans are manually controlled via breakers and/or timeclocks. This can lead to fans which run continuously or at least more often than is required.



Typical Exhaust Fans

Proposed Solution

Honeywell will install new BACnet controllers to control the exhaust fans, incorporate exhaust fan command start/stop and status into the BMS, and schedule the fans to operate only when the buildings are opened.

Building	Number of Fans
Bradford Elementary School	10
Bullock Elementary School	18
Buzz Aldrin Middle School	4
Glenfield Middle School	10
Hillside Elementary School	1
Montclair High School	4
Northeast Elementary School	5
Watchung Elementary School	5
Woodman Field	2

Buildings where exhaust fans will be controlled

Energy Savings Methodology and Results

The savings approach is based upon reducing the amount of energy consumed by the fans by reducing the number of hours over which they operate.

Changes in Infrastructure

Exhaust fans will be connected to BMS system as part of this measure.

Customer Support and Coordination with Utilities

Coordination of the electrical tie-in will be required.

Environmental Issues

Resource Use	Energy savings will result from reduced fan run hours.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 4A BUILDING ENVELOPE IMPROVEMENTS

The key benefits of this ECM include:

- **Energy savings** from reducing unwanted outside air infiltration.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.
- **Occupancy comfort and productivity** by way of enhanced temperature and humidity control throughout your buildings.
- **Improved building envelope** from addressing building gaps that allow unconditioned air penetration.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
4A Building Envelope Improvements	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

Existing Conditions

Heat loss due to infiltration is a common problem, particularly in places with long and cold winter seasons such as New Jersey. This problem has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings. Our work has found 30% to 50% of heat loss attributable to air leaks in buildings.

Honeywell uncovered several leaks that allow for heat loss to occur during the winter season and unwanted heat gains during the summer season. These problems include door gaps, exhaust fans in poor condition, open windows or windows in poor condition, lack of air sealing and insulation.

Honeywell has helped customers such as you to address these problems with a comprehensive and thorough building envelope solution that seals up your buildings to improve occupancy comfort and help eliminate unwanted energy waste. We propose to conduct a comprehensive weatherization job to weatherproof doors and windows, caulk and seal leaks, and install spray foam and rigid foam boards to stop unwanted air movement and provide a thermal barrier between spaces. Part of this process may include decoupling floor-to-floor and compartmentalizing of components of the building to equalize pressure differences.




Building Envelope Opportunities

Proposed Solution

AC Unit Weatherization

Make upper sash stationary using fasteners, caulk upper sash in place for air tight seal. Install flexible foam between raised lower sash and upper sash of double hung window system. Install mastic to seal insulation strips in place and adhere to window frame. Paint to match aesthetics as necessary of each treated window.

Attic Air Barrier Retrofit

Re-locate the existing fiberglass batt insulation to create open access to attic floor framing (save for re-use). Install Dow Thermax rigid insulation fastened to the existing framing using screws and screw plates; use sheathing tape to cover all fastener penetrations in rigid insulation material; install polyurethane foam sealant or sheathing tape at perimeter and seams of all rigid insulation boards for an air tight seal. At the attic floor intersection with gable walls and the intersection of the underside of the roof assembly create an air-tight seal between Dow Thermax rigid insulation and the adjoining wall or roof surface using polyurethane sealants. In areas of high traffic install 5/8" CDX plywood to support future workers; install polyurethane foam sealant or sheathing tape at perimeter and seams of all plywood for an air tight seal. Use caution tape or other clear markings to partition off areas of ceiling structure that will not support future workers in the attic. Re-install the fiberglass batt insulation on the attic-side of the retrofit Thermax and plywood air barrier materials; re-install fiberglass batt for 100% coverage of attic surface with fiberglass batt material.

Attic Bypass Air Sealing

Seal the attic air barrier retrofit material/ surface to the original ceiling surface/ air barrier. Install Dow Thermax Sheathing as blocking/ backer and install polyurethane sealants at the perimeter and seams of the Thermax Sheathing for an air-tight seal. Pull-Down stair is to be covered with Therma-Dome Product or similar to provide complete thermal cover as well as treatment with weather stripping. Carpentry may be necessary to provide an air tight seal with framing around the pull-down stair setup.

Insulation Baffles

Install insulation baffles at the eaves; install in an air-tight fashion at the exterior top plate using sealants. The baffles should create a space for air to properly flow to the ridge of the attic between the underside of the roof deck and the cellulose insulation.

Attic Insulation

After all Attic Bypass Air Sealing and Attic Insulation Baffles work is complete; install additional cellulose insulation to desired depth. Cellulose insulation is assumed to settle to a depth of 80% of its original installed depth. In an empty attic if desired settled depth is 12 inches of cellulose the installed depth of cellulose when first blown in should be 15 inches. The desired R value of all attics treated with cellulose insulation is a minimum of R40.

Buck Frame Air Sealing

Remove existing loose paints and other debris between the window frame and wall assembly at the window header joint above the drop ceiling. Install new polyurethane sealant between the window header and window frame for an air-tight transition from the top of the aluminum window frame, to the header, and to the wall assembly above. For smaller gaps, install spray polyurethane foam sealant to seal the gap. For mid-size or large gaps, install Dow Thermax Sheathing as blocking/ backer, install fasteners with washers as necessary to fasten the Thermax Sheathing in place, install polyurethane sealants at the perimeter and seams of the Thermax Sheathing for an air-tight seal.

Caulking

Caulk the non-operational components of the window jamb, casing or trim that have been identified as pathways for air leakage using siliconized acrylic caulk; install backer rod and elastomeric caulking if necessary. Install caulking with colors to match the interior aesthetics as closely as possible. A majority of windows throughout the district were replaced with similar style window assemblies. The linear footage reported to be sealed mostly comes from installing 3 lines of caulk per window; 2 at the snap trim intersections and one at the wood casing to wall intersection. All windows and doors are to be fully caulked as required; there will be instances where more or less than 3 lines of caulk are required in order to complete the caulking task at select locations.

Door Weather Stripping

Ensure the door operates and closes appropriately. Notify prime contractor and/or owner when doors are damaged. Install heavy duty weather stripping with aluminum carrier and Q-lon insert gasket at door sides and top jamb. Install for 40% - 60% weather strip compression. Caulk behind weather strip carrier for air-tight seal. Cut aluminum carrier weather strip at locks, swing arms or any other hardware where necessary. Install door bottom sweep with aluminum carrier and sweep insert. For double doors install an astragal weather strip material at both sides of the center meeting.

Hopper Window Weatherization

Clean debris from the mounting surface on the aluminum sash. Apply weather stripping around the perimeter of the sash to create an air tight compression seal when the windows are closed. Cut and remove any excess material from the corners of the window sash to ensure it operates properly. Broken and inoperable windows are to be caulked/sealed shut; no less than 2 windows per classroom are to be caulked/sealed shut in to allow ample egress in case of emergency.

Overhead Door Weather Stripping

Remove existing weather-stripping materials and fasteners; install heavy-duty aluminum carrier with oversized vinyl insert gasket at the sides and top of the overhead door; install heavy-duty aluminum carrier with an oversized bottom U-style gasket at bottom.

Roof-Wall Intersection Air Sealing

Install air barrier materials and sealants to create an air-tight transition at the roof-to-wall intersection. For smaller gaps, install spray polyurethane foam sealant to seal the gap. For mid-size or large gaps, install Dow Thermax Sheathing as blocking/ backer, install fasteners with washers as necessary to fasten the Thermax Sheathing in place, install polyurethane sealants at the perimeter and seams of the Thermax Sheathing for an air-tight seal. Install all materials to create an air-tight seal in accordance with the manufacturer's specifications.

Wall Air Sealing

Install air barrier materials and sealants to create an air-tight transition at the incomplete areas of wall air barrier and insulation materials. For smaller gaps, install spray polyurethane foam sealant to seal the gap. For mid-size or large gaps, install Dow Thermax Sheathing as blocking/ the primary air barrier material, install fasteners with washers as necessary to fasten the Thermax Sheathing in place, install polyurethane sealants at the perimeter and seams of the Thermax Sheathing for an air-tight seal. Install all materials to create an air-tight seal in accordance with the manufacturer's specifications.

Benefits

This work will allow for more efficient operation of your buildings by reducing heating and cooling losses throughout the year. In addition, the draftiness of the buildings and hot and cold spots will be significantly reduced. A reduction in air infiltration will also minimize potential concerns for dirt infiltration or indoor air quality concerns including allergies.

Energy Savings Methodology and Results

The energy savings for this ECM are realized at the buildings' HVAC equipment. The improved building envelope will limit conditioned air infiltration through openings in the building air barrier. Less infiltration means less heating required by the heating system.

Changes in Infrastructure

Building envelope will be improved with little or no noticeable changes.

Customer Support and Coordination with Utilities

Minimal coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced HVAC energy usage and better occupant comfort.
Waste Production	Some existing caulking and weather-stripping will be removed and disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 5A COMPUTER POWER MANAGEMENT

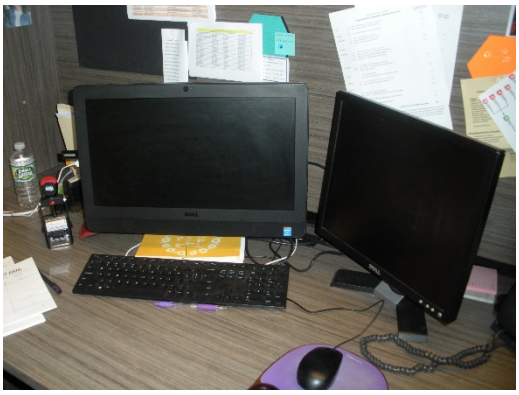
The key benefits of this ECM include:

- **Guaranteed energy savings** by better managing the power consumption of computer equipment.
- **Longer equipment life** thanks to reduced usage.
- **Security protection** because external access can't occur when the computer system is shut down after hours.
- **Virus protection** from the ability to shot down the computers before viruses reach the network.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
5A Computer Power Management	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

Existing Conditions

Information Technology (IT) is a major consumer of energy in school buildings and campuses. At more than 25 percent of total energy consumption energy efficient IT becomes less of a nice-to-have and more of a necessity. This ECM implements a power management system for all of your LAN based computers, printers and copiers throughout the building. The software system will automatically shut down your IT equipment at scheduled times to prevent unnecessary energy consumption during unoccupied hours.





Computer Power Management Opportunities

Honeywell proposes computer power management software *Surveyor* by Verdiem to manage PC consumption from phantom power, providing a detailed breakdown of usage by IT device type to allow energy managers to better plan, manage and optimize an organization's overall power consumption. This ECM will also provide for enhanced staff productivity. Energy consumption of distributed IT devices can

be reduced by up to 60%. Verdiem helps IT departments to accurately measure IT device energy consumption, enforce policies for greater energy efficiency, and optimize savings.

Building	Number of Computers (est.)
Bradford Elementary School	80
Bullock Elementary School	73
Buzz Aldrin Middle School	187
Edgemont Elementary School	35
Glenfield Middle School	81
Hillside Elementary School	19
Community Pre-K	3
Board of Education Offices	5
Montclair High School	310
George Inness Annex	105
Nishuane K-2	68
Northeast Elementary School	48
Renaissance Middle School	100
Watchung Elementary School	52
Woodman Field	2
TOTAL	**1,168**

Proposed Equipment for Computer Power Management

Energy Savings Methodology and Results

Annual savings for administrative and student computers is based on previous logging results for computers with similar usage types.

Changes in Infrastructure

Server will be integrated into current IT network.

Customer Support and Coordination with Software

Support will be required for software deployment by IT department.

Environmental Issues

Resource Use	Annual savings for administrative and student computers is based on previous logging results for computers with similar usage types.
Waste Production	None.
Environmental Regulations	No environmental impact is expected.

ECM 6A PERMANENT LOAD REDUCTION PROGRAM

The key benefits of this ECM include:

- **Energy Savings** from reducing energy loads during peak hours.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.
- **Revenue generation** from participation in the PJM permanent load reduction program.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
6A Permanent Load Reduction	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Proposed Solution

Honeywell proposed to facilitate the District's participation in the PJM Energy Efficiency Program. This program is offered through the PJM Regional Transmission Organization (RTO), and Independent System Operator (ISO). The energy efficiency program pays PJM customers for implementing ECMs that result in permanent load reductions during defined hours.



PJM Permanent Electrical Load Reduction

PJM Permanent Load Reduction

PJM offers incentives to customers who install energy-efficient equipment that permanently reduces the use of electricity during peak times. Documentation of the type of new energy-efficient equipment installed, when it was installed, and how it is being used is required. PJM also requires a measurement of electricity usage during the peak summer periods to verify if a building is actually using less energy. Also, as a cooperative, PJM relies on its members to combine projects together to make sure the volume is

significant enough to impact their system. The table below outlines the anticipated kW reduction that will be incentivized by PJM.

Building	Permanent Load Reduction (KW)
Bradford Elementary School	24.1
Bullock Elementary School	74.2
Buzz Aldrin Middle School	61.6
Edgemont Elementary School	18.7
Glenfield Middle School	58.4
Valley Road Complex	134.7
Montclair High School	109.4
George Inness Annex (HS-9th), Athletics	23.7
Nishuane K-2	33.8
Northeast Elementary School	24.8
Renaissance Middle School	24.6
Watchung Elementary School	15.8
Woodman Field	6.5

Proposed Permanent Load Reduction

Energy Savings Methodology and Results

Revenue is generated through participation in the PJM program.

Changes in Infrastructure

None.

Customer Support and Coordination with Utilities

Initiation of demand response curtailment will be required.

Environmental Issues

Resource Use	None.
Waste Production	This measure will produce no waste by-products.
Environmental Regulations	None.

ECM 7A TRANSFORMER REPLACEMENTS

The key benefits of this ECM include:

- **Guaranteed energy savings** from reducing total energy consumption with more efficient, state of the art technology.
- **Equipment longevity** due to more efficient and less wasteful equipment utilization.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
7A Transformer Replacements	●										●					

Existing Conditions

The transformers in locations within the electrical distribution systems in the District consist of 480 Volts. Distribution transformers are installed in the boiler rooms and in various electrical and utility closets to step down the voltage to 120-208 Volts. Typically, an electrical distribution system has some losses associated with the electrical system and a considerable portion of these losses are associated with distribution transformers.



Typical Transformers

Systems Evaluation and Selection

Typical transformers are not designed to handle harmonic loads of today's modern facilities, and suffer significant losses, even if the transformer is relatively new. Typically, conventional transformer losses, which are non-linear, increase by 2.7 times when feeding computer loads. The nonlinear load loss multiplier reflects this increase in heat loss, which decreases the net transformer efficiency. Also, unlike

most substation transformers that are vented to the exterior, building transformers are ventilated within the building they are located, and their heat losses therefore add to the cooling load.

Based on site investigation conducted by our staff, we identified the following transformers that we propose to replace with energy efficient replacements at a size matching the existing loads as indicated in the table below:

Building	kVA	Qty	Location
Bradford Elementary School	112.5	1	Electric Rm 3
Bradford Elementary School	150.0	1	Boiler Rm
Bradford Elementary School	15.0	1	Boiler Rm
George Inness Annex (HS-9th), Athletics	300.0	1	Main Electric
George Inness Annex (HS-9th), Athletics	225.0	1	Electric Rm 2

Existing Transformers to be Replaced

Proposed Solution

The proposed transformers will be Power Smiths High Efficiency K-Star Harmonic Mitigating units. They are Energy-Star rated and meet the new TP1 Law requiring replacement of transformers of 600 volts or under.

Scope of Work

Remove and install new E-saver transformers

Per Transformer Unit:

- Shut off the main electric power to the transformer to be replaced
- Disconnect the existing transformer and install replacement unit
- Turn power back on
- Inspect unit operation by performing electrical and harmonics testing
- Dispose of old transformers properly

Energy Savings Methodology and Results

The energy savings for this ECM is realized by reduction in electric energy lost in the existing transformers as a result of the higher efficiency of the new transformers.

Changes in Infrastructure

New transformers where indicated.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of services for the affected areas.

Environmental Issues

Resource Use	Energy savings will result from increased voltage conversion efficiency.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 8A COMBINED HEAT & POWER (COGENERATION)

The key benefits of this ECM include:

- **Energy Savings** from utilizing a combined heat and power system to supplement the existing heating system.
- **Operational savings** thanks to improved operational efficiencies unique to CHP technology.
- **Resiliency** unique to CHP technology that can allow you to operate the building during emergency situations and grid disruptions.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
8A Combined Heat and Power					●											

Existing Conditions

The Glenfield Middle School is a candidate for a small CHP system based on its seasonal profile of natural gas usage.

Proposed Solution

Honeywell recommends the installation of one 35 kW CHP generating unit that will generate electric power and produce thermal energy that can supplement heating loads. This system will be appropriate to this site given the year-round operational needs of this facility and leverage healthy state rebates to help pay for it. Since the unit is a synchronous generator it does not require any excitation energy to produce electricity and therefore may be used for emergency back-up power.

Yanmar Unit

Yanmar CP35 Low Emissions CHP Module takes the many benefits of modular cogeneration. Modules come fully pre-packaged from the factory, including engine, generator, oil/ jacket/ exhaust heat recovery, controls, electrical switchgear, emissions controls, and modem for remote monitoring and data-logging. This allows for standardization and minimizes installation cost and complexity in the field. Also, the comprehensive third-party (ETL/IEEE/NYSIR/UL) certifications provide streamlined interconnection permitting with the local electric utility and are NJDEP Air Permit Exempt.



Scope of Work

Building	Qty	Make	Model
Glenfield Middle School	1	Yanmar	CP35

Recommended Cogeneration Unit

Equipment Information

Manufacturer and Type	Yanmar CP35, Electrical Output 35 kW, Thermal Output 407,000 Btu/hr, or approved equal
Equipment Identification	Product cut sheets and specifications for generally used are available upon request. As part of the measure design and approval process, specific product selection will be provided for your review and approval.

Energy Savings Methodology and Results

Savings are based on energy conversion of natural gas to thermal and electrical energy.

Changes in Infrastructure

The proposed micro-generator would reside in or near the boiler room.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods. The customer and Honeywell will decide the exact location of the cogeneration installation at the central utility plant.

Environmental Issues

Resource Use	Renewable energy will be generated to supplement energy purchased from the electrical utility.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	Aside from the environmental benefits from on-site energy generation, no other environmental impact is expected.

ECM 9A ROOF RE-SEALING

The key benefits of this ECM include:

- **Equipment longevity** due to newly installed materials and updated warranty term.
- **Occupancy comfort and productivity** thanks to a tighter and more efficient building envelope.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
9A Roof Re-sealing	●		●	●	●	●	●		●	●	●	●	●	●	●	●

Existing Conditions

Due to the age of the existing roofs across the district, and the fact that many of them are near or past their warranty expiration, Honeywell investigated the implementation of a Silicone Coating to existing roofs for the purpose of extending the warranty periods, allowing for the installation of rooftop solar photovoltaic systems, through a power purchase agreement (PPA), without the risk of roof warranties expiring before the end of the PPA term. This coating will re-seal the roof surfaces, increasing water-tightness and decreasing unwanted air infiltration.

Building	Square Footage
Bradford Elementary School	10,687
Buzz Aldrin Middle School	7,210
Edgemont Elementary School	8,720
Glenfield Middle School	32,053
Valley Road Complex	35,350
Montclair High School	80,251
George Inness Annex (HS-9th), Athletics	6,293
Nishuane K-2	33,505
Northeast Elementary School	6,156
Renaissance Middle School	15,162
Watchung Elementary School	23,100
Woodman Field	3,615




Roof Replacement Opportunities

Proposed Solution

Honeywell proposes the installation of a new Silicone Roof Coating over the existing roofing materials. This solution will decrease unwanted air infiltration while also providing a new warranty period to the district for the roofing surface.

Energy Savings Methodology

Following approach is used to determine savings for this specific measure:

Existing Roof Efficiency	= Existing U + Existing Infiltration Rate
Proposed Roof Efficiency	= Proposed U + Proposed Infiltration Rate
Energy Savings (Btu)	= UAdTproposed – UAdTexisting
Winter Savings (Therms)	= Energy Savings/Boiler Eff./100,000
Summer Savings (Tons Cooling)	= Energy Savings/12,000 Btu/Ton

Interface with Building

The new roof coating will be installed over existing roofing materials.

Energy Savings Methodology

The energy savings for this ECM are realized at the buildings' HVAC equipment. The improved roof will limit conditioned air infiltration through openings in the building air barrier. Less infiltration means less heating and cooling required by HVAC systems.

Changes in Infrastructure

A Silicone roof coating will be implemented on portions of the roofs identified.

Support and Coordination with Utilities

Coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced HVAC energy usage and better occupant comfort.
Waste Production	Any materials removed will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 10A KITCHEN EQUIPMENT CONVERSION

The key benefits of this ECM include:

- **Lower operational costs** through less expensive utility rates for heating fuel.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
10A Kitchen Equipment Conversion	●		●	●	●		●					●	●			

Existing Conditions

The existing kitchen cooking equipment utilizes electricity to generate heat. Electrical heating is a much more expensive way to power heating/cleaning equipment than natural gas.



Typical Kitchen Equipment

Proposed Solution

Honeywell recommends replacing existing kitchen cooking and cleaning equipment with natural gas-fired units. This new equipment will last much longer than the old electrical equipment would have and reduce operating costs due to the price difference between electricity and natural gas.

Building	Equipment Type	Quantity
Bradford Elementary School	Electric Double Convection Oven	1
Buzz Aldrin Middle School	Electric Double Convection Oven	1
Hillside Elementary School	Electric Double Convection Oven	1

Building	Equipment Type	Quantity
Edgemont Elementary School	Electric Double Convection Oven	1
Glenfield Middle School	Electric Double Convection Oven	1
Nishuane K-2	Electric Double Convection Oven	1
Northeast Elementary School	Electric Single Convection Oven	1

Existing Kitchen Equipment to be Replaced

Scope of Work

- Disconnect and remove select existing electrically-heated kitchen equipment.
- Run new gas line from new natural gas service/meter location to the kitchen.
- Install and connect new gas-fired kitchen equipment.
- Start-up and test new units.

Energy Savings Methodology and Results

The savings approach is based upon the difference in energy use and cost between the existing and new kitchen equipment.

Changes in Infrastructure

New gas piping will need to be run from the new gas service/meter to the kitchen.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Energy savings will result from reduced energy.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 11A SOLAR POWER PURCHASE AGREEMENT

The key benefits of this ECM include:

- **Reduced utility costs** due to lower electricity rates than grid-supplied power.
- **Guaranteed utility rates for 15 years** to provide a valuable hedge against future price volatility and deliver greater budgetary certainty utilizing clean electricity.
- **Additional savings** from solar can provide the District with more potential ESIP funding to expand the overall project scope and include additional projects.
- **Educational asset** to provide additional tools for teachers to engage students on sustainability and the environment.
- **Low risk** given that maintenance is provided by the 3rd party system owner.
- **No upfront costs**.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
11A Solar Power Purchase Agreement	●		●	●	●	●	●		●	●	●	●	●	●	●	●

ECM Overview

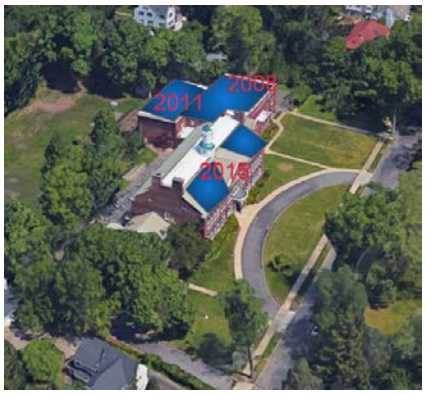
Honeywell recommends that the District further assess the feasibility of a solar photovoltaic system on District owned roofs to generate on-site renewable electricity. This could be provided at no upfront cost via a power purchase agreement (PPA). A PPA is a public-private partnership financial arrangement in which a third-party solar company owns, operates, and maintains your photovoltaic system, while the host customer agrees to provide the site for the system on its property. The solar system's power production is purchased by you for a predetermined price ($/kWh) and for a predetermined period. This stable price for electricity will be lower than the utilities and third-party suppliers, thereby allowing you to benefit from cheaper electricity prices, on-site renewable energy generation, a reduction in greenhouse gas emissions and a powerful educational tool for your teachers and students. Meanwhile, the system will not add any additional maintenance costs since it is owned by the third-party solar company. One of the more significant benefits of this potential ECM is that it will provide for a rate change, helping to deliver greater savings within your ESIP project to help fund other measures.



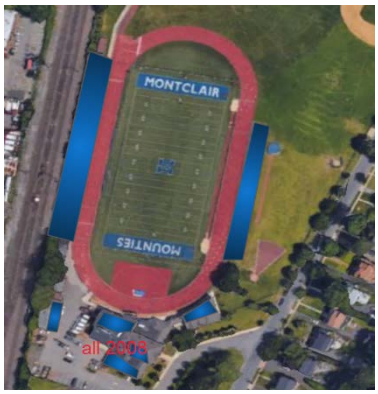
Bradford Elementary School



Buzz Aldrin Middle School



Edgemont Elementary School



Woodman Field



George Innes Annex



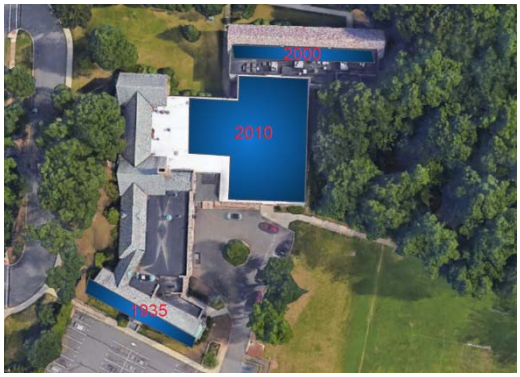
Glenfield Middle School



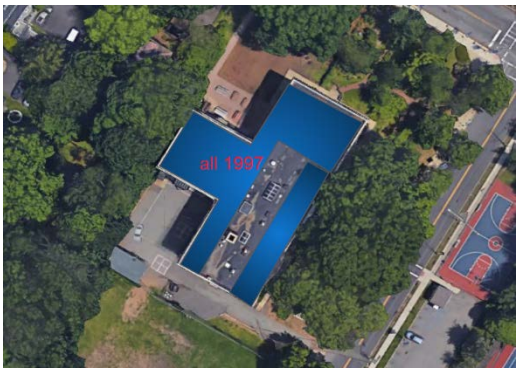
Montclair High School



Nishuane School



Northeast Elementary School



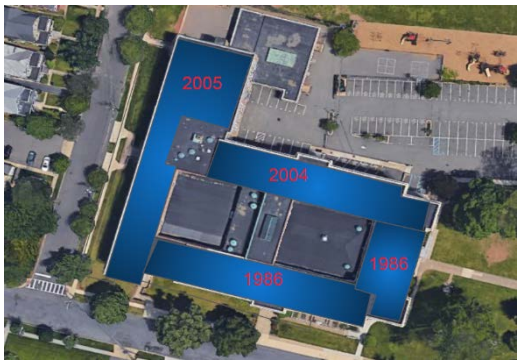
Renaissance Middle School



Admin & Community Pre-K



Watchung Elementary School



Hillside Elementary School

Honeywell will oversee the design and construction and help with the operations and maintenance of the system. We will first help conduct a feasibility study in conjunction with your technical consultant and legal team, to provide RFP development, solicitation, and oversight of the installation of a solar photovoltaic system.

Proposed Solution

Honeywell proposes to install the solar PPA system at the buildings listed in the chart below.

Location	Rating kW-DC
Bradford Elementary School	177.1
Buzz Aldrin Middle School	156.4
Edgemont Elementary School	373.9
Glenfield Middle School	361.2
Hillside Elementary School	47.9
Community Pre-K	254.2
Montclair High School	843.7
George Inness Annex	161.1
Nishuane K-2	319.3
Northeast Elementary School	182.1
Renaissance Middle School	52.7
Watchung Elementary School	250.7
Woodman Field	409.8

Proposed Solar Arrays

Energy Savings Methodology and Results

Savings are based on the difference in kWh price between the PPA and the current electrical supplier.

Changes in Infrastructure

The proposed solar array would be primarily roof-mounted only, with some canopy arrays.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	None.
Waste Production	Any removed parts will be disposed of properly.
Environmental Regulations	Aside from the environmental benefits of increasing energy awareness no other environmental impact is expected.

ECM 12A WATER CONSERVATION (DI)

The key benefits of this ECM include:

- **Reduction in water consumption** from replacing the existing plumbing fixtures to lower water flow rates.
- **Improved performance** of existing systems by optimizing equipment.
- **Reduction in maintenance costs** from new flush valves and tuning each fixture to the right amount of water.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
12A Water Conservation (DI)	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

ECM Overview

Honeywell will seek to increase the operational performance of your water systems with the minimal water required to provide optimal performance.

Existing Conditions

These are a mixture of wall hung and floor mounted toilets exceeding 1.5 gallons per flush (gpf), in addition to faucet flow aerators which exceed 1.0 gpm. These fixtures use more water than is generally needed to accomplish their task.



Typical Existing Fixtures

Proposed Solution

Flushometers (Toilets and Urinals): Benefits of our proposed approach include:

- Increased Performance and Flush-to-Flush Consistency. The first objective is to ensure every fixture operates properly. Our calibration and tuning via Variable Flow Technology will ensure each fixture is using the right amount of water.
- Standardization and Reduce Maintenance Costs. By having only one valve throughout the campus, staff may eliminate the wide variety of replacement components they now have in inventory. Likewise, the replacement of all wear parts will create a new "zero baseline" for future maintenance.
- Flushometer Scope. As detailed on scope quantities and options.
  - Valve Recommissioning: Replace diaphragm kit and inner cap. Re- engineering of the new kit will provide the proper flush curve for each fixture.
  - Valve Rebuilding: Remove and replace diaphragm kit and inner cap. Re- engineering of the new kit will provide the proper flush curve for each fixture. Replace vacuum breaker, handle assembly and O-Rings.
  - New Valve X-Body: HydraMetrics will remove and replace the valve body assembly for standardization, aesthetic enhancement and a maintenance baseline.
  - Spud and/or Flushtube Replacement: HydraMetrics will remove and replace the fixture spuds and flushtubes (optional or as needed).

Tank Toilet Retrofit Upgrade: Benefits of our proposed approach include:

- Tank Toilet Retrofit Upgrade: HydraMetrics will remove and replace the flapper, flow diverter ballcock assembly, and refill tube. As necessary, to ensure proper operation during the warranty period, HydraMetrics will remove and replace the trip lever and supply line.
- Improved Flushing Effectiveness: all fixtures will operate at the "right" amount of water.
- Establishes New Baseline of Maintenance: all new components will resist the rigors of substantial use. This creates a new "zero baseline" for maintenance and translates into significantly reduced labor and costs for years to come.

Sinks: Benefits of our proposed approach include:

- Pressure Independent Performance. End-users will enjoy the same level of performance regardless of incoming pressure (flow rate is constant at pressures between 20 and 80 psi). Pressure variations within the facility would be transparent to the end-users.
- Invisible to End-Users. Because we carefully apply the appropriate flow rate and pattern to each sink (based upon sink application), end-users will not realize a decline in performance.
- Long-Life. Because our flow components are robust in their construction, these devices will serve you well for years to come. Furthermore, we protect the longevity of these products by applying tamper-resistant technology.
- One Size Fits All. No longer will you need to stock different aerators for the various faucets within your facility. Rather, because we adapt all faucets to accommodate the same-size flow control device, you need only one size.

Changes in Infrastructure

New low-flow water fixture components will be installed as part of this ECM.

Customer Support and Coordination with Utilities

Minor support will be required for the interruption of utilities for brief tie-in periods.

Environmental Issues

Resource Use	Water savings will result from lower water flows through new fixtures.
Waste Production	Old components will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

ECM 13A WINDOW FILM

The key benefits of this ECM include:

- **Energy savings** from reducing unwanted heat transfer.
- **Occupancy comfort and productivity** by way of enhanced temperature control throughout your buildings.

ECM Description	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Community Pre-K	Hillside Elementary School	Central Heating Plant	Board of Education Offices	Montclair High School	George Inness Annex	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
13A Window Film	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●

Existing Conditions

Windows throughout the district are not considered energy efficient by modern standards, allowing infrared heat to be radiated out during the winter, and solar energy to increase the load in the classrooms during the warmer months.



Window Film Opportunities

Proposed Solution

Honeywell proposes the installation of new solar/safety window film to the existing windows throughout the district. This film reduces the amount of solar energy which passes through the window glass causing hot rooms and taxing the cooling systems. It also reduces the loss of heat via infrared radiation during the winter, lowering heating usage and costs. Overall, through the implementation of this measure, your district will reduce its heating fuel usage and cooling costs each year. The upgrade will result in savings and improved comfort to students and teachers which in turn will foster a better learning environment.

The window film also acts as a safety mechanism by holding the glass together and preventing unwanted entry in the event that the glass itself is compromised.

Building	Square Footage
Bradford Elementary School	9,286
Bullock Elementary School	11,164
Buzz Aldrin Middle School	9,286
Edgemont Elementary School	7,168
Glenfield Middle School	13,633
Valley Road Complex	15,979
Montclair High School	19,747
George Inness Annex (HS-9th), Athletics	11,507
Nishuane K-2	11,389
Northeast Elementary School	9,159
Renaissance Middle School	7,426
Watchung Elementary School	8,792
Woodman Field	4,423

Window Film Opportunities

Energy Savings Methodology and Results

The energy savings for this ECM are realized at the buildings' HVAC equipment. The improved windows will limit heat gain and loss from the spaces, decreasing energy used by the heating and cooling systems.

Following approach is used to determine savings for this specific measure:

Existing Window Efficiency	U_E = 1/Existing R
Proposed Window Efficiency	U_P = 1/Proposed R
Energy Savings $	= (U_E – U_P) * $Area_{windows}$ * audit hours * ($dTemperature_{BIN}$) * ($1/n_{boiler}$) * fuel unit cost

Changes in Infrastructure

New window film will be installed.

Customer Support and Coordination with Utilities

Minimal coordination efforts will be needed to reduce or limit impact to building occupants.

Environmental Issues

Resource Use	Energy savings will result from reduced HVAC energy usage and better occupant comfort.
Waste Production	Any waste materials generated will be disposed of properly.
Environmental Regulations	No environmental impact is expected.

SECTION D TECHNICAL AND FINANCIAL SUMMARY

1. Recommended ESIP Project

Recommended ESIP Project	
Value of Project	10,719,303
Term of Repayment	15 Years
Projected Savings Over Term	$13,447,419
Projected NJ Rebates & Incentives	$1,059,473
Projected Interest Rate	2.2%

Recommended Project Technical and Financial Summary Documents

Form II: Energy Conservation Measures (ECMs) Summary Form
Form III: Projected Annual Energy Savings Data Form
Form IV: Projected Annual Energy Savings Data Form in MMBTUs
Form V: ESCOs Proposed Final Project Cost Form
Form VI: ESCOs Preliminary Annual Cash Flow Analysis Form

Building by Building Simple Payback Summary

A simple payback summary broken down by building by ECM has been provided for the Montclair BOE's use in reviewing available scope combinations and options.

Building by Building Simple Payback Summary (Hard Costs Only)

FORM II: RECOMMENDED PROJECT - ENERGY CONSERVATION MEASURES (ECMS) SUMMARY FORM

FORM II

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ENERGY CONSERVATION MEASUREs (ECMs) SUMMARY FORM
MONTCLAIR BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Honeywell International

Proposed Preliminary Energy Savings Plan: ECMs (Base Project)	Estimated Installed Hard Costs [1] $	Estimated Annual Savings $	Estimated Simple Payback (years)
1A LED Lighting	$ 1,633,343	$ 345,579	4.73
1C Vending Misers	$ 3,888	$ 687	5.66
1D De-Stratification Fans	$ 106,500	$ 17,012	6.26
2D Rooftop Unit Replacement (DI)	$ 0	$ 761	0.00
2H Piping Insulation	$ 288,238	$ 34,725	8.30
2J Steam Trap Replacement	$ 657,824	$ 50,826	12.94
3A Building Management Control System	$ 3,562,611	$ 199,337	17.87
3B Demand Control Ventilation (in BMS scope)	$ 0	$ 522	0.00
3C Exhaust Fan Controls (in BMS scope)	$ 0	$ 4,811	0.00
4A Building Envelope Improvements	$ 1,027,177	$ 62,680	16.39
6A Permanent Load Reduction	$ -	$ -	-
7A Transformer Replacement	$ 96,000	$ 7,163	13.40
9A Roof Re-sealing	$ 909,004	$ 495	1,835.92
11A Solar PPA	$ -	$ 110,163	-
12A Water Conservation (DI)	$ 0	$ 603	0.00
Add additional lines as needed* **Project Summary:**	$ 8,284,585	$ 835,362	9.92

Optional ECMs Considered, but not included with base project at this time	Estimated Installed Hard Costs [1] $	Estimated Annual Savings $	Estimated Simple Payback (years)
1B Lighting Controls	$ 472	$ 370	1.27
1E Plug Load Management via WiFi	$ 178,080	$ 24,083	7.39
2A Boiler Upgrade	$ 1,193,844	$ 23,210	51.44
2A.1 Vacuum Tank Replacements	$ 936,540	$ 341	2,744.50
2B Boiler Burner Replacement & Controls	$ 284,400	$ 1,103	257.84
2C Domestic Hot Water Replacement	$ 93,708	$ 693	135.21
2E Kitchen Hood Controls	$ 300,000	$ 4,000	75.00
2F Walk In Compressor Controls	$ 8,640	$ 209	41.24
2G Premium Efficiency Motors and VFDs	$ 130,800	$ 12,928	10.12
2I Split System Replacement	$ 856,236	$ 1,902	450.14
2K Air Handling Unit Refurbishment	$ 170,880	$ 57	3,007.19
5A Computer Power Management	$ 22,426	$ 9,246	2.43
8A Cogeneration	$ 231,000	$ 1,377	167.70
10A Kitchen Equipment Conversion	$ 126,000	$ 7,561	16.66
13A Window Film	$ 1,321,849	$ 71,957	18.37

Add additional lines as needed*

(1) The total value of Hard Costs is defined in accordance with standard AIA definitions that include: Labor Costs, Subcontractor Costs, Cost of Materials & Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups, Overhead, Profit, etc.

FORM III: RECOMMENDED PROJECT - PROJECTED ANNUAL ENERGY SAVINGS DATA FORM

FORM III

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP)
PROJECTED ANNUAL ENERGY SAVINGS DATA FORM
MONTCLAIR BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

The projected annual savings for each fuel type MUST be completed using the following format. Data should be given in the form of fuel units that appear in the utility bills.

Energy/Water	ESCO Developed Baseline (Units)	ESCO Developed Baseline (Costs $)	Proposed Annual Savings (Units)	Proposed Annual Savings (Costs $)
Electric Demand (KW)	22,045	$315,682	7,423	$103,700
Electric Energy (KWH)	5,536,584	$784,322	2,052,491	$289,554
Natural Gas (therms)	477,378	$375,368	291,481	$229,788
Fuel Oil (Gal)	0	$0	0	$0
Steam (Pounds)				
Water (gallons)	11,311,000	$85,593	56,391	$426
Avoided Emissions (1)	Provide in Pounds (Lbs)			
NOX	4,631			
SO2	4,536			
CO2	5,792,070			

(1) ESCOs are to use the rates provided as part of this RFP to calculate Avoided Emissions. Calculation for all project energy savings and greenhouse gas reductions will be conducted in accordance with adopted NJBPU protocols

(2) "ESCOs Developed Baseline": Board's current annual usages and costs as determined by the proposing ESCO; based off Board's utility information as provided to proposing ESCO.

(3) "Proposed Annual Savings": ESCOs proposed annual savings resulting from the Board's implementation of the proposed ESP, as based upon "ESCOs Developed Baseline".

FORM IV: RECOMMENDED PROJECT - PROJECTED ANNUAL ENERGY SAVINGS DATA FORM IN MMBTUS

FORM IV

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
PROJECTED ANNUAL ENERGY SAVINGS DATA FORM IN MMBTUs
MONTCLAIR BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

The projected annual energy savings for each fuel type MUST be completed using the following format. Data should be given in equivalent MMBTUs.

ENERGY	ESCO Developed Baseline	ESCO Proposed Savings Annual	Comments
Electric Energy (MMBTUs)	18,891	7,003	
Natural Gas (MMBTUs)	47,738	29,148	
Fuel Oil (MMBTUs)	0	0	
Steam (MMBTUs)			
Other (Specify) (MMBTUs)			
Other (Specify)			

NOTE: MMBTU Defined: A standard unit of measurement used to denote both the amount of heat energy in fuels and the ability of appliances and air conditioning systems to produce heating or cooling.

FORM V: RECOMMENDED PROJECT ESCO'S PROPOSAL PROJECT COST FORM

FORM V

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCOs PROPOSED FINAL PROJECT COST FORM FOR BASE CASE PROJECT
MONTCLAIR BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **HONEYWELL INTERNATIONAL**

PROPOSED CONSTRUCTION FEES

Fee Category	Fees [1] Dollar ($) Value	Percentage of Hard Costs
Estimated Value of Hard Costs [2]:	$8,284,584.97	
Project Service Fees		
Investment Grade Energy Audit	$165,691.70	2.00%
Design Engineering Fees	$0.00	0.00%
Construction Management & Project Administration	$414,229.25	5.00%
System Commissioning	$33,138.34	0.40%
Equipment Initial Training Fees	$33,138.34	0.40%
ESCO Overhead	$704,189.72	8.50%
ESCO Profit	$289,960.47	3.50%
Project Service Fees Sub Total	$646,197.63	7.80%
TOTAL FINANCED PROJECT COSTS:	$9,924,932.80	19.80%
ESCO Termination Fee (To be paid only if the Board decides not to proceed beyond the ESP)	$0.00	0.00%

PROPOSED ANNUAL SERVICE FEES

First Year Annual Service Fees	Fees [1] Dollar ($) Value	Percentage of Hard Costs
SAVINGS GUARANTEE (OPTION)	$0.00	0.00%
Measurement and Verification (Associated w/ Savings Guarantee Option)	$65,000.00	Flat Fee
ENERGY STAR™ Services (optional)	Included	0.00%
Post Construction Services (If applicable)	N/A	-
Performance Monitoring	Included	-
On-going Training Services	N/A	-
Verification Reports	Included	-
TOTAL FIRST YEAR ANNUAL SERVICES	$65,000.00	Flat Fee

NOTES:
(1) Fees should include all mark-ups, overhead, and profit. Figures stated as a range will NOT be accepted.
(2) The total value of Hard Costs is defined in accordance with standard AIA definitions that include:

Labor Costs, Subcontractor Costs, Cost of Materials and Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups, Overhead and Profit, etc.
ESCO's proposed interest rate at the time of submission: 5% TO BE USED BY ALLRESPONDING ESCOs FOR PROPOSAL PURPOSES

*Annual Service only applies if customer accepts energy guarantee.

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FORM VI: RECOMMENDED PROJECT ESCO'S PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM

FORM VI
ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
MONTCLAIR BOARD OF EDUCATION
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: **Honeywell International**

Note: Proposers must use the following assumptions in all financial calculations:
(a) The cost of all types of energy should be assumed to inflate at: **2.4%** gas, **2.2%** electric per year and

1. Term of Agreement: **15** (Years) (Months)
2. Construction Period (2) (months): **12**
3. Cash Flow Analysis Format:

Architect/Engineer:	$	744,370	7.5%
Abatement:	$	-	
Total Project Cost (1):	$	9,924,933	
Lease Issuance Fees:	$	50,000	
Total Finance Amount:	**$**	**10,719,303**	Interest Rate to Be Used for Proposal Pu **2.2%**

Year	Annual Energy Savings	Solar Savings	Annual Operational Savings	Energy Rebates/Incentives	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs (3)	Net Cash-Flow to Client	Cumulative Cash Flow
Installation	$ 153,991				$ 153,991		$ -	$ -	$ 153,991	$ 153,991
1	$ 513,304	$ 110,163	$ 211,895	$ 48,319	$ 883,681	$ (864,481)	$ (929,481)	$ (65,000)	$ 19,200	$ 173,191
2	$ 525,057	$ 112,587	$ 211,895	$ 560,317	$ 1,409,855	$ (1,390,655)	$ (1,390,655)	$ -	$ 19,200	$ 192,391
3	$ 537,080	$ 115,064	$ 103,078	$ 560,317	$ 1,315,538	$ (1,296,338)	$ (1,296,338)	$ -	$ 19,200	$ 211,591
4	$ 549,378	$ 117,595	$ 103,078	$ 16,935	$ 786,986	$ (767,786)	$ (767,786)	$ -	$ 19,200	$ 230,792
5	$ 561,959	$ 120,182	$ 103,078	$ 16,935	$ 802,154	$ (782,954)	$ (782,954)	$ -	$ 19,200	$ 249,992
6	$ 574,828	$ 122,826		$ -	$ 697,655	$ (678,455)	$ (678,455)	$ -	$ 19,200	$ 269,192
7	$ 587,993	$ 125,529		$ -	$ 713,521	$ (694,321)	$ (694,321)	$ -	$ 19,200	$ 288,392
8	$ 601,459	$ 128,290		$ -	$ 729,750	$ (710,550)	$ (710,550)	$ -	$ 19,200	$ 307,592
9	$ 615,235	$ 131,113		$ -	$ 746,348	$ (727,148)	$ (727,148)	$ -	$ 19,200	$ 326,792
10	$ 629,327	$ 133,997		$ -	$ 763,324	$ (744,124)	$ (744,124)	$ -	$ 19,200	$ 345,992
11	$ 643,742	$ 136,945		$ -	$ 780,687	$ (761,487)	$ (761,487)	$ -	$ 19,200	$ 365,192
12	$ 658,488	$ 139,958		$ -	$ 798,446	$ (779,246)	$ (779,246)	$ -	$ 19,200	$ 384,392
13	$ 673,573	$ 143,037		$ -	$ 816,609	$ (797,409)	$ (797,409)	$ -	$ 19,200	$ 403,592
14	$ 689,003	$ 146,184		$ -	$ 835,187	$ (815,987)	$ (815,987)	$ -	$ 19,200	$ 422,792
15	$ 704,788	$ 149,400		$ -	$ 854,188	$ (834,442)	$ (834,442)	$ -	$ 19,746	$ 442,537
Totals	$ 9,219,204	$ 1,932,869	$ 733,023	$ 1,202,823	$ 13,087,920	$ (12,645,382)	$ (12,710,382)	$ (65,000)	$ 442,537	$ 442,537

NOTES:
(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"
(2) No payments are made by MONTCLAIR BOARD OF EDUCATION during the construction period.
(3) This figure should equal the value indicated on the ESCO's PROPOSED "FORM V". DO NOT include in the Financed Project Costs.

HONEYWELL IS NOT ACTING AS A MUNICIPAL ADVISOR OR FIDUCIARY ON YOUR BEHALF. ANY MUNICIPAL SECURITIES OR FINANCIAL PRODUCTS INFORMATION PROVIDED IS FOR GENERAL INFORMATIONAL AND EDUCATIONAL PURPOSES ONLY AND YOU SHOULD OBTAIN THE ADVICE OF A LICENSED AND QUALIFIED FINANCIAL ADVISOR REGARDING SUCH INFORMATION

***Annual Service only applies if customer accepts energy guarantee.**

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BUILDING BY BUILDING SIMPLE PAYBACK SUMMARY (HARD COSTS ONLY)

Building & ECM	kWh Savings ($)	kW Savings ($)	Natural Gas Savings ($)	Fuel Oil Savings ($)	Water Savings ($)	Annual Energy Cost Savings ($)	Annual Operational Savings ($)	Net Cost ($)	Simple Payback
Bradford Elementary School	**$ 28,562**	**$ 3,189**	**$ 12,345**	**$ -**	**$ 43**	**$ 58,086**	**$ 13,946**	**$ 561,113**	**7.8**
1A LED Lighting	$ 7,120	$ 2,940	$ (498)	$ -	$ -	$ 15,528	$ 5,965	$ 23,576	1.1
1D De-Stratification Fans	$ (86)	$ -	$ 1,192	$ -	$ -	$ 1,106	$ -	$ 9,000	8.1
2H Piping Insulation	$ -	$ -	$ 1,524	$ -	$ -	$ 1,524	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 3,219	$ -	$ -	$ 3,219	$ -	$ 41,599	12.9
3A Building Management Control System	$ 526	$ -	$ 3,069	$ -	$ -	$ 11,576	$ 7,981	$ 281,799	14.4
4A Building Envelope Improvements	$ 1,189	$ -	$ 3,789	$ -	$ -	$ 4,978	$ -	$ 59,525	12.0
7A Transformer Replacement	$ 1,855	$ 249	$ -	$ -	$ -	$ 2,104	$ -	$ 48,000	22.8
11A Solar PPA	$ 16,896	$ -	$ -	$ -	$ -	$ 16,896	$ -	$ -	-
2D Rooftop Unit Replacement (DI)	$ 94	$ -	$ -	$ -	$ -	$ 94	$ -	$ 0	0.0
3C Exhaust Fan Controls (in BMS scope)	$ 950	$ -	$ -	$ -	$ -	$ 950	$ -	$ 0	0.0
9A Roof Re-sealing	$ 17	$ -	$ 45	$ -	$ -	$ 63	$ -	$ 97,614	1,556.0
12A Water Conservation (DI)	$ -	$ -	$ 6	$ -	$ 43	$ 49	$ -	$ 0	0.0
Bullock Elementary School	**$ 24,122**	**$ 7,535**	**$ -**	**$ -**	**$ -**	**$ 51,149**	**$ 19,493**	**$ 364,269**	**5.2**
1A LED Lighting	$ 21,897	$ 7,535	$ -	$ -	$ -	$ 39,029	$ 9,597	$ 277,599	5.7
1C Vending Misers	$ 120	$ -	$ -	$ -	$ -	$ 120	$ -	$ 709	5.9
3A Building Management Control System	$ -	$ -	$ -	$ -	$ -	$ 9,896	$ 9,896	$ 69,880	3.5
4A Building Envelope Improvements	$ 397	$ -	$ -	$ -	$ -	$ 397	$ -	$ 16,081	40.6
3C Exhaust Fan Controls (in BMS scope)	$ 1,708	$ -	$ -	$ -	$ -	$ 1,708	$ -	$ 0	0.0
Buzz Aldrin Middle School	**$ 24,777**	**$ 11,787**	**$ 26,836**	**$ -**	**$ 17**	**$ 72,376**	**$ 8,959**	**$ 545,442**	**6.7**
1A LED Lighting	$ 13,190	$ 11,787	$ (1,268)	$ -	$ -	$ 25,911	$ 2,202	$ 37,558	1.3
1D De-Stratification Fans	$ (104)	$ -	$ 2,035	$ -	$ -	$ 1,930	$ -	$ 15,000	7.8
2H Piping Insulation	$ -	$ -	$ 1,906	$ -	$ -	$ 1,906	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 8,832	$ -	$ -	$ 8,832	$ -	$ 102,558	11.6
3A Building Management Control System	$ -	$ -	$ 10,690	$ -	$ -	$ 17,446	$ 6,757	$ 238,564	9.9
4A Building Envelope Improvements	$ 1,054	$ -	$ 4,617	$ -	$ -	$ 5,672	$ -	$ 92,398	16.3
11A Solar PPA	$ 10,356	$ -	$ -	$ -	$ -	$ 10,356	$ -	$ -	-
3C Exhaust Fan Controls (in BMS scope)	$ 275	$ -	$ -	$ -	$ -	$ 275	$ -	$ 0	0.0
9A Roof Re-sealing	$ 6	$ -	$ 24	$ -	$ -	$ 30	$ -	$ 59,364	2,005.3
12A Water Conservation (DI)	$ -	$ -	$ 1	$ -	$ 17	$ 18	$ -	$ 0	0.0
Edgemont Elementary School	**$ 4,810**	**$ 4,139**	**$ 13,946**	**$ -**	**$ 13**	**$ 30,598**	**$ 7,691**	**$ 258,102**	**6.7**
1A LED Lighting	$ 4,433	$ 4,139	$ (424)	$ -	$ -	$ 11,548	$ 3,400	$ 13,121	0.9
1D De-Stratification Fans	$ (46)	$ -	$ 1,116	$ -	$ -	$ 1,070	$ -	$ 6,000	5.6
2H Piping Insulation	$ -	$ -	$ 2,139	$ -	$ -	$ 2,139	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 3,171	$ -	$ -	$ 3,171	$ -	$ 34,103	10.8
3A Building Management Control System	$ -	$ -	$ 4,256	$ -	$ -	$ 8,546	$ 4,290	$ 151,485	11.8
4A Building Envelope Improvements	$ 423	$ -	$ 3,687	$ -	$ -	$ 4,111	$ -	$ 53,394	13.0
12A Water Conservation (DI)	$ -	$ -	$ 1	$ -	$ 13	$ 14	$ -	$ 0	0.0
George Inness Annex (HS-9th), Athletics	**$ 22,143**	**$ 5,294**	**$ 25,230**	**$ -**	**$ 117**	**$ 71,019**	**$ 18,234**	**$ 796,283**	**8.9**
1A LED Lighting	$ 4,835	$ 4,184	$ (530)	$ -	$ -	$ 16,321	$ 7,832	$ 34,098	1.4
1D De-Stratification Fans	$ (105)	$ -	$ 2,012	$ -	$ -	$ 1,908	$ -	$ 12,000	6.3
2H Piping Insulation	$ -	$ -	$ 791	$ -	$ -	$ 791	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 4,105	$ -	$ -	$ 4,105	$ -	$ 73,921	18.0
3A Building Management Control System	$ 1,682	$ -	$ 12,497	$ -	$ -	$ 24,581	$ 10,403	$ 367,303	10.5
4A Building Envelope Improvements	$ 1,563	$ -	$ 6,240	$ -	$ -	$ 7,803	$ -	$ 204,658	26.2
7A Transformer Replacement	$ 3,949	$ 1,110	$ -	$ -	$ -	$ 5,059	$ -	$ 48,000	9.5
11A Solar PPA	$ 9,983	$ -	$ -	$ -	$ -	$ 9,983	$ -	$ -	-
2D Rooftop Unit Replacement (DI)	$ 230	$ -	$ -	$ -	$ -	$ 230	$ -	$ 0	0.0
9A Roof Re-sealing	$ 6	$ -	$ 25	$ -	$ -	$ 31	$ -	$ 56,304	1,822.6
12A Water Conservation (DI)	$ -	$ -	$ 90	$ -	$ 117	$ 207	$ -	$ 0	0.0
Glenfield Middle School	**$ 11,599**	**$ 9,854**	**$ 14,325**	**$ -**	**$ -**	**$ 55,963**	**$ 20,186**	**$ 734,148**	**9.6**
1A LED Lighting	$ 10,981	$ 9,854	$ (1,303)	$ -	$ -	$ 30,113	$ 10,581	$ 186,621	4.6
1C Vending Misers	$ 86	$ -	$ -	$ -	$ -	$ 86	$ -	$ 1,050	12.2
1D De-Stratification Fans	$ (73)	$ -	$ 1,816	$ -	$ -	$ 1,742	$ -	$ 12,000	6.9
2H Piping Insulation	$ -	$ -	$ 422	$ -	$ -	$ 422	$ -	$ 7,171	17.0
3A Building Management Control System	$ -	$ -	$ 3,891	$ -	$ -	$ 13,496	$ 9,604	$ 339,117	14.7
4A Building Envelope Improvements	$ -	$ -	$ 9,393	$ -	$ -	$ 9,393	$ -	$ 188,189	20.0
3B Demand Control Ventilation (in BMS scope)	$ -	$ -	$ 106	$ -	$ -	$ 106	$ -	$ 0	0.0
3C Exhaust Fan Controls (in BMS scope)	$ 605	$ -	$ -	$ -	$ -	$ 605	$ -	$ 0	0.0
Montclair High School	**$ 92,480**	**$ 10,603**	**$ 29,359**	**$ -**	**$ -**	**$ 166,869**	**$ 34,427**	**$ 2,018,374**	**10.0**
1A LED Lighting	$ 32,271	$ 10,603	$ (2,259)	$ -	$ -	$ 58,814	$ 18,198	$ 577,411	7.5
1C Vending Misers	$ 480	$ -	$ -	$ -	$ -	$ 480	$ -	$ 2,129	4.4
1D De-Stratification Fans	$ (284)	$ -	$ 3,554	$ -	$ -	$ 3,270	$ -	$ 22,500	6.9
2H Piping Insulation	$ -	$ -	$ 5,497	$ -	$ -	$ 5,497	$ -	$ 119,280	21.7
2J Steam Trap Replacement	$ -	$ -	$ 1,777	$ -	$ -	$ 1,777	$ -	$ 31,255	17.6
3A Building Management Control System	$ 2,656	$ -	$ 14,276	$ -	$ -	$ 33,160	$ 16,228	$ 572,998	11.6
4A Building Envelope Improvements	$ 1,977	$ -	$ 6,302	$ -	$ -	$ 8,279	$ -	$ 90,899	11.0
11A Solar PPA	$ 54,923	$ -	$ -	$ -	$ -	$ 54,923	$ -	$ -	-
3C Exhaust Fan Controls (in BMS scope)	$ 379	$ -	$ -	$ -	$ -	$ 379	$ -	$ 0	0.0
9A Roof Re-sealing	$ 76	$ -	$ 212	$ -	$ -	$ 288	$ -	$ 601,902	2,089.1

Building & ECM	kWh Savings ($)	kW Savings ($)	Natural Gas Savings ($)	Fuel Oil Savings ($)	Water Savings ($)	Annual Energy Cost Savings ($)	Annual Operational Savings ($)	Net Cost ($)	Simple Payback
Nishuane K-2	**$ 7,900**	**$ 8,025**	**$ 19,469**	**$ -**	**$ 45**	**$ 52,581**	**$ 17,141**	**$ 516,842**	**7.4**
1A LED Lighting	$ 7,363	$ 8,025	$ (753)	$ -	$ -	$ 21,362	$ 6,726	$ 21,451	0.8
1D De-Stratification Fans	$ (43)	$ -	$ 1,362	$ -	$ -	$ 1,319	$ -	$ 6,000	4.5
2H Piping Insulation	$ -	$ -	$ 1,143	$ -	$ -	$ 1,143	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 7,116	$ -	$ -	$ 7,116	$ -	$ 79,337	11.1
3A Building Management Control System	$ -	$ -	$ 7,899	$ -	$ -	$ 18,315	$ 10,416	$ 367,771	12.8
4A Building Envelope Improvements	$ 579	$ -	$ 2,696	$ -	$ -	$ 3,275	$ -	$ 42,283	12.9
12A Water Conservation (DI)	$ -	$ -	$ 6	$ -	$ 45	$ 51	$ -	$ 0	0.0
Northeast Elementary School	**$ 16,281**	**$ 6,255**	**$ 12,755**	**$ -**	**$ 102**	**$ 54,853**	**$ 19,460**	**$ 572,556**	**7.7**
1A LED Lighting	$ 5,410	$ 6,255	$ (548)	$ -	$ -	$ 20,825	$ 9,708	$ 34,835	1.1
1D De-Stratification Fans	$ (64)	$ -	$ 1,792	$ -	$ -	$ 1,728	$ -	$ 9,000	5.2
2H Piping Insulation	$ -	$ -	$ 754	$ -	$ -	$ 754	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 2,118	$ -	$ -	$ 2,118	$ -	$ 40,857	19.3
3A Building Management Control System	$ 351	$ -	$ 5,697	$ -	$ -	$ 15,800	$ 9,752	$ 344,318	13.5
4A Building Envelope Improvements	$ 642	$ -	$ 2,668	$ -	$ -	$ 3,310	$ -	$ 86,018	26.0
11A Solar PPA	$ 9,276	$ -	$ -	$ -	$ -	$ 9,276	$ -	$ -	-
2D Rooftop Unit Replacement (DI)	$ 305	$ -	$ 2	$ -	$ -	$ 307	$ -	$ 0	0.0
3B Demand Control Ventilation (in BMS scope)	$ -	$ -	$ 186	$ -	$ -	$ 186	$ -	$ 0	0.0
3C Exhaust Fan Controls (in BMS scope)	$ 351	$ -	$ -	$ -	$ -	$ 351	$ -	$ 0	0.0
9A Roof Re-sealing	$ 9	$ -	$ 47	$ -	$ -	$ 56	$ -	$ 57,528	1,035.6
12A Water Conservation (DI)	$ -	$ -	$ 41	$ -	$ 102	$ 144	$ -	$ 0	0.0
Renaissance Middle School	**$ 5,513**	**$ 7,295**	**$ 11,814**	**$ -**	**$ 36**	**$ 37,704**	**$ 13,046**	**$ 316,694**	**6.2**
1A LED Lighting	$ 5,110	$ 7,295	$ (555)	$ -	$ -	$ 17,945	$ 6,095	$ 12,898	0.5
1D De-Stratification Fans	$ (20)	$ -	$ 890	$ -	$ -	$ 870	$ -	$ 3,000	3.4
2H Piping Insulation	$ -	$ -	$ 1,226	$ -	$ -	$ 1,226	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 2,246	$ -	$ -	$ 2,246	$ -	$ 27,343	12.2
3A Building Management Control System	$ -	$ -	$ 5,802	$ -	$ -	$ 12,753	$ 6,951	$ 245,429	12.5
4A Building Envelope Improvements	$ 424	$ -	$ 2,095	$ -	$ -	$ 2,518	$ -	$ 28,024	11.1
3B Demand Control Ventilation (in BMS scope)	$ -	$ -	$ 100	$ -	$ -	$ 100	$ -	$ 0	0.0
12A Water Conservation (DI)	$ -	$ -	$ 11	$ -	$ 36	$ 46	$ -	$ 0	0.0
Valley Road Complex	**$ 36,230**	**$ 24,182**	**$ 46,756**	**$ -**	**$ -**	**$ 133,376**	**$ 26,209**	**$ 1,037,159**	**6.5**
1A LED Lighting	$ 34,641	$ 24,182	$ (3,025)	$ -	$ -	$ 75,399	$ 19,601	$ 388,962	4.1
1D De-Stratification Fans	$ (50)	$ -	$ 793	$ -	$ -	$ 742	$ -	$ 6,000	8.1
2H Piping Insulation	$ -	$ -	$ 17,714	$ -	$ -	$ 17,714	$ -	$ 161,786	9.1
2J Steam Trap Replacement	$ -	$ -	$ 13,524	$ -	$ -	$ 13,524	$ -	$ 155,025	11.5
3A Building Management Control System	$ -	$ -	$ 11,434	$ -	$ -	$ 18,041	$ 6,608	$ 233,307	9.5
4A Building Envelope Improvements	$ 1,556	$ -	$ 6,186	$ -	$ -	$ 7,742	$ -	$ 92,080	11.9
3B Demand Control Ventilation (in BMS scope)	$ -	$ -	$ 131	$ -	$ -	$ 131	$ -	$ 0	0.0
3C Exhaust Fan Controls (in BMS scope)	$ 83	$ -	$ -	$ -	$ -	$ 83	$ -	$ 0	0.0
Watchung Elementary School	**$ 4,028**	**$ 3,992**	**$ 14,018**	**$ -**	**$ 44**	**$ 32,553**	**$ 10,471**	**$ 386,296**	**9.0**
1A LED Lighting	$ 3,253	$ 3,992	$ (351)	$ -	$ -	$ 9,640	$ 2,745	$ 12,324	1.0
1D De-Stratification Fans	$ (40)	$ -	$ 1,367	$ -	$ -	$ 1,326	$ -	$ 6,000	4.5
2H Piping Insulation	$ -	$ -	$ 970	$ -	$ -	$ 970	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 4,706	$ -	$ -	$ 4,706	$ -	$ 57,626	12.2
3A Building Management Control System	$ -	$ -	$ 4,937	$ -	$ -	$ 12,663	$ 7,726	$ 272,800	13.4
4A Building Envelope Improvements	$ 484	$ -	$ 2,375	$ -	$ -	$ 2,859	$ -	$ 37,546	13.1
3C Exhaust Fan Controls (in BMS scope)	$ 331	$ -	$ -	$ -	$ -	$ 331	$ -	$ 0	0.0
12A Water Conservation (DI)	$ -	$ -	$ 14	$ -	$ 44	$ 57	$ -	$ 0	0.0
Woodman Field	**$ 11,110**	**$ 1,550**	**$ 2,934**	**$ -**	**$ 9**	**$ 18,235**	**$ 2,632**	**$ 177,306**	**8.5**
1A LED Lighting	$ 1,309	$ 1,550	$ (143)	$ -	$ -	$ 3,144	$ 428	$ 12,890	3.6
2H Piping Insulation	$ -	$ -	$ 639	$ -	$ -	$ 639	$ -	$ 0	0.0
2J Steam Trap Replacement	$ -	$ -	$ 11	$ -	$ -	$ 11	$ -	$ 14,200	1,287.2
3A Building Management Control System	$ 346	$ -	$ 512	$ -	$ -	$ 3,063	$ 2,205	$ 77,840	14.8
4A Building Envelope Improvements	$ 463	$ -	$ 1,881	$ -	$ -	$ 2,344	$ -	$ 36,084	15.4
11A Solar PPA	$ 8,729	$ -	$ -	$ -	$ -	$ 8,729	$ -	$ -	-
2D Rooftop Unit Replacement (DI)	$ 129	$ -	$ -	$ -	$ -	$ 129	$ -	$ 0	0.0
3C Exhaust Fan Controls (in BMS scope)	$ 129	$ -	$ -	$ -	$ -	$ 129	$ -	$ 0	0.0
9A Roof Re-sealing	$ 4	$ -	$ 24	$ -	$ -	$ 28	$ -	$ 36,292	1,285.5
12A Water Conservation (DI)	$ -	$ -	$ 9	$ -	$ 9	$ 18	$ -	$ 0	0.0
Project Total	**$ 289,554**	**$ 103,700**	**$ 229,788**	**$ -**	**$ 426**	**$ 835,362**	**$ 211,895**	**$ 8,284,585**	**7.9**

2. Utility and Other Rebates and Incentives

NJ Pay-for-Performance Program (P4P)



Honeywell has been certified as a Pay for Performance Program Partner to provide technical services under direct contract to you. Acting as your energy expert, Honeywell will develop an Energy Reduction Plan for each project with a whole-building technical component of a traditional energy audit, a financial plan for funding the energy efficient measures and a construction schedule for installation. This supports your ability to take a comprehensive, whole-building approach to saving energy in your existing facilities and earn incentives that are directly linked to your savings.

Eligibility

Existing commercial, industrial and institutional buildings with a peak demand over 100 kW for any of the preceding twelve months are eligible to participate including hotels and casinos, large office buildings, multi-family buildings, supermarkets, manufacturing facilities, schools, shopping malls and restaurants. Buildings that fall into the following five customer classes are not required to meet the 100kW demand to participate in the Program: hospitals, public districts and universities, nonprofits, affordable multifamily housing, and local governmental entities. Your Energy Reduction Plan must define a comprehensive package of measures capable of reducing the existing energy consumption of your building by 15% or more to utilize the Pay Performance Program.

ENERGY STAR Portfolio Manager



Pay for Performance takes advantage of the ENERGY STAR Program with Portfolio Manager, EPA's interactive tool that allows facility managers to track and evaluate energy and water consumption across all their buildings. The tool provides the opportunity to load in the characteristics and energy usage of your buildings and determine an energy performance benchmark score. You can then assess energy management goals over time, identify strategic opportunities for savings, and receive EPA recognition for superior energy performance.

Incentives

Incentives for the P4P program are based on the annual electric and natural gas savings produced by the Energy Conservation Measures. There are three incentives to the program; details are included in the follow page. The first incentive is distributed after a finalized project is selected and bid. This usually occurs shortly before construction starts or shortly thereafter. The second incentive is distributed a few months after construction is completed, while the third incentive is distributed usually thirteen to fourteen months after the second incentive - once a year of building usage, post-retrofit, is completed.

Incentives, Rebates and Grants Summary

Honeywell has a great deal of experience in applying for, and successfully securing, all available incentives, rebates and grants for our clients. We have been approved and allocated for over $9M of incentives on behalf of our New Jersey customers alone since the introduction of the Energy Savings Improvement Program legislation in 2009. The New Jersey programs employed included primarily the

Office of Clean Energy's Pay for Performance and Cogeneration Incentives. A table of the incentive amounts on a per project basis is provided below.

NJ Customers	Rebate Amount
Hudson County (Projected)	$2,369,012
East Brunswick Public Schools (Projected)	$1,601,318
West Orange Board of Education	$1,399,747
City of Newark	$1,242,368
Passaic County (Projected)	$1,209,061
Old Bridge Board of Education	$1,085,614
Bridgewater-Raritan Regional District	$963,034
Elizabeth Schools	$934,209
Parsippany-Troy Hills Board of Education	$831,175
Camden County Technical Schools	$734,803
West Orange Board of Education	$644,744
Hillsborough Board of Education	$584,736
NH-Voorhees Regional HS District	$511,558
School District of the Chathams	$419,056
West Morris Regional High School (Projected)	$392,700
Phillipsburg School District	$274,278
Educational Services Commission of NJ	$260,603
Somerset County Vocational	$246,095
Robbinsville Public School District	$231,015
Bloomfield Board of Education	$225,868
Mountain Lakes Board of Education	$194,722
Lower Cape May Regional	$190,658
Verona School District	$171,015
Hanover Township School District	$169,882
City of Perth Amboy	$137,441
Town of Kearny	$84,147
Frankford School District	$30,743

Honeywell has determined that the Montclair BOE is eligible for **$1,202,823** in estimated total incentives for the projects. This includes **$1,135,083** for the P4P program and **$67,740** Permanent Load Reduction Incentives.

Please refer to the tables on below for a breakdown of Montclair BOE incentive levels on a building by building basis for each type of incentive.

P4P Incentives

Building	P4P Incentives			
	First Incentive	Second Incentive	Third Incentive	Total Incentive
Bullock Elementary School	$6,301	$50,915	$50,915	$108,132
Glenfield Middle School	$9,396	$82,853	$82,853	$175,101
Valley Road Complex	$12,908	$231,807	$231,807	$476,521
Montclair High School	$19,714	$177,807	$177,807	$375,329
TOTALS	**$48,319**	**$543,382**	**$543,382**	**$1,135,083**

Permanent Load Reduction Incentives

Description	Permanent Load Reduction Incentives			
	1st Year Incentive	2nd Year Incentive	3rd Year Incentive	4th Year Incentive
Permanent Load Reduction Incentives	**$16,935**	**$16,935**	**$16,935**	**$16,935**

Total Rebates and Incentives

Year	P4P Incentives	Permanent Load Reduction Incentives	Total Incentives
Installation	$48,319	$0	$48,319
Year 1	$543,382	$16,935	$560,317
Year 2	$543,382	$16,935	$560,317
Year 3	$0	$16,935	$16,935
Year 4	$0	$16,935	$16,935
TOTALS	**$1,135,083**	**$67,740**	**$1,202,823**

3. Financing the ESIP

In accordance with P.L.2012, c.55 an ESIP can be financed through energy savings obligations. The term refers to the two primary financing tools, debt and lease-purchase instruments. Each of these options is discussed below.

Energy savings obligations shall not be used to finance maintenance, guarantees, or the required third-party verification of energy conservation measures guarantees. Energy saving obligations, however, may include the costs of an energy audit and the cost of verification of energy savings as part of adopting an energy savings plan or upon commissioning. While the audit and verification costs may be financed, they are not to be considered in the energy savings plan as a cost to be offset with savings.

In all cases, maturity schedules of lease-purchase agreements or energy savings obligations shall not exceed the estimated average useful life of the energy conservation measures.

An ESIP can also include installation of renewable energy facilities, such as solar panels. Under an energy savings plan, solar panels can be installed, and the reduced cost of energy reflected as savings.

The law also provides that the cost of energy saving obligations may be treated as an element of the local unit's utility budget, as it replaces energy costs.

DEBT ISSUANCE

The law specifically authorizes municipalities, school districts, cities, counties, and fire districts to issue refunding bonds as a general obligation, backed with full faith and credit of the local unit to finance the ESIP. Because an ESIP does not effectively authorize new costs or taxpayer obligations, the refunding bond is appropriate, as it does not affect debt limits, or in the case of a board of education, require voter approval. The routine procedures for refunding bonds found in the Local Bond Law and Public School Bond Law would be followed for issuance of debt, along with any required Bond Anticipation Notes as authorized pursuant to law.

Regarding bonds for public schools, the Department of Education (DOE) has concluded that debt financed ESIP projects are not covered by State aid for debt service or a "Section 15 EFFCA Grant" as there is no new local debt being authorized.

TAX-EXEMPT LEASE PURCHASE FINANCING

The tax-exempt lease is a common form of financing for ESIP projects. Tax-exempt leasing is a tool that meets the basic objectives of debt, spreading the cost of financing over the life of an asset, while avoiding constitutional or statutory limitations on issuing public debt. If structured properly, by including non-appropriation language in the financing documents, the tax-exempt lease will not be considered debt for state law purposes but will be considered debt for federal income tax purposes. Thus, for federal purposes, the interest component of the lease payment is tax-exempt.

Under the New Jersey Energy Savings Improvement Program (ESIP), the Montclair BOE may authorize a lease purchase agreement between the Montclair BOE and a financier. Ownership of the equipment or improved facilities will pass to the Montclair BOE when all the lease payments have been made. There are legal expenses and other minimal closing costs associated with this type of structure. The lease purchase agreement may not exceed 15 years (commencing upon completion of the construction work), or 20 years where a combined heat and power or cogeneration plant is included in the project. The primary benefits of a lease are lower rates and the acquisition of essential use property without creating debt.

Under a lease there is typically a single investor. The lease may have non-appropriation language that allows the Montclair BOE to access low tax-exempt rates. Some previous customers have chosen to remove the non-appropriation language which has resulted in lower competitive rates.

Repayment of the lease payments is tailored to meet the requirements of the Montclair BOE. Payments are typically scheduled to commence after the construction is complete and acceptance of the project has been received by the Montclair BOE. Typically, payment terms are structured so there is no up-front capital expense to the Montclair BOE and payments are aligned within your cash flow and fiscal limits.

CERTIFICATES OF PARTICIPATION (COP'S)

Certificates of Participation are another form of a lease purchase agreement with the differentiating factor being that there are multiple investors participating in the purchase of the lease. COP's require financial disclosure and are typically utilized on higher value projects where one investor doesn't have the capacity to hold a high value lease for a single customer.

ENERGY SAVINGS OBLIGATIONS

Energy Savings Obligations can be issued as refunding bonds in accordance with the requirements of N.J.S.A *40A:11-4.6(c)(3)*. These bonds may be funded through appropriation for the utility services in the annual budget of the contract unit and may be issued as refunding bonds pursuant to N.J.S.40A:2-52 et seq., including the issuance of bond anticipation notes as may be necessary, provided that all such bonds and notes mature within the periods authorized for such energy savings obligations. Energy savings obligations may be issued either through the contracting unit or another public agency authorized to undertake financing on behalf of the unit but does not require bond referendum.

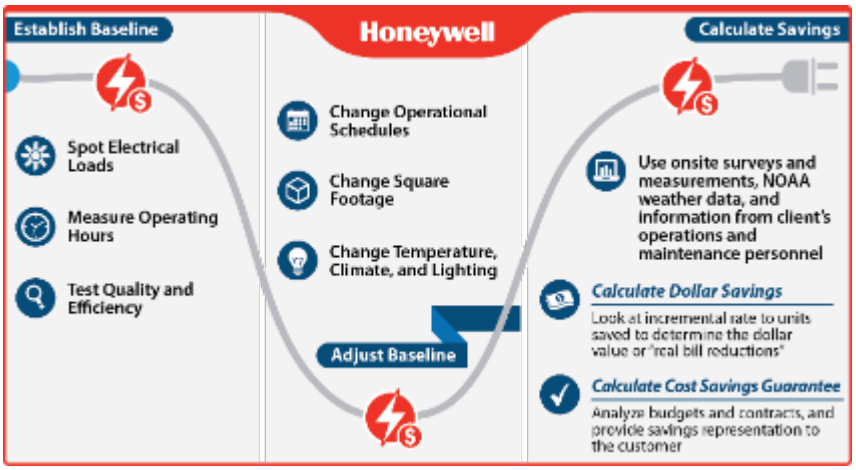
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SECTION E MEASUREMENT & VERIFICATION AND MAINTENANCE PLAN

1. Baseline

The purpose for establishing a baseline for an energy performance project is to accurately predict what the energy consumption and costs would have been as if the energy project was never completed. The baseline can then be used to measure the improvement in efficiency and determine the overall energy savings of the project. Since the energy consumption of all facilities is somewhat affected by variable weather conditions, a baseline for heating and cooling systems is typically dependent on degree-days or outside temperature. A baseline also needs to incorporate changes in facility use, such as a change in hours of operation or increased levels of outside air. Once again, if these changes would have occurred in the absence of the energy project, they should be incorporated into the project's baseline.

Honeywell will calculate the baseline based on the systems and operating conditions as they currently exist. Honeywell finds baseline development most accurate if specific measurements are taken on equipment over a period of time (early in the audit phase) to determine actual kW, kWh, oil and gas consumption, cfm, gpm, hours of use, etc. A summary of some of the methods, which will be used by Honeywell to establish baselines and support, calculated savings are listed below.



1. Spot measurements of electrical loads such as lighting, fan and pump motors, chillers, electric heat, etc.
2. Measurement of equipment operating hours using electric data recorders.
3. Measurement of existing operating conditions using data recorders for space temperature and humidity, air handler temperatures (mixed, return, cooling and heating coil discharges), and space occupancy using lighting loggers.
4. Spot measurement for boiler efficiencies, water use.
5. Running measurements of chiller operation, including simultaneous measurement of input kWh or steam flow, and chilled water supply and return temperatures and flow (gpm).
6. Records of operating conditions from building management systems and utility-grade meters.

The data from the above is used to calculate existing energy use, which is then reconciled with current facility utility bills, and adjusted as required to provide a mutually agreed baseline.

To provide valid savings evaluations, Honeywell's maintains a significant inventory of metering equipment utilized by its auditors and Energy Engineers to ascertain critical data about the operation of the facility.

Typically, Honeywell's auditors use the following equipment for their onsite measurements:

1. Recording and instantaneous power and harmonic analyzers.
2. Data loggers for pressures, temperatures, flow rates, humidity and CO_2.
3. Lighting level and recording profile/run-hour and occupancy meters.
4. Multimeters, hand held kW meters.
5. Combustion analyzers.
6. Ultrasonic flow meters.
7. Infrared thermometers

The ECMs installed in many projects allow for energy savings to be identified by direct metering or a combination of metering and calculations with accepted assumptions. In the case of lighting, for example, it is relatively easy to meter representative samples of unique fixture types, both before and after a retrofit, to determine the power consumption difference in Watts. When multiplied by the quantity of each fixture type, the total connected load reduction can be derived. In combination with run time assumptions, or meters, the electrical reduction can be accurately determined. Where possible, direct measurement of ECMs during construction (before and after the retrofit) coupled with energy savings calculations is a method the Honeywell finds to be very accurate and cost-effective.

Due to the nature of some ECMs, or when a combination of ECMs is installed, individual (discrete) metering may not be either possible or able to fully document a baseline and calculate savings. Many of these situations can be handled by combining results from metering along with either engineering-based calculations or output from nationally recognized building simulation programs such as DOE II, ASEAM, TRACE or HAP. This method would be used for ECMs such as night setback, and where no other ECMs have significant interaction with the setback measure.

Formulas exercised in energy savings calculations follow the laws of physics, and many are included in the ASHRAE Handbook of Fundamentals. However, such calculations (i.e. equipment operation profiles) must be tempered by experience, past retrofit practice, and expectations of future operating conditions to arrive at achievable values in practice. Honeywell always reviews each and every project, in detail, for the anticipated savings and never hesitates to reduce the anticipated energy calculations where experience dictates necessary. The final result is a coupled project where the final savings are equal to or greater than anticipated.

Calculating the units of energy saved is a critical measure of energy efficiency improvements, but it does not indicate the actual dollars saved. To do this, Honeywell and the Montclair BOE will establish the base rates that will act as "floor" rates in calculating the savings. These are usually the rates that are in effect at the time of the start of the contract or rates used for audit estimated savings.

2. Adjustment to Baseline Methodology[1]

Honeywell's methodology for establishing and adjusting the baseline is determined by the characteristics of the facility, the conservation technology being installed, the technology being replaced, the type of measurement and verification the Montclair BOE requires and the needs of the Montclair BOE for future changes in facility use.

The purpose of this flexible approach is to make the most accurate possible measurement of the changes in energy uses that are specifically attributable to Honeywell installed ECMs. This creates the ability over the life of the contract to continue measuring only savings achieved by Honeywell and leaves the Montclair BOE free to make future changes to the building or systems without affecting the savings agreement. It also necessitates fewer provisions for making adjustments to the baseline.

Modifications to the energy baseline or savings will be made for any of the following:

1. Changes in the number of days in the annual review cycle.
2. Changes in the square footage of the facilities.
3. Changes in the operational schedules of the facilities.
4. Changes in facility indoor temperatures.
5. Significant changes in climate.
6. Significant changes in the amount of equipment or lighting utilized in the facility.

Examples of situations where the baseline needs to be adjusted are: i) changes in the amount of space being air conditioned, ii) changes in auxiliary systems (towers, pumps, etc.) and iii) changes in occupancy or schedule. If the baseline conditions for these factors are not well documented it becomes difficult, if not impossible, to properly adjust them when they change and require changes to payment calculations. To compensate for any addition and deletion of buildings and impact on the baseline model, Honeywell will use sound technical methodologies to adjust the baseline. An example would be to add or delete building energy impact via the calculated cooling load in tons as a percentage of the existing campus tonnage baseline or use indices like W/ft^2 and Btu/ft^2 to calculate the energy consumption of the building and then add or subtract the energy usage to or from the baseline energy consumption.

3. Energy Savings Calculations

In calculating energy savings, Honeywell's highly experienced audit staff uses onsite surveys and measurements, National Oceanic and Atmospheric Administration weather data, detailed discussions with the client's operations and maintenance personnel and engineers, utility records, and other sources to ensure accurate energy, water and O&M savings.
Typically, the following data is gathered:

1. Local weather data.
2. Utility bills and sub-metered consumption trends.

[1] The energy baseline modifications shall use commonly accepted energy engineering methods that are mutually agreeable to both Honeywell and customer. Should agreement on these methods, including the climate adjustments, not be reached between Honeywell and customer, both parties could appeal to an independent engineering.

3. Utility rate structure.
4. Facility use and occupancy data.
5. Internal equipment loads.
6. Interviews of operations and maintenance staff and management.
7. Building construction, age, use and layout.
8. Schematics of energy and water distribution systems.
9. Identification and inventory of HVAC equipment.
10. Identification and inventory of process equipment.
11. Design, configuration and operating characteristics of HVAC systems.
12. Design, configuration and operating characteristics of process systems.
13. Control strategies and sequences of operation for HVAC and other process equipment.
14. Identification and count of all lighting fixtures and determination of power consumption for each type.
15. Identification and inventory of lighting control methods.
16. Measurement of foot-candle levels at sample locations.
17. Power quality and harmonics, power factor.
18. Indoor air quality issues.

Calculating the units of energy saved is a critical measure of energy efficiency improvements, but it does not indicate the actual dollars saved. To do this, Honeywell and the Montclair BOE will establish the base rates that will act as "floor" rates in calculating the savings. These are usually the rates that are in effect at the time of the start of the contract or rates used for audit estimated savings.

The equation below will be used to calculate the annual savings in dollars.

$$AnnualSavings(\$) = \sum_{m=1}^{12} \{\left(Rate_{kWh,Base} \times kWh_{Saved,m}\right) + (Rate_{\,fuel\ Oil,\ Base} \times Fuel\ Oil_{\,Saved,\ gal,\ m}) + (Rate_{\,Steam,\ Base} \times Steam_{\,Saved,\ klbs,\ m}) + (Rate_{\,NG} \times NG_{\,Saved,\ MCF,\ m})\} + Agreed(\$)$$

where:

$Rate_{kWh,Base}$= defined base rate for kWh consumption
$kWh_{Saved,m}$= calculated kWh savings for month *m*

$Rate_{Fuel\ Oil,\ Base}$= defined base rate for fuel Oil savings (XX/gal.)
$Fuel\ Oil_{Saved,m}$= calculated chilled water savings in gal. for month *m*

$Rate_{Steam,Base}$= defined base rate for steam consumption ($XX/MMBtu.)
$Steam_{Saved,m}$= calculated Steam savings in MMBtu. for month *m*

$Rate_{NG,Base}$= defined base rate for natural gas consumption ($XX/Therm)
$NG_{Saved,m}$= calculated natural gas savings in Therms for month *m*

Agreed($)= Annual savings in dollars (water, sewer, maintenance, etc.)

Honeywell assigns dollar values to the true incremental value of savings for energy and water. In other words, we do not combine for example, demand and consumptions numbers so that there is an average value to savings. Honeywell looks at each incremental rate to units saved to properly determine the value (dollar) to the Montclair BOE or “real bill reductions”. As noted in the RFP energy escalation rates will be established in accordance with New Jersey Board of Public Utility guidelines.
Based on this, Honeywell will review all utility bills (hourly data), tariffs, special contracts and commodity contracts to develop the incremental value (costs) of each utility.

The O&M savings is typically a function of existing the Montclair BOE's budgets (labor & direct costs), maintenance contracts and operations (supplier) contracts. Honeywell will analyze the information to provide a conservative savings representation for the Montclair BOE's review and acceptance. The information will include all calculations and assumptions.

4. Measurement & Verification

The purpose of performing any monitoring and verification is to establish an agreed upon process that provides the customer both a level of satisfaction that the improvements have been delivered and ongoing information as to their operation and performance. Additionally, this effort will be used to assess the actual dollars of savings versus the guarantee level.

It is essential for the success of this program that Honeywell and the Montclair BOE agree on a mutually acceptable methodology for measuring and verifying energy savings that are attributable to the energy conservation measures (ECMs) Honeywell installs. This M&V plan provides the procedures to document the energy and cost savings of each of the proposed ECMs.

The plan for monitoring and verifying energy savings for the proposed ECMs is based on the methods described in the ***International Performance Measurement and Verification Protocol (IPMVP)***[2]. Our approach to M&V is directly consistent with, and in compliance with, the IPMVP. This protocol provides a framework for the most widely accepted and used M&V methods by the industry.

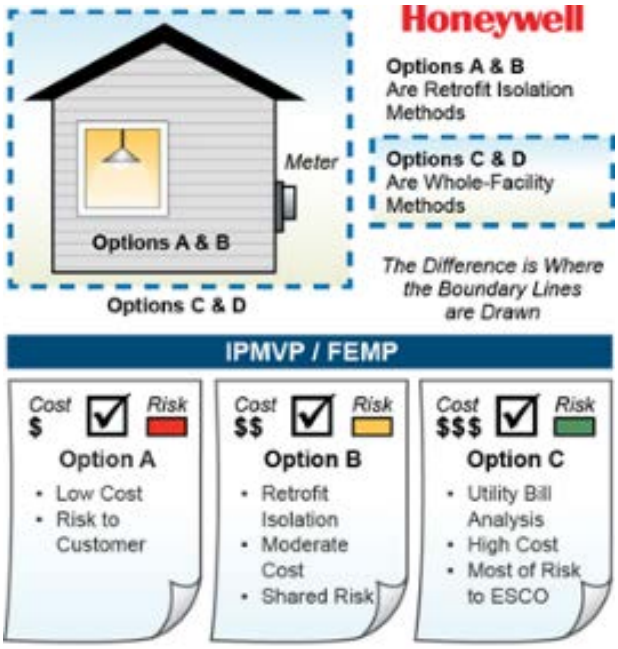
Engineering calculations of energy and cost savings for the project are based on operating parameters (such as weather, temperature settings, run hours, occupancy patterns, and space usage) and equipment performance characteristics. The M&V plan uses the operating parameters established in the baseline for all savings calculations during the term of the project. The intent of the M&V plan is to verify that the ECMs installed by Honeywell will provide the expected energy savings. Therefore, Honeywell will collect data and relative information during the post-retrofit period to demonstrate that the installed equipment is performing at expected levels. It is assumed that the Montclair BOE will continue to be a dynamic institution adding or renovating buildings and desiring to retain the right to set comfort and operating characteristics. To accommodate this, Honeywell will develop its M&V plan in a way that allows the Montclair BOE to adapt to the demands of future campus growth and changes without the need for the Montclair BOE and Honeywell to negotiate energy baseline adjustments.

Our typical M&V plan will utilize broadband Internet access to the appropriate the Montclair BOE's control interfaces to both confirm operating status and to download trend data to verify proper equipment maintenance.

[2] www.ipmvp.org.

One year after the commencement date of the ECMs, Honeywell will submit a report verifying and calculating the energy and cost savings for the first year. This report will be submitted for facility review and approval. For the remaining contract term, Honeywell will provide annual reports. These reports will include results of inspections of the installed equipment/systems, energy and cost savings, and recommendations to provide optimum energy performance.

All permanent measurement equipment will be purchased new with a calibration certificate from the manufacturer. The power multi-meter and the TSI multi-meter will be calibrated annually before using them in the annual inspection.



General Approach to M&V

Energy and water savings are determined by comparing the energy and water use associated with a facility or certain systems within a facility before and after the installation of an ECM or other measure. The “before” case is the baseline. The “after” case is the post-installation or performance period. Baseline and post-installation energy use measurements or estimates can be constructed using the methods associated with M&V options A, B, C, and D, as described in the IPMVP. The challenge of M&V is to balance M&V costs, accuracy, and repeatability with the value of the ECM(s) or systems being evaluated, and to increase the potential for greater savings by careful monitoring and reporting.

M&V Options

The IPMVP guidelines classify the M&V procedures into four categories, Options A, B, C and D. As shown in the table below, these options differ in their approach to the level of complexity of the M&V procedures.

M&V Option	Performance Verification Techniques
Option A Verifying that the measure has the potential to perform and to generate savings.	**Option A** is appropriate for ECMs that have energy use that can be readily quantified, such as the use of high efficiency lighting fixtures, high efficiency constant speed motors, and other standard engineering calculations. Engineering calculations before and after installation spot measurements and use of EMS data points with stipulated values.
Option B Verifying that the measure has the potential to perform and verifying actual performance by end use.	**Option B** is appropriate for ECMs that require periodic or on-going measurements to quantify energy use; such as the use of variable frequency drives on pump or fan motors. Engineering calculations with metering and monitoring strategy throughout term of the contract.

M&V Option	Performance Verification Techniques
Option C Verifying that the measure has the potential to perform and verifying actual performance (whole building analysis.)	**Option C** is used for ECMs for which the energy use or energy savings cannot be measured directly, such as building envelope modifications. Option C is based on the use of utility meters to quantify building energy use. Utility meter billing analysis-using techniques from simple comparison to multivariable regression analysis.
Option D Verifying actual performance and savings through simulation of facility components and/or the whole facility	**Option D** is used for ECMs for which the energy use or energy savings cannot be measured directly, or savings for individual ECMs are heavily interdependent. Calibrated building simulation is used to separate the energy savings attributable to each ECM. Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.

In general,

ECM Energy Savings = Baseline Energy Use - Post-Installation Energy Use

And
Energy Cost savings ($) = Total Energy Savings x Contractual Energy Rates

Exceptions to this simple equation are as follows:

Projects where an on/off M&V method is used. For example, after a new energy management system is installed, control features are turned off for a set period of time to recreate baseline conditions. Thus, savings are determined after installation by comparing energy use with and without the control features activated.

Since energy use at a facility is rarely, if ever, constant, another way to define M&V is as a comparison of a facility's post-installation energy use with its usage if the ECM or system had not been installed. This takes into account situations in which baseline energy use must be adjusted to account for changing conditions, such as changes in facility operation, occupancy, or use or external factors such as weather.

Post-Retrofit M&V Activities

There are two components associated with M&V of performance contract projects:

1. Verifying the potential of the ECM to generate savings also stated as confirming that the proper equipment/systems were installed, are performing to specification and have the potential to generate the predicted savings.
2. Determining/verify energy savings achieved by the installed ECM(s).

Verifying the Potential to Generate Savings

Verifying baseline and post-installation conditions involves inspections (or observations), spot measurements, and/or commissioning activities. Commissioning includes the following activities:

- Documentation of ECM or system design assumptions
- Documentation of the ECM or system design intent for use by contractors, agencies and operators
- Functional performance testing and documentation necessary for evaluating the ECM or system for acceptance
- Adjusting the ECM or system to meet actual needs within the capability of the system

Post-Installation Verification

Post-installation M&V verification will be conducted by both Honeywell and the Client to ensure that the proper equipment/systems that were installed are operating correctly and have the potential to generate the predicted savings. Verification methods may include surveys, inspections, and/or spot or short-term metering.

Regular Interval Post-Installation Verification

At least annually, Honeywell will verify that the installed equipment/systems have been properly maintained, continue to operate correctly, and continue to have the potential to generate the predicted savings. Savings report for all the installed ECMs will be submitted each year after the acceptance date of the work performed by Honeywell.

Computation of Energy Savings

After the ECMs are installed, energy and cost savings will be determined annually by Honeywell in accordance with an agreed-upon M&V approach, as defined in a project-specific M&V plan.

Construction/Interim Savings

Construction or Interim savings are usually measured by using the same methodology as described in the detail M&V plan for each ECM. The start and the completion time for each ECM must be agreed to between Honeywell and the Montclair BOE.

Electricity and thermal savings from the ECMs where no detailed long-term data is required to be collected will be stipulated and will be based on the starting and the final completion dates and verification of the operation of the ECMs. For other ECMs where long-term data collection is required by the M&V plan, data will be used to calculate the savings using the same equations as described in the detail plan. For example, to calculate electricity savings for the installation of a VFD, the kW is spot measured at a set speed for selected motors through a sampling plan. The measured kW is subtracted from the baseline kW to calculating the savings. Thermal savings are tied to the electrical savings in the manner described in the detail M&V plan. The results are extrapolated to cover all the VFDs installed by Honeywell.

The savings for each of the monitored VFD is calculated on an interval basis as follows:

$kW_{Saved} = (kW_{Base} – kW_{Spot\ Measured})$
kWh_{Saved} = Estimated operating hours during the interim period * kW_{Saved}
The total kWh savings is the sum of the kWh_{Saved} for all the installed VFDs.

5. Site Specific M&V Plan

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 1A – LED Lighting	Upgrade Lighting systems: Re-lamp/Re-ballast T8/T12 to LED, Incandescent to LED Metal Halide and Sodium Vapor to LED High Bays	Option A: Pre and Post measurements Line by Line scope and engineering calculations	Pre-M&V: Measurement of kW for 5% sample fixtures in each category. Data log usage hours. Data Log occupancy schedules. Update Line by Line scope with measured kW and usage hours. Post M&V: Measurement of kW for 5% sample fixtures in each category. Usage Hours to remain same. Occupancy schedules to remain same. Energy Savings: Update Line by Line scope with measured kW and usage hours and compare to pre-retrofit calculated savings.
ECM 1B – Lighting Controls	Install lighting control devices	Option A: Pre and Post measurements Line by Line scope and engineering calculations	Pre-M&V: Measurement of kW for 5% sample fixtures in each category. Data log usage hours. Data Log occupancy schedules. Update Line by Line scope with measured kW and usage hours. Post M&V: Measurement of kW for 5% sample fixtures in each category. Usage Hours to remain same. Occupancy schedules to remain same. Energy Savings: Update Line by Line scope with measured kW and usage hours and compare to pre-retrofit calculated savings.
ECM 1C – Vending Misers	Install Vending machine energy management devices	Option A: Pre and Post measurements Line by Line scope and engineering calculations	Pre-M&V: Measurement of kW for 5% sample machines in each category. Data log usage hours. Data Log occupancy schedules. Update Line by Line scope with measured kW and usage hours. Post M&V: Measurement of kW for 5% sample machines in each category. Usage Hours to remain same. Energy Savings scope with measured kW and usage hours and compare to pre-retrofit calculated savings.

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 1D - De-Stratification Fans	Install De-Stratification fans in Gymnasiums and Multipurpose Rooms to minimize stratification of hot air and maintain hot air flow below the fan level	Option A Engineering calculations based on programmed parameters.	Pre-M&V: Verify existing operating parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions. Verify savings based on programmed parameters and engineering calculations.
ECM 1E - Plug Load Management via Wi-Fi	Provide Wi-Fi enabled programmed electrical control devices to shut down various plug loads when building is not occupied	Option A: Engineering calculations based on comparison of existing operations and post installation operation.	Pre-M&V: Verify parameters used in the calculations based on data provided by Data loggers on selected pieces of equipment. Post M&V: Verify that the control equipment is installed and programmed as specified. Data log to verify reduced hours of operation.
ECM 2A – Boiler Upgrade	Replace boilers in select locations to handle base load	Option A: Pre and Post measurements and engineering calculations.	Pre-M&V: Perform combustion efficiency test on boilers to be replaced. Post M&V: Perform combustion efficiency test on replaced boilers.
ECM 2A.1 – Vacuum Tank Replacements	Replace condensate return vacuum tanks	Option A: Engineering calculations based on data for the existing and replacement units.	Pre-M&V: Verify existing systems match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified to match the savings assumptions. Verify savings based on installed systems and engineering calculations.
ECM 2B – Boiler Burner Replacements & Controls	Install advanced combustion controls, on existing burners, replace burners where necessary	Option A: Pre and Post measurements and engineering calculations.	Pre-M&V: Perform combustion efficiency test on boilers where burners/controls are to be replaced. Post M&V: Perform combustion efficiency test on boilers where burners/controls were replaced.
ECM 2C – Domestic Hot Water Replacements	Replace existing domestic hot water heaters with condensing natural gas domestic hot water heater	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement units.	Pre-M&V: Verify manufacturer provided data for existing unit efficiency. Post M&V: Verify manufacturer provided data for new unit. Verify the new equipment and controls are installed and commissioned as recommended by manufacturer.
ECM 2D - Rooftop Unit Replacement	Replace antiquated Roof Top Units with new high efficiency Rooftop Units	Option A: Engineering calculations based on nameplate and manufacturer	Pre-M&V: Verify manufacturer provided data for existing unit efficiency (SEER).

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
		supplied data for the existing and replacement units.	Post M&V: Verify manufacturer provided data for new rooftop unit (SEER) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer.
ECM 2E - Kitchen Hood Controls	Install control devices on the Kitchen hoods to control exhaust air in response to the cooking load. Replace fan motors with new premium efficiency motors and VFD drives	Option A: Engineering calculations for VSDs following affinity laws. Engineering calculations based on nameplate, manufacturer supplied data and operating hours for the existing and replacement motors.	Pre-M&V: Verify manufacturer provided data for the motor performance data and motor efficiencies. Post M&V: Obtain trend data for VFD operation from the BMS system to verify baseline calculation assumptions on system loads. Verify efficiency of new motors.
ECM 2F – Walk-In Compressor Controls	Install control device on walk-in freezer and refrigerator evaporators to shut down the fan motor when the compressor is off on duty cycle	Option A: Stipulated Engineering calculations based on case studies for the Intellidyne control.	Pre-M&V: None Post M&V: Savings stipulated based on engineering calculations for the term of contract.
ECM 2G - Motors and VFD Replacements	Install VFDs on select pumps to operate the pump motors in response to the system load. Replace motors with new premium efficiency motors	Option A: Engineering calculations for VFDs following pump affinity laws. Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement motors.	Pre-M&V: Verify manufacturer provided data for the pump performance data and motor efficiencies. Post M&V: Obtain trend data for VFD operation from the BMS system to verify baseline calculation assumptions on system loads. Verify efficiency of new motors. Verify manufacturer provided data for new VFDs – verify the new equipment and controls are installed and commissioned as recommended by manufacturer.
ECM 2H - Piping Insulation	Insulate Various Piping sizes and runs to prevent thermal losses.	Option A Engineering calculations based on installed systems.	Pre-M&V: Verify existing systems match the baseline calculation assumptions. Verify that systems are installed as specified to match the savings assumptions. Verify savings based on installed systems and engineering calculations.
ECM 2I– Split System Replacements	Replace select split systems with new high efficiency units	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement Units.	Pre-M&V: Verify manufacturer provided data for existing units efficiency (SEER). Post M&V: Verify manufacturer provided data for new units (SEER) – verify the new equipment and controls are installed and commissioned as recommended by manufacturer.

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 2J - Steam Trap Replacement	Repair or replace failed steam traps	Option A: Engineering calculations based on data for the existing and replacement units.	Pre-M&V: Verify existing systems match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified to match the savings assumptions. Verify savings based on installed systems and engineering calculations.
ECM 2K - Air Handling Unit Refurbishment	Refurbish antiquated Air Handling Units	Option A: Engineering calculations based on nameplate and manufacturer supplied data for the existing and replacement units.	Pre-M&V: Verify manufacturer provided data for existing unit efficiency (SEER). Post M&V: Verify manufacturer provided data for new air handling unit (SEER). Verify the new equipment and controls are installed and commissioned as recommended by manufacturer. Verify savings based on programmed parameters and engineering calculations.
ECM 3A - Building Management Control System	Upgrade Building Management Systems to DDC and integrate all systems to a central platform such that the systems may be monitored and controlled as programmed to maintain global settings such as night set back, optimum stop-start etc.	Option A Engineering calculations based on programmed parameters.	Pre-M&V: Verify existing operating parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions. Verify savings based on programmed parameters and engineering calculations.
ECM 3B – Demand Control Ventilation	Install CO2 sensor controls to limit OA based on occupancy of space	Option A: Engineering calculations based on programmed parameters.	Pre-M&V: Verify existing operating parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions. Verify savings based on programmed parameters and engineering calculations.
ECM 3C – Exhaust Fan Controls	Integrate exhaust fans into BMS to control operating times	Option A: Engineering calculations based on programmed parameters.	Pre-M&V: Verify existing operating parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions. Verify savings based on programmed parameters and engineering calculations.
ECM 4A - Building	Install weather stripping on doors, seal roof wall	Option A:	Pre-M&V: Verify existing systems match the baseline calculation assumptions.

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
Envelope Improvements	joints and roof penetrations	Engineering calculations based on programmed parameters.	Post M&V: Verify that systems are installed as specified to match the savings assumptions. Verify savings based on systems installed and engineering calculations.
ECM 5A – Computer Power Management	Install control software to ensure computers revert to sleep mode when not being used.	Option A: Stipulated Engineering calculations based on computer power management Manf. Software information.	Pre-M&V: None Post M&V: Savings stipulated based on engineering calculations for the term of contract.
ECM 6A – Permanent Load Reduction	Participate in PJM permanent load reduction program	N/A	Pre-M&V: N/A Post M&V: N/A
ECM 7A – Transformer Upgrades	Replace existing secondary transformers with high efficiency equivalents	Option A: Engineering calculations based on increase in transformer efficiency.	Pre-M&V: Measure typical existing transformer (typical one for each size) input and output kW to establish transformer losses Post M&V: Measure input and output kW for new transformer (typical one for each size). Verify savings with engineering calculations.
ECM 8A – Combined Heat & Power (CHP)	Install Cogeneration units	Option A Engineering calculations based on nameplate and manufacturer supplied data for the cogeneration units and - engineering calculations based on programmed parameters.	Pre-M&V: Verify parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified and controls are programmed to match the savings assumptions. Measure kW production and Natural gas usage. Verify savings based on programmed parameters and engineering calculations.
ECM 9A – Roof Replacement	Install new high efficiency roofs on select areas/buildings	Option A: Engineering calculations based on system parameters.	Pre-M&V: Verify existing parameters match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified to match the savings assumptions. Verify savings based on installed systems and engineering calculations.
10A Kitchen Equipment Conversion	Convert Electric Kitchen Equipment to Gas	Option A: Engineering calculations based on system parameters.	Pre-M&V: Verify existing operating systems match the baseline calculation assumptions. Post M&V: Verify that systems are installed as specified to match the savings assumptions. Verify savings based on engineering calculations.
ECM 11A – Solar PPA	Install solar PV arrays as part of Power Purchase Agreement	N/A	Pre-M&V: Utilize baseline kWh consumption to determine kWh produced. Post M&V: Measure and Provide a report of the kWh generated.

ECM # and Name	Summary of ECM	Measurement and Verification Methodology / Recommendation	Description of M&V – Pre and Post Process
ECM 11A – Water Conservation	Install low-flow water fixtures (faucets, toilets, urinals)	Option A: Engineering calculations based on decrease in flow rates.	Pre-M&V: Measure typical existing water fixture flow rates to confirm water loss calculations. Post M&V: Confirm installation of new, low-flow water fixtures per scope. Verify savings with engineering calculations.
ECM 13A – Window Film	Install solar film on specified windows	Option A: Electric energy savings - Engineering calculations based on programmed parameters.	Pre-M&V: Verify existing system parameters match the baseline calculation assumptions. Post M&V: Verify that materials are installed as specified to match the savings assumptions. Verify savings based on engineering calculations.

6. Guarantee of Savings

The approach that Honeywell utilizes in this asset management program includes two key components: a *performance guarantee* and *financial savings*. Honeywell guarantees the Montclair BOE that all installations and work performed are subject to final inspection and the Montclair BOE's acceptance. This procedure ensures all work will be to the level of quality the Montclair BOE expects.

Honeywell also guarantees it will meet the objectives mutually defined with the Montclair BOE. Honeywell takes its commitment to partner with the Montclair BOE for the life of the contract seriously, and looks forward to a successful, long-term partnership.

Honeywell considers the guarantee to be the cornerstone of our service to you. To be considered a *performance contract* an energy guarantee is an optional component under the New Jersey Energy Savings Improvement Program (ESIP) legislation. The basis of an energy performance contract is that the majority of risk is shifted from the Montclair BOE to the ESCO. The strength of the Guarantee is only as good as the Company backing it and their financial solvency. With over $40.5 Billion in assets, Honeywell has the financial strength and background to support the Montclair BOE for the long term.

Savings Guarantee: With the understanding that the Montclair BOE must maintain fiscal health and accountability, Honeywell can financially guarantee the results of its programs and clearly support this obligation with the commitment to regular review of program results and reconciliation. **Honeywell's financial strength and stability give it the ability to extend a FIRST-PARTY GUARANTEE to the Montclair BOE. A first party guarantee eliminates the risk on the Montclair BOE and places it directly onto Honeywell.** This differs from some other ESCO's who provide a third-party guarantee, which insulates them from the owner through the use of insurance instruments.

If at the end of any year the program has not met or exceeded the guaranteed savings for that year, Honeywell will refund the difference between the guaranteed amount and what was actually saved.

For all equipment covered by the Energy Savings Guarantee, the Montclair BOE shall be responsible for on-going maintenance and component replacement in accordance with manufacturer's standards. The customer will also be responsible for operating the equipment in accordance with manufacturer's specifications.

Honeywell will develop savings methodologies that follow current industry practice, such as outlined by the New Jersey Board of Public Utilities (BPU) and Federal Energy Management Program's (FEMP) M&V Guidelines: Measurement and Verification for Federal Energy Projects. References to M&V protocols from the International Performance Measurement and Verification Protocol (IPMVP), ASHRAE Guideline 14 and the Air-Conditioning Refrigeration Institute (ARI) are used to further qualify the M&V plan.

As stated above, under the New Jersey ESIP legislation acceptance of a performance guarantee is optional at the Montclair BOE sole discretion. In the same way, the duration of the guarantee is also optional. Many of Honeywell's New Jersey customers have elected to keep the guarantee in force for less than the total performance periods, i.e. three (3) to five (5) years. Others have elected to accept a one (1) year guarantee, while reserving the option to renew for additional years after they have had the

opportunity to review the track record of actual savings results. Obviously, this a very customer specific decision based on the risk management culture of each unique organization. The key point is that Honeywell is flexible regarding the structure and duration of the guarantee. The final terms will be discussed and defined as part of our co-authored ESIP project.

Solely for informational purposes, it is worth noting that if the Montclair BOE does elect to accept a guarantee, New Jersey ESIP law requires that the Montclair BOE contract with a third-party independent firm to verify that the energy savings are realized. To preserve the independent status of this contractor these costs are required to be incurred directly by the Montclair BOE.

Honeywell develops and implements every project with the same high level of detail and confidence and therefore will always provide a Savings Guarantee at no additional cost. However, if the Montclair BOE opts to accept the Savings Guarantee, the fee indicated on Form V in Section D will be applicable to account for on-going Honeywell service costs incurred during the measurement and verification of the savings as indicated in Form V of our RFP response.

All guarantees require that the owner maintain the system in accordance with the manufacturer's specifications. Regardless of guarantee acceptance, ongoing maintenance as recommended by the BPU, Honeywell and / or manufacturer specifications is required to achieve the projected energy savings. Maintenance should also include a periodic verification of the system to make sure the maintenance is properly conducted, and the system is meeting the original specifications and design.

7. Recommended Preventive Maintenance Services

Per the NJ ESIP program, all services are required to be bid by the Montclair BOE for services as desired. Based on Honeywell's vast service organization, we are uniquely qualified to develop design specification for the public bidding per NJ Law.

Honeywell strongly believes that the long-term success of any conservation program is equally dependent upon the appropriate application of energy savings technologies, as well as solid fundamental maintenance and support. One of the primary contributors to energy waste and premature physical plant deterioration is the lack of operations, personnel training and equipment maintenance.

Honeywell recommends routine maintenance on the following systems throughout the Montclair BOE for the duration of an energy guarantee of savings

Maintenance, Repair and Retrofit Services:

- Mechanical Systems
- Building Automation Systems
- Temperature Control Systems
- Air Filtration

Honeywell will work with the Montclair BOE to evaluate current maintenance practices and procedures. This information will be the basis of a preventive maintenance and performance management plan designed to maximize building operating efficiencies, extend the useful life of your equipment and support the designed Energy Savings Plan.

At a minimum, we recommend the following tasks be performed on a quarterly basis with the Montclair BOE Wide Building Management System.

System Support Services

1. Review recent mechanical system operation and issues with customer primary contact, on a monthly basis.
2. Review online automation system operation and event history logs and provide summary status to the customer primary contact. Identify systemic or commonly re-occurring events.
3. Check with customer primary contact and logbook to verify that all software programs are operating correctly.
4. Identify issues and prioritize maintenance requests as required.
5. Provide technical support services for trouble shooting and problem solving as required during scheduled visits.
6. Provide ongoing system review and operations training support; including two semi-annual lunches and learn sessions.
7. Establish dedicated, site-specific emergency stock of spare parts to ensure prompt replacement of critical components. These will be stored in a secure location with controlled access.

Configuration Management

1. Update documentation and software archives with any minor changes to software made during maintenance work.
2. Verify and record operating systems and databases.
3. Record system software revisions and update levels.
4. Archive software in designated offsite Honeywell storage facility, on an annual basis.
5. Provide offline software imaging for disaster recovery procedures, updated on a regular basis.

Front End / PC Service

1. Verify operation of personal computer and software:
2. Check for PC errors on boot up
3. Check for Windows errors on boot up
4. Check for software operations and performance, responsiveness of system, speed of software
5. Routinely backup system files, on an annual basis:
6. Trend data, alarm information and operator activity data
7. Custom graphics and other information
8. Ensure disaster recovery procedures are updated with current files
9. Clean drives and PC housing, on an annual basis:
10. Open PC and remove dust and dirt from fans and surfaces
11. Open PC interface assemblies and remove dust and dirt
12. Clean and verify operation of monitors.
13. Verify printer operation, check ribbon or ink.
14. Initiate and check log printing functions.
15. Verify modem operation (if applicable).
16. Review IVR schedule for alarms and review (if applicable).

Temperature Controls

UNIT VENTS

Services Performed

Annual Inspection

1. Inspect motor and lubricate.
2. Lubricate fan bearings.
3. Inspect coil(s) for leaks.
4. Vacuum interior.
5. Test operation of unit controls.

PUMPS

Services Performed

Preseason Inspection

1. Tighten loose nuts and bolts.
2. Check motor mounts and vibration pads.
3. Inspect electrical connections and contactors.

Seasonal Start-up

1. Lubricate pump and motor bearings per manufacturer's recommendations.
2. Visually check pump alignment and coupling.
3. Check motor operating conditions.
4. Inspect mechanical seals or pump packing.
5. Check hand valves.

Mid-season Inspection

1. Lubricate pump and motor bearings as required.
2. Inspect mechanical seals or pump packing.
3. Ascertain proper functioning.

Seasonal Shut-down

1. Switch off pump.
2. Verify position of hand valves.
3. Note repairs required during shut-down.

PACKAGED AIR-CONDITIONING SYSTEMS

Services Performed

Preseason Inspection

1. Energize crankcase heater.
2. Lubricate fan and motor bearings per manufacturer's recommendations.
3. Check belts and sheaves. Adjust as required.
4. Lubricate and adjust dampers and linkages.
5. Check condensate pan.

Seasonal Start-up

1. Check crankcase heater operation.

2. Check compressor oil level.
3. Inspect electrical connections, contactors, relays, operating and safety controls.
4. Start compressor and check operating conditions. Adjust as required.
5. Check refrigerant charge.
6. Check motor operating conditions.
7. Inspect and calibrate temperature, safety and operational controls, as required.
8. Secure unit panels.
9. Pressure wash all evaporator and condenser coils (if applicable)
10. Log all operating data.

Mid-season Inspection

1. Lubricate fan and motor bearings per manufacturer's recommendations.
2. Check belts and sheaves. Adjust as required.
3. Check condensate pan and drain.
4. Check operating conditions. Adjust as required.
5. Log all operating data.

Seasonal Shut-down *

1. Shut down per manufacturer's recommendations.

* If no Shut-down is required then (2) Mid-season Inspections are performed

BOILERS

Services Performed

Preseason Inspection

1. Inspect fireside of boiler and record condition.
2. Brush and vacuum soot and dirt from flues (not chimneys) and combustion chamber.
3. Inspect firebrick and refractory for defects.
4. Visually inspect boiler pressure vessel for possible leaks and record condition.
5. Disassemble, inspect and clean low-water cutoff.
6. Check hand valves and automatic feed equipment. Repack and adjust as required.
7. Inspect, clean and lubricate the burner and combustion control equipment.
8. Reassemble boiler.
9. Check burner sequence of operation and combustion air equipment.
10. Check fuel piping for leaks and proper support.
11. Review manufacturer's recommendations for boiler and burner start-up.
12. Check fuel supply.
13. Check auxiliary equipment operation.

Seasonal Start-up

1. Inspect burner, boiler and controls prior to start-up.
2. Start burner and check operating controls.
3. Test safety controls and pressure relief valve.
4. Perform combustion analysis.
5. Make required control adjustments.
6. Log all operating conditions.

7. Review operating procedures and owner's log with boiler operator.

Mid-season Inspection

1. Review operator's log.
2. Check system operation.
3. Perform combustion analysis.
4. Make required control adjustments.
5. Log all operating conditions.
6. Review operating procedures and log with boiler operator.

Seasonal Shut-down

1. Review operator's log.
2. Note repairs required.

SECTION F DESIGN APPROACH

In accordance with the ESIP PL 2012, c.55 as part of the implementation process, an agreement between the Montclair BOE and Honeywell will determine the energy conservation measures (ECM's) to be implemented. The services of a NJ Licensed Engineering firm and / or Architectural firm shall then be secured to properly comply with local building codes, compliance issues and NJ Public contracts law. Specifications will be designed and developed to exact standards as recommended by Honeywell to achieve all savings outlined in this Energy Savings Plan (ESP). Once specifications are completed, Honeywell will publicly solicit contractors capable of meeting the requirements of the specification for each trade. However, even before the completion of the bidding process, Honeywell project management will be engaged to maintain the overall project schedule and ensure the Montclair BOE's expectations are met. An overview of these activities and functions are detailed below.

1. Safety Management Plan

All of Honeywell's Project Management Plans begin with safety. By integrating health, safety and environmental considerations into all aspects of our business, we protect our customers, our people and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop the technologies that expand the sustainable capacity of our world. Our health, safety and environment management systems reflect our values and help us meet our customer's needs and our business objectives.

Honeywell's Safety Management Plan is provided in Appendix 4.

2. Project Management Process

Honeywell approaches any ESIP project with a systematic, tested and proven delivery process based upon industry best practices including strong project management, open and collaborative communication, superior technical design and state of the art technologies. We go above and beyond, with multiple NJ delivery teams to ensure sufficient resources, meticulous and thorough training and commissioning, and robust maintenance planning that goes the extra mile for the long term. Honeywell excels at project delivery because of our experience in New Jersey delivering ESIP projects with results that meet or exceed expectations.

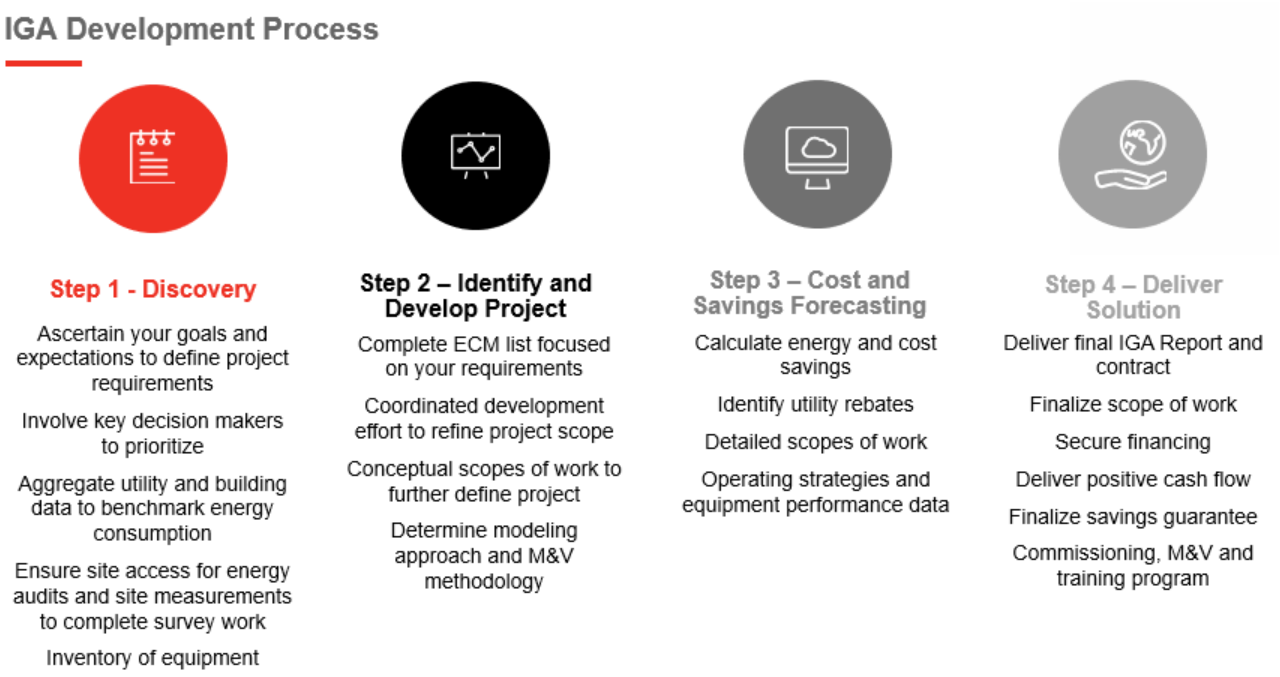
Honeywell will demonstrate our partnership-based commitment to The Montclair BOE throughout the development and delivery of your ESIP project, as we have done for dozens of other public entities throughout New Jersey under the ESIP Law. Our approach is backed by our references and track record and highly experienced engineering resources, which will be fully utilized to help you achieve your unique project goals and requirements.

Honeywell prescribes four phases in the ESIP Process that constitutes your project, including:

- Phase 1: Investment Grade Energy Audit (IGEA)
- Phase 2: Project Implementation
- Phase 3: Commissioning and Training
- Phase 4: Energy Savings Guarantee Period

The IGEA will commence with a kickoff meeting between key project stakeholders of the Montclair BOE and Honeywell to review the ESIP Process, including the expectations of both parties during the IGEA, audit parameters, reporting methods, building access protocols, availability of utility and building data, et cetera. Phase 2 will commence after our kickoff meeting has concluded with agreed upon next steps.

Honeywell takes a holistic approach in development of a comprehensive solution that is customized to meet your operational and facility needs and project goals. Our integrated project delivery approach supports continuous and collaborative communication between key stakeholders throughout the process. Our IGEA development process includes the following steps:



Step 1 Discovery

The first step of your IGEA is to gain a thorough comprehension of the Montclair BOE's key priorities and requirements. Honeywell will work with you to identify what your key needs and goals include and investigate your buildings and systems with that in mind during this step.

Honeywell will initiate your IGEA shortly after formal selection with a kickoff meeting involving all key project decision makers of the Montclair BOE and Honeywell. The purpose of this meeting is to establish preliminary project expectations and define key next steps of the process to inform the IGEA.

Honeywell will develop a customized plan for developing an efficient, cost effective and solutions-based project including schedule, finance, performance requirements and scheduling activities.

Honeywell will schedule site visits to commence at the earliest convenience. Utility data is a key component used for establishing your energy baseline to project potential energy savings. Building plans and operating schedules will assist Honeywell to focus our time during the site visits and serve to provide

the means for our engineers to complete their calculations. Data required for this step includes 24 months of electric, thermal, water/sewer data, original and renovation drawings, equipment lists, equipment operating schedules, occupancy data and maintenance records and repair costs.

Our goal for the site surveys is to understand your systems in each facility and to identify potential energy conservation measures (ECMs) for inclusion in your final project scope. This step allows Honeywell to determine needed improvements by evaluating each building and its systems in terms of condition, performance and age, including lighting and HVAC systems, Building Automation Systems, building envelopes, electrical distribution, domestic water and heating systems, et cetera.

Step 2 Identify and Develop Project

Honeywell will take the findings of our earlier diagnostic phase to develop solutions that address your priorities and key needs as ascertained in Step 1. Our collaborative, solutions-based approach will allow you to maximize savings to invest more into modernizing buildings and generate maximum rebates to help deliver the most positive cash flow available.

Our primary objective is to ensure quality control and on time delivery throughout your project. Your project will have a dedicated team consisting of project management and engineering who have helped deliver similarly sized project under ESIP in recent past.



Honeywell will create an exhaustive ECM list following the completion of the site survey process. Each opportunity is then analyzed individually to determine both economic and construction feasibility. Input from the Montclair BOE is critical to determine how each ECM fits within your overall project priorities. Honeywell's ECM Opportunity Funnel will help further narrow down the list of potential ECMs to your final ESIP project scope, by analyzing all aspects of your energy consumption to deliver an optimal project scope based on realistic savings potential. Our unique collaborative approach ensures that we deliver on your expectations while providing for turnkey solutions that are cost effective.

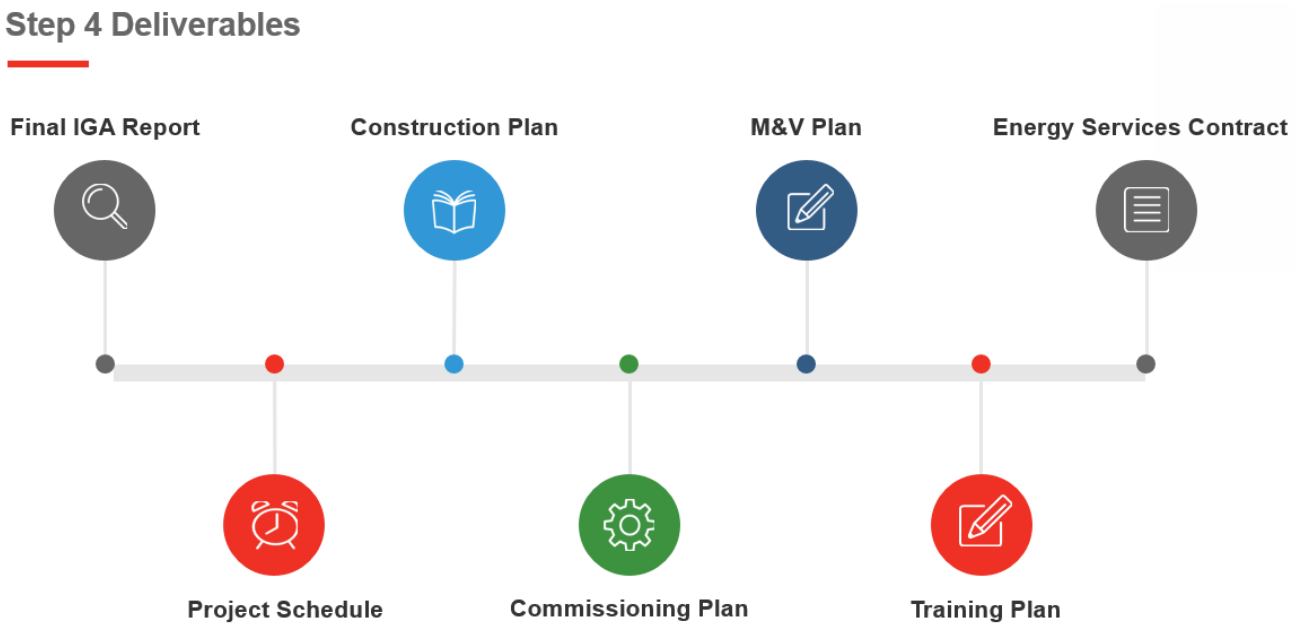
Step 3 Cost and Savings Forecasting

Honeywell will then move on to analyze and quantify your unique savings guarantee utilizing the Montclair BOE's dedicated ESIP Team. During this step, we will quantify energy savings by identifying the scope of work and its impact on your facilities and systems. We will measure individual ECMs based on how they will impact future performance of the building as a whole. This will help to ensure that the ECM savings are accounted for only once. Results are then subject to peer reviews to verify accurate modeling and savings forecasts based on the proposed scope of work. Honeywell's unique approach to engineering is why we often exceed the savings guarantee of our contracts.

Step 4 Deliver Solution

Honeywell will leverage our experience delivering more than two dozen NJ ESIP projects since 2009 to help the Montclair BOE complete a successful project on time that maximizes realistic savings, cash rebates and positive cash flow. We have learned through this unrivaled experience that what matters most is to meet your expectations and ensure your involvement in the decision-making process. REACT (Rebate Energy Analysis Constructability Tool) will provide for an interactive solution development experience designed to maximize New Jersey Office of Clean Energy rebates. Our No Change Orders policy (which helps distinguish Honeywell from the competition) will further reduce risk and enhance project results. And our in-house finance team (Honeywell Global Finance) will work to ensure that you secure the most competitive financial offering and interest rate available. No ESCO offers more value throughout the ESIP Process than Honeywell.

Our deliverables during this final phase will include:



A. HONEYWELL PERFORMANCE CONTRACTING

Honeywell is the undisputed performance contracting market leader in the Northeast. Honeywell's Guaranteed Performance Contracting, which we pioneered in the early 1980's, has surpassed the $2 billion mark in cumulative sales. Our performance contracting business features specialized and dedicated resources, including people with expertise specifically to address the needs of our customers. Our portfolio of business experience in the region is over 400 projects and over $500 million in project investment.

B. PROJECT MANAGEMENT POLICY - HONEYWELL'S COMMITMENT TO HEALTH, SAFETY, THE ENVIRONMENT AND SCHOOL

All of Honeywell's Project Management Plans begin with safety. By integrating health, safety and environmental considerations into all aspects of our business, we protect our customers, our people and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop the technologies that expand the sustainable capacity of our world. Our health, safety and environment management systems reflect our values and help us meet our customer's needs and our business objectives.

Our Safety Commitment to the Montclair BOE

In today's world, nothing is more important than safeguarding our families at home, at work and at school. Through Honeywell's safety awareness process, we commit to our customers to protect and safeguard our construction sites, our employees, sub-contractors, and your staff.

Our projects all begin with the following steps:

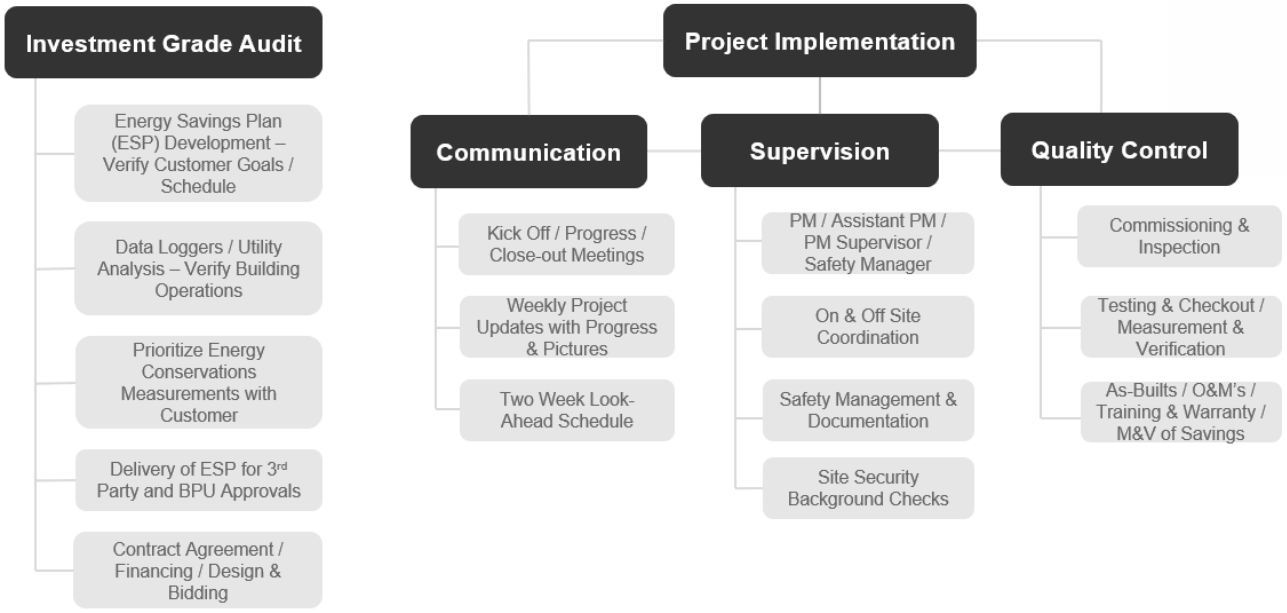
- Safety Training for Employee's and Sub-contractors
- Detailed Work Schedules around the day
- Detailed Background Checks of Personnel
- Detail Logs of Sub Contractor Personnel
- On-Site Logs of Time Sheets, Contact Information for All Personnel
- Clearly Displayed Identification Badges of All Construction Personnel
- On-Site Daily Supervision of All Sub-contractors
- Detailed and Weekly Reviews of Accident Reports and Remediation Strategy

We protect the safety and health of our customers and employees through prevention of illness, injury and pollution.

- We actively promote and develop opportunities for expanding sustainable capacity by increasing fuel efficiency, improving security and safety, and reducing emissions of harmful pollutants.
- We are committed to compliance with all of our health, safety, environmental and legal requirements everywhere we operate
- Our commitment to health, safety and the environment is an integral aspect of our design of products, processes and services, and of the lifecycle management of our products.
- Our management systems apply a global standard that provides protection of both human health and the environment during normal and emergency situations
- We identify, control and endeavor to reduce emissions, waste and inefficient use of resources and energy.
- We abide by the company's own strict standards in cases where local laws are less stringent.
- Our senior leadership and individual employees are accountable for their role in meeting our commitments.
- We measure and periodically review our progress and strive for continuous improvement.
- These are our commitments to health, safety, and the environment, and to creating a safe, clean environment everywhere we operate.

C. PROJECT MANAGEMENT PROCESS

Project Management Process



The project management process applies technical knowledge, people and communication skills, and management talent in an on-site, pro-active manner to ensure that our contract commitments are met on time, within budget, and at the quality you expect.

A Honeywell Project Management Plan defines plans and controls the tasks that must be completed for your project. But more than task administration, our project management process oversees the efficient allocation of resources to complete those tasks.

Each project and each customer's requirements are unique. At Honeywell, we address customer needs through a formal communication process. This begins by designating one of our project managers to be responsible for keeping the customer abreast of the status of the project.

As the facilities improvements portion of the partnership begins, the Project Manager serves as a single focal point of responsibility for all aspects of the partnership. The Project Manager monitors labor, material, and project modifications related to the Montclair BOE/Honeywell partnership and makes changes to ensure achievement of performance requirements in the facilities modernization component. The Project Manager regularly reviews the on-going process of the project with the customers.

The Project Manager will develop and maintain effective on-going contact with the Montclair BOE and all other project participants to resolve issues and update project status.

There are several challenges in this position. The Project Manager must staff the project and create a work force capable of handling the technologies associated with the project (pneumatic or

electric/electronic controls, mechanical systems, etc.), and plan for and use these personnel to achieve optimum results focused on occupant comfort and guarantee requirements.

3. Construction Management

Prior to any work in the buildings, our Project Manager will sit down with your administrative and building staff to outline the energy conservation upgrades that we will be installing in their building. We will discuss proper contractor protocol of checking in and out of the buildings on a daily basis, wearing identifiable shirts, identification badges, and checking in with your facilities staff. We will coordinate certain projects for different times of the day, so we do not interrupt the building and learning environments. Our staff will work a combination of first and second shifts to accomplish the pre-set implementation schedule.

Communication is the key success factor in any construction management plan, and our project manager will be the key focal point during the installation process.
Our team will prevent schedule slippages by continuously tracking the location of all equipment and components required for the project. We make sure all equipment and components will be delivered on time prior to the scheduled date of delivery. Our thorough survey, evaluation and analysis of existing conditions, performed prior to the commencement of construction, will also prevent schedule slippages.

Honeywell is required to subcontract various portions of our projects to contractors. Within the Montclair BOE project, all subcontractors will be selected in accordance with New Jersey public contracts law. Typical areas that are subcontracted are as follows:

- Electrical Installation
- Lighting Retrofits
- HVAC Installation (depends upon the project size and scope)
- Associated General Contracting specialty items to support the project etc., (ceilings, windows, concrete, structural steel, roofing, demolition and removal of equipment, painting and rigging)

Where possible under New Jersey public contracts law, Honeywell uses the following guidelines in hiring subcontractors to perform work on our projects.

- Local Presence in the Community (Customer Recommendations)
- Firm’s Qualifications and WBE/MBE Status
- Firm’s Financial Stability
- Ability to perform the work within the project timeline
- Price
- Ability to provide service on the equipment or materials installed over a long period of time.

Approval of subcontractors that Honeywell proposes to use lies with the Montclair BOE.

4. Commissioning

Honeywell provides full commissioning of energy conservation measures (ECM’s) as part of our responsibility on this project. We will customize this process based on the complexity of ECMs. Specifically, Honeywell will be responsible for start-up and commissioning of the new equipment and systems to be installed during the project. This will include verifying that the installed equipment meets specifications, is installed and started up in accordance with manufacturer’s recommendations and

operates as intended. A commissioning plan will be prepared that describes the functional tests to be performed on the equipment and the acceptance criteria.

Prior to customer acceptance of the project, Honeywell submits the final commissioning report containing signed acceptance sheets for each ECM. Signed acceptance sheets are obtained upon demonstrating the functionality of each ECM to a Montclair BOE appointed representative.

Additionally, Honeywell provides training for facility operators and personnel as needed when each ECM is completed and placed into service. All training is documented in the final commissioning report.

After the completion of the Honeywell commissioning effort, in accordance with New Jersey ESIP legislation, the Montclair BOE will be required to secure the services of a 3rd party independent firm to verify that the new equipment and systems meet the standards set forth in the Energy Savings Plan. To maintain the independence of this review, these costs must be born directly by the Montclair BOE. However, at the option of the Montclair BOE, these services can be financed as a portion of the total project cost.

5. Installation Standards

When Honeywell designs a solution, we consider current and future operations. For any upgrades, we install, we follow building codes/standards, which dictate certain standards for energy or building improvements. Listed in tables following this section are standards for building design. During the life of the agreement, there is a partnership approach to maintaining these standards for reasons of comfort and reliability. For lighting our standard is to meet or exceed Illuminating Engineering Society (IES) light level requirements, achieving the relevant standards wherever possible.

In the case of fluorescent lighting upgrades, we recommend that a group re-lamping of lamps be done approximately five years after the initial installation depending upon run times. Your building facility staff, on an as needed basis, can complete normal routine maintenance of lamps and ballasts. This maintains the quality of the lighting levels, and color rendering qualities of the lamps.

Space temperatures will be set by the energy management system and local building controls and will be maintained on an annual basis. Flexibility will be maintained to regulate space temperatures as required to accommodate building occupant needs.

Your facility staff and building personnel will operate the energy management system with ongoing training and support from Honeywell. Therefore, both the Montclair BOE and Honeywell will maintain the standards of comfort. The comfort standards will be maintained throughout the life of the agreement through sound maintenance planning and services recommended as part of this ESP.
Regarding ventilation, Honeywell will upgrade ventilation to meet current standards in those areas where our scope of work involves upgrades to or replacement of systems providing building ventilation. We generally will not upgrade ventilation in those areas where our work doesn't involve the upgrade or replacement of systems or equipment providing ventilation to a building or facility.

Heating and Cooling Standards

Heating Temperatures	Cooling Temperatures	Unoccupied Temperatures
70-72° F	72-74° F	58-62° F

Honeywell uses a variety of in-house labor as well as subcontractors to install the energy conservation measures. We have on staff trained professionals in fire, security, energy management systems, all temperature control systems, and HVAC. However, per the ESIP law, all trades will be publicly bid except for specific controls applications. Listed below is a sampling of some of the disciplines that would apply to the Montclair BOE:

Improvements	Honeywell	Subcontractor
Engineering Design/Analysis	●	
Technical Audit	●	
Construction Administration/Management	●	
On-Site Construction Supervision	●	
Installation of Energy Management System	●	●
Manufacturer of Energy Management Equipment	●	●
Installation of HVAC/Mechanical Equipment		●
Installation of Renewable Technology		●
Installation of Building Envelope		●
Energy Supply Management Analysis/Implementation	●	
Installation of Boilers		●
Maintenance of Energy Management Equipment	●	●
Manufacturer/Installation of Temperature Controls	●	●
Monitoring/Verification Guarantee	●	
Training of Owner Staff	●	
Financial Responsibility for Energy Guarantees	●	

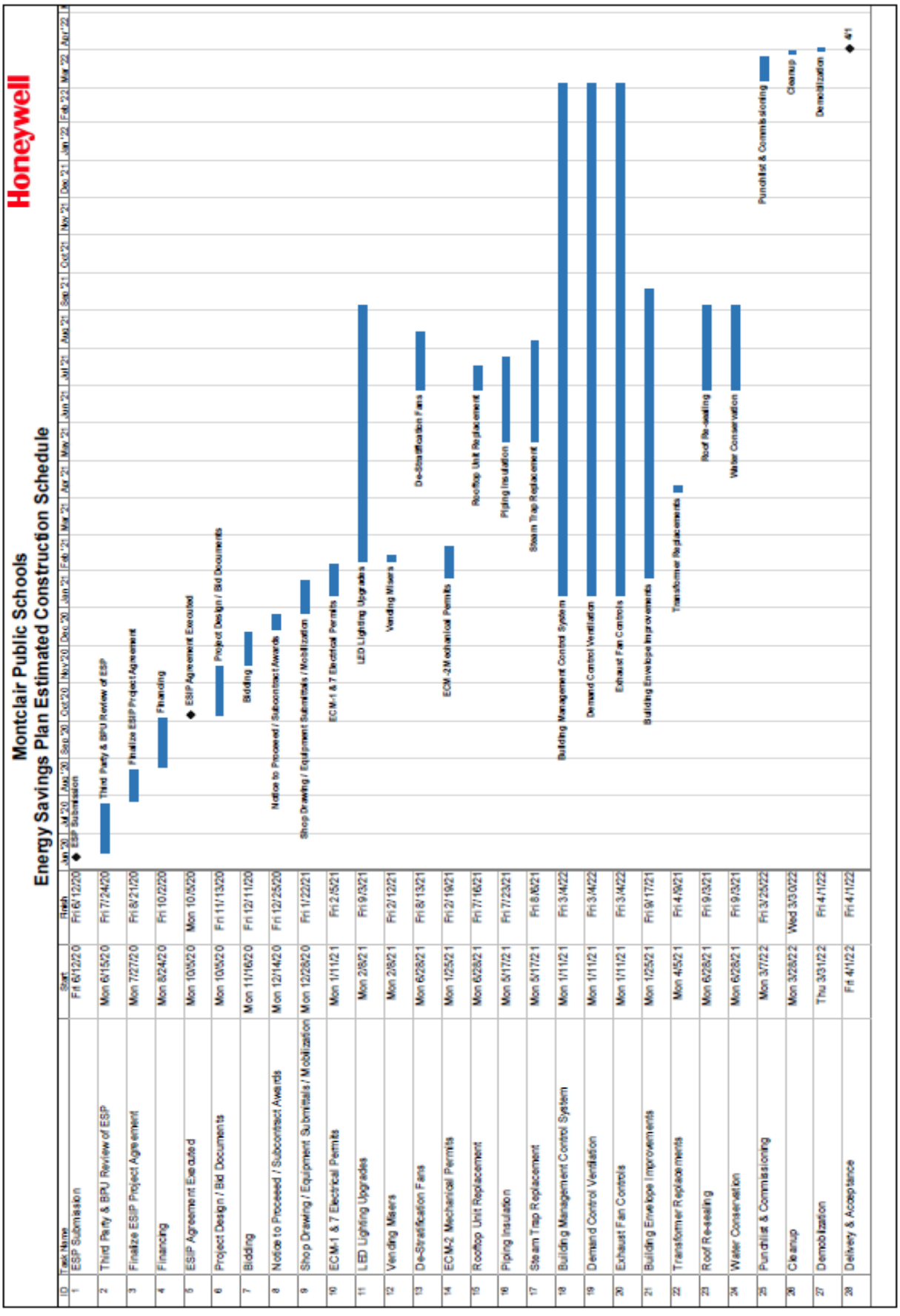
Hazardous Waste Disposal or Recycling

Honeywell disposes of all PCB ballasts or mercury containing materials removed as part of the project per EPA guidelines. Honeywell will complete all the required paperwork on behalf of the Montclair BOE. Honeywell will work with the Montclair BOE to review your hazardous material reports and will identify the areas where work will be completed so that the Montclair BOE can contract to have any necessary material abatement completed.

Honeywell can help schedule or coordinate waste removal, but does not contract for, or assume responsibility for, the abatement work. Honeywell also has the capabilities to assist the Montclair BOE in working with the EPA under compliance management issues. We also develop and manufacture automated systems to track and report a wide variety of environmental factors.

6. Implementation Schedule

Attached please find a sample schedule for construction and completion of the Project.



ID	Task Name	Start	Finish
1	ESP Submission	Fri 6/12/20	Fri 6/12/20
2	Third Party & BPU Review of ESP	Mon 6/15/20	Fri 7/24/20
3	Finalize ESIP Project Agreement	Mon 7/27/20	Fri 8/21/20
4	Financing	Mon 8/24/20	Fri 10/2/20
5	ESIP Agreement Executed	Mon 10/5/20	Mon 10/5/20
6	Project Design / Bid Documents	Mon 10/5/20	Fri 11/13/20
7	Bidding	Mon 11/16/20	Fri 12/11/20
8	Notice to Proceed / Subcontract Awards	Mon 12/14/20	Fri 12/25/20
9	Shop Drawing / Equipment Submittals / Mobilization	Mon 12/28/20	Fri 1/22/21
10	ECM-1 & 7 Electrical Permits	Mon 1/11/21	Fri 2/5/21
11	LED Lighting Upgrades	Mon 2/8/21	Fri 9/3/21
12	Vending Misers	Mon 2/8/21	Fri 2/12/21
13	De-Stratification Fans	Mon 6/28/21	Fri 8/13/21
14	ECM-2 Mechanical Permits	Mon 1/25/21	Fri 2/19/21
15	Rooftop Unit Replacement	Mon 6/28/21	Fri 7/16/21
16	Piping Insulation	Mon 5/17/21	Fri 7/23/21
17	Steam Trap Replacement	Mon 5/17/21	Fri 8/6/21
18	Building Management Control System	Mon 1/11/21	Fri 3/4/22
19	Demand Control Ventilation	Mon 1/11/21	Fri 3/4/22
20	Exhaust Fan Controls	Mon 1/11/21	Fri 3/4/22
21	Building Envelope Improvements	Mon 1/25/21	Fri 9/17/21
22	Transformer Replacements	Mon 4/5/21	Fri 4/9/21
23	Roof Re-sealing	Mon 6/28/21	Fri 9/3/21
24	Water Conservation	Mon 6/28/21	Fri 9/3/21
25	Punchlist & Commissioning	Mon 3/7/22	Fri 3/25/22
26	Cleanup	Mon 3/28/22	Wed 3/30/22
27	Demobilization	Thu 3/31/22	Fri 4/1/22
28	Delivery & Acceptance	Fri 4/1/22	Fri 4/1/22

APPENDIX 1 INDEPENDENT ENERGY AUDITS

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Local Government Energy Audit:
Energy Audit Report



Buzz Aldrin Middle School

Montclair Board of Education

173 Bellevue Avenue
Montclair, New Jersey 07043

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Buzz Aldrin Middle School.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local governments and school districts in controlling their energy costs and help protect our environment by encouraging more efficient usage of energy resources statewide.

1.1 Facility Summary

Buzz Aldrin Middle School is a 58,128 square foot facility comprised of various space types within a single building. The school building is three floors. It includes classrooms, offices, gyms, locker rooms, a cafeteria, and an auditorium.

Interior lighting at Buzz Aldrin Middle School consists mostly of 1, 2, and 4-lamp T8 linear fluorescent fixtures. There are also many incandescent bulbs used in recessed cans, wall sconces, and ceiling fixtures in the auditorium. The ceiling fixtures in the front foyer and the post lighting by the main entrance also use incandescent bulbs. The exterior perimeter of the building is lit by High Intensity Discharge (HID) spotlight fixtures.

Heating is supplied by the school's two main boilers. They are Weil-McLain low-pressure steam boilers, each with a rated output of 6,100 MBh (@5 psi). Only about 25% of the building's total space is air conditioned. There are approximately 43 window air conditioning (AC) units, which are used to cool some classrooms and 11 packaged terminal air conditioning (PTAC) serving some administrative offices. A thorough description of the facility and our observations are provided in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated eight potential energy efficient upgrades. We recommend seven ECMs for implementation. The seven ECMs together represent an opportunity for Buzz Aldrin Middle School to reduce annual energy costs by roughly $39,607 and annual greenhouse gas emissions by 242,568 lbs CO_2e. We estimate that if all recommended measures are implemented, the project would pay for itself in energy savings alone in about 3.3 years. The breakdown of existing utility costs is shown in Figure 1. The potential energy savings, following project implementation, is shown in Figure 2. Together these measures represent an opportunity to reduce Buzz Aldrin Middle School's annual energy usage by about 11% overall.

We evaluated the cost and savings for replacement of the school's two main boilers. However, we chose not to include that measure among our recommended ECMs. We estimate that replacement of the main boilers with higher efficiency units could save the school an additional $2,009 per year, but energy savings alone is not sufficient to justify the high cost of that measure. Adding replacement of the boilers to the list of recommended measures would increase overall energy savings to about 15%, but the combined payback period would increase to 8.2 years. (See Figure 3 below).

Figure 1 – Previous 12 Month Utility Costs

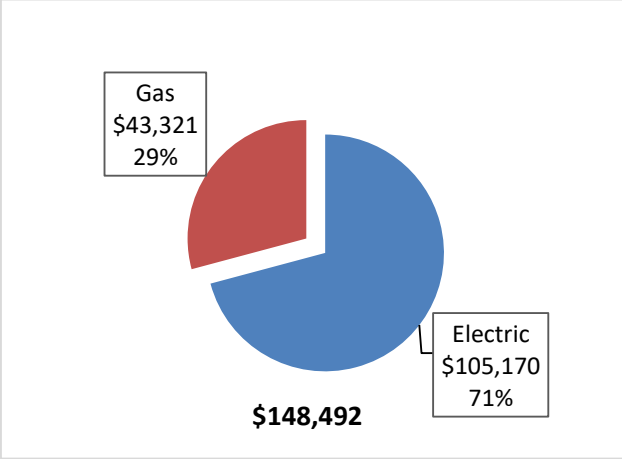
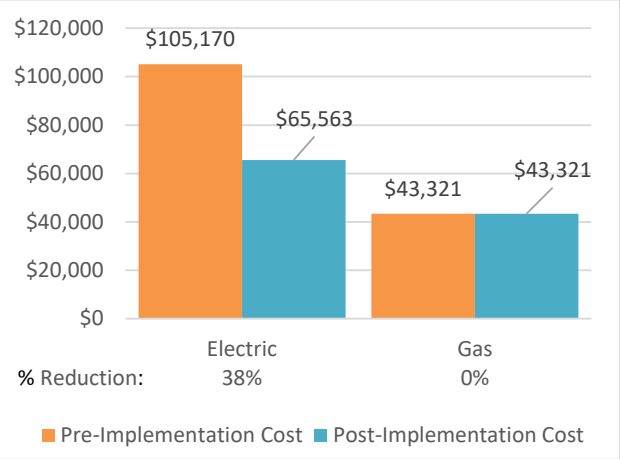


Figure 2 – Potential Post-Implementation Costs



A detailed description of Buzz Aldrin Middle School's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**207,198**	**51.0**	**0.0**	**$34,068.52**	**$120,707.89**	**$22,415.00**	**$98,292.89**	**2.9**	**208,647**
ECM 1	Install LED Fixtures	Yes	15,380	3.3	0.0	$2,528.88	$7,211.34	$1,200.00	$6,011.34	2.4	15,488
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	417	0.1	0.0	$68.50	$392.00	$20.00	$372.00	5.4	420
ECM 3	Retrofit Fixtures with LED Lamps	Yes	190,978	47.5	0.0	$31,401.55	$112,244.11	$21,195.00	$91,049.11	2.9	192,313
ECM 4	Install LED Exit Signs	Yes	423	0.1	0.0	$69.58	$860.44	$0.00	$860.44	12.4	426
Lighting Control Measures			**32,074**	**8.6**	**0.0**	**$5,273.74**	**$35,926.00**	**$4,245.00**	**$31,681.00**	**6.0**	**32,298**
ECM 5	Install Occupancy Sensor Lighting Controls	Yes	30,452	8.5	0.0	$5,007.14	$32,326.00	$4,245.00	$28,081.00	5.6	30,665
ECM 6	Install High/Low Lighitng Controls	Yes	1,621	0.1	0.0	$266.60	$3,600.00	$0.00	$3,600.00	13.5	1,633
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**234.4**	**$2,009.23**	**$209,050.93**	**$0.00**	**$209,050.93**	**104.0**	**27,442**
	Install High Efficiency Steam Boilers	No	0	0.0	234.4	$2,009.23	$209,050.93	$0.00	$209,050.93	104.0	27,442
Plug Load Equipment Control - Vending Machine			**1,612**	**0.0**	**0.0**	**$265.03**	**$460.00**	**$0.00**	**$460.00**	**1.7**	**1,623**
ECM 7	Vending Machine Control	Yes	1,612	0.0	0.0	$265.03	$460.00	$0.00	$460.00	1.7	1,623
TOTAL FOR PROPOSED MEASURES			**240,884**	**59.7**	**0.0**	**$39,607.29**	**$157,093.89**	**$26,660.00**	**$130,433.89**	**3.3**	**242,568**
TOTAL FOR ALL MEASURES			**240,884**	**59.7**	**234.4**	**$41,616.52**	**$366,144.82**	**$26,660.00**	**$339,484.82**	**8.2**	**270,010**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Gas Heating (HVAC/Process) measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

Plug Load Equipment control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.

Energy Efficient Practices

TRC also identified five low-cost (or no-cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Buzz Aldrin Middle School include:

- Close Doors and Windows
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Buzz Aldrin Middle School. Based on the configuration of the site and its loads there appears to be a high potential for cost-effective installation of a rooftop solar photovoltaic (PV) array at this site.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	94	kW DC STC
Electric Generation	111,989	kWh/yr
Displaced Cost	$9,740	/yr
Installed Cost	$268,800	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator/ Board Secretary	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Tom Page	Auditor	tpage@TRCsolutions.com	(732) 855-0033

2.2 General Site Information

On November 16, 2016, TRC performed an energy audit at Buzz Aldrin Middle School located in Montclair, New Jersey. TRC's team met with (former Director of Facilities) Leonard Saponara to review the facility operations and help focus our investigation on specific energy-using systems.

Buzz Aldrin Middle School is a 58,128 square foot facility comprised of various space types within a single building. The school building is three floors. It includes classrooms, offices, gyms, locker rooms, a cafeteria, and an auditorium. It is a STEM magnet school for grades 6, 7, and 8.

The original building was constructed in 1909. Additions were constructed in 1920, 1924, 1930, and 1972. A greenhouse was added in 2000. It was originally known as the Mount Hebron School. In 2016, it was renamed in honor of Apollo 11 Astronaut Buzz Aldrin, a school alumnus.

2.3 Building Occupancy

The school building is typically open Monday to Friday, 7:00 AM to 3:30 PM, from September through June. The typical schedule is presented in the table below. During a typical day, the facility is occupied by approximately 600 students and staff.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Buzz Aldrin Middle School	Weekday	7:00 AM - 3:30 PM
Buzz Aldrin Middle School	Weekend	CLOSED

2.4 Building Envelope

The building is constructed of concrete block and structural steel with a brick facade. Around the perimeter, the building has a sloped roof with slate shingles. The center of the building has flat roof covered by a rubber membrane. The building has mostly double-paned, operable windows, which are in good condition. Doors are mostly steel with double-paned glass. All door and window seals appeared tight. No sign of excessive air infiltration was noted.

Image 1: Buzz Aldrin Middle School - Front Exterior



2.5 On-Site Generation

Buzz Aldrin Middle School does not have any on-site electric generation.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Interior lighting at Buzz Aldrin Middle School consists mostly of 1, 2, and 4-lamp T8 linear fluorescent fixtures. There are also many incandescent bulbs used in recessed cans, wall sconces, and ceiling fixtures in the auditorium. The ceiling fixtures in the front foyer and the post lighting by the main entrance also use incandescent bulbs.

The exterior perimeter of the building is lit by High Intensity Discharge (HID) spotlight fixtures.

Image 2: Lighting Fixtures at Buzz Aldrin Middle School















The exterior lighting is controlled by timers or photocells. Interior lighting is controlled by manual switches.

Steam Heating System

Heating is supplied by the school's two main boilers. They are Weil-McLain gas-fired low-pressure steam boilers, each with a rated output of 6,100 MBh. Steam is supplied to radiators throughout the building at 5 psi. The boilers are 26 years old. They are estimated to be about 80% efficient.

The ASHRAE rated useful lifetime for this type of equipment is 25 years. Though the boilers are at the end of their rated useful life, they are not in bad condition. They are not in critical need of replacement at this time. Replacing them with a high efficiency steam boiler (~85% efficient) is a significant capital expense which would be cost effective on the basis of energy savings alone.

Image 3: HVAC at Buzz Aldrin Middle School





Air Conditioning (AC)

Only about 25% of the building's total space is air conditioned. Cooling is supplied to classrooms by approximately 43 window AC units. The main office and nurse's office are cooled by a total of 11 packaged terminal air conditioning (PTAC) units.

Some of the window AC units are old and in need of repair or replacement, but most were found in good condition. The classrooms are generally not used through the summer months, so replacement of these units with higher efficiency models cannot be justified on the basis of energy savings alone.

Domestic Hot Water Heating System

The domestic hot water is provided by a 75-gallon Bradford-White gas-fired water heater, which is located in the boiler room. It is a fairly efficient model and in good condition.

Image 4: Domestic Hot Water at Buzz Aldrin Middle School



Refrigeration

TRC counted six refrigerators at the school. There are two large Traulsen commercial refrigerators in the kitchen and one glass door refrigerator in the cafeteria for beverages. The rest are standard small to medium sized units used by school staff.

Image 5: Refrigeration Equipment at Buzz Aldrin Middle School



Building Plug Load

Plug-Load equipment at the school appeared to be fairly typical for a building of this size and type. The school has approximately 187 desktop computers and monitors, about a dozen small printers, four large copy machines, six large flat screen TVs, and about six computer servers. There are also many microwaves, toaster ovens, coffee makers, and other devices used by school staff. Also found were one clothes washer, one dryer, and three electric stoves.

The school has just two vending machines (one beverage machine and one snack machine) located in the teacher's room.






2.7 Water-Using Systems

There are approximately 15 restrooms at this facility. In our sampling of restrooms fixtures, all faucets appeared to meet current guidelines for "low-flow" water conserving devices for public restrooms. All toilets and urinals also appeared to be low-flow devices. For more on current water conservation standards, see Section 5.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

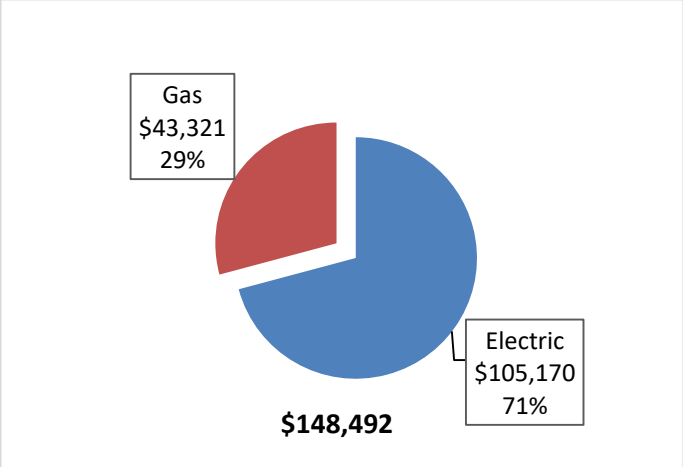
The following energy consumption and cost data is based on a recent 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 7 - Utility Summary

Utility Summary for Buzz Aldrin Middle School		
Fuel	**Usage**	**Cost**
Electricity	639,624 kWh	$105,170
Natural Gas	50,534 Therms	$43,321
Total		**$148,492**

The current annual energy cost for this facility is $148,492 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric rate over a recent 12-month period was found to be $0.164/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Electric usage appears to be fairly constant throughout the year, with a slight decline in the summer months due to lack of occupancy.

Figure 9 - Electric Usage & Demand

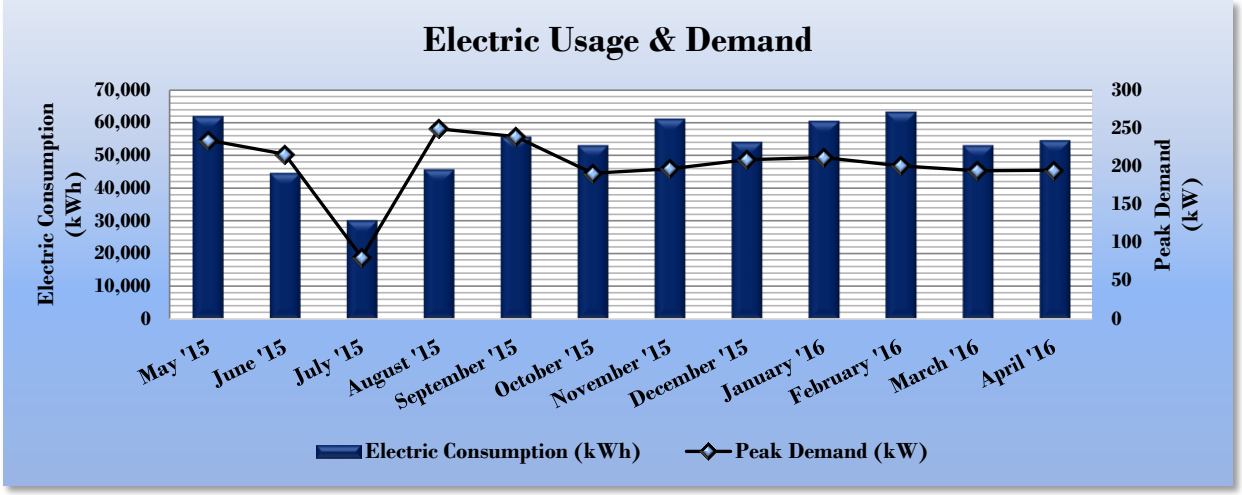


Figure 10 - Electric Usage & Demand

Electric Billing Data for Buzz Aldrin Middle School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
6/15/15	31	61,910	234	$4,858	$12,000
7/15/15	30	44,623	216	$4,154	$10,064
8/13/15	29	30,171	81	$2,089	$6,889
9/14/15	32	45,701	249	$4,422	$10,215
10/13/15	29	55,673	239	$2,445	$8,909
11/11/15	29	53,095	191	$2,179	$8,441
12/14/15	33	61,175	197	$2,169	$9,066
1/14/16	31	54,088	209	$1,825	$8,037
2/12/16	29	60,533	212	$1,807	$8,083
3/15/16	32	63,259	201	$1,722	$8,243
4/14/16	30	53,058	194	$1,603	$7,453
5/13/16	29	54,586	195	$1,621	$7,481
Totals	**364**	**637,872**	**249.1**	**$30,893**	**$104,882**
Annual	**365**	**639,624**	**249.1**	**$30,978**	**$105,170**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average natural gas rate for a recent 12-month period was found to be $0.857/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below. Gas usage appears to be fairly typical for a facility of this size and type, which is heated by natural gas with little or no other significant gas usage during non-heating months.

Figure 11 - Natural Gas Usage

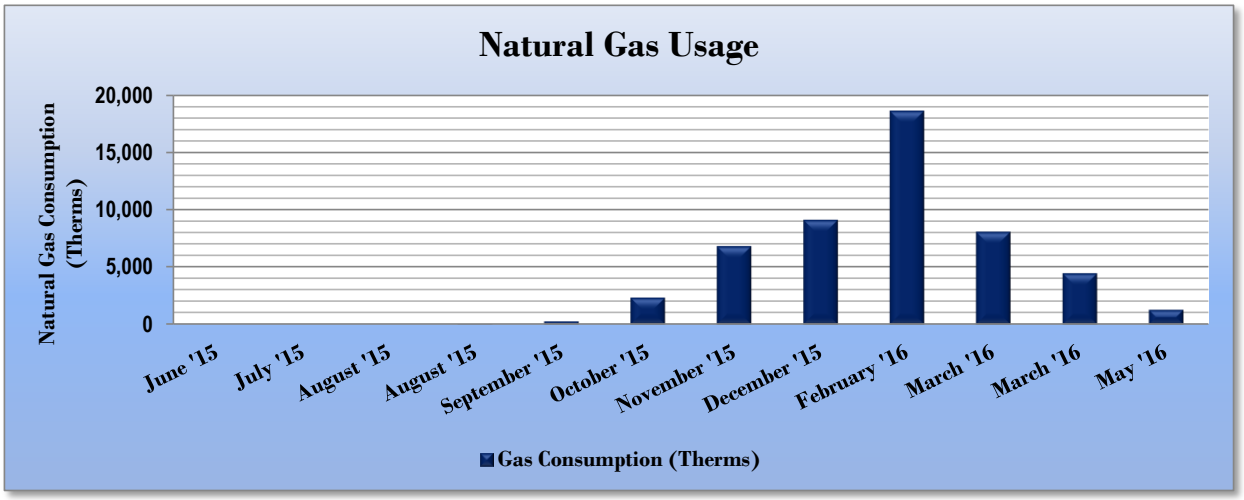


Figure 12 - Natural Gas Usage

Gas Billing Data for Buzz Aldrin Middle School				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/16/15	32	0	$103	No
7/20/15	34	0	$103	No
8/17/15	28	0	$103	No
9/15/15	29	22	$117	No
10/14/15	29	248	$241	No
11/12/15	29	2,325	$4,086	Yes
12/15/15	33	6,806	$6,808	No
1/15/16	31	9,120	$8,214	No
2/18/16	34	18,620	$13,495	Yes
3/17/16	28	8,083	$7,102	No
4/15/16	29	4,458	$2,513	No
5/17/16	32	1,268	$793	No
Totals	**368**	**50,949**	**$43,677**	2
Annual	**365**	**50,534**	**$43,321**	

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Buzz Aldrin Middle School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	209.2	141.4
Site Energy Use Intensity (kBtu/ft^2)	124.5	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Buzz Aldrin Middle School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	164.8	141.4
Site Energy Use Intensity (kBtu/ft^2)	110.3	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This facility was estimated to have a current ENERGY STAR® score of 38, which means that it is slightly less efficient than the median value for buildings of its size, age, and type.

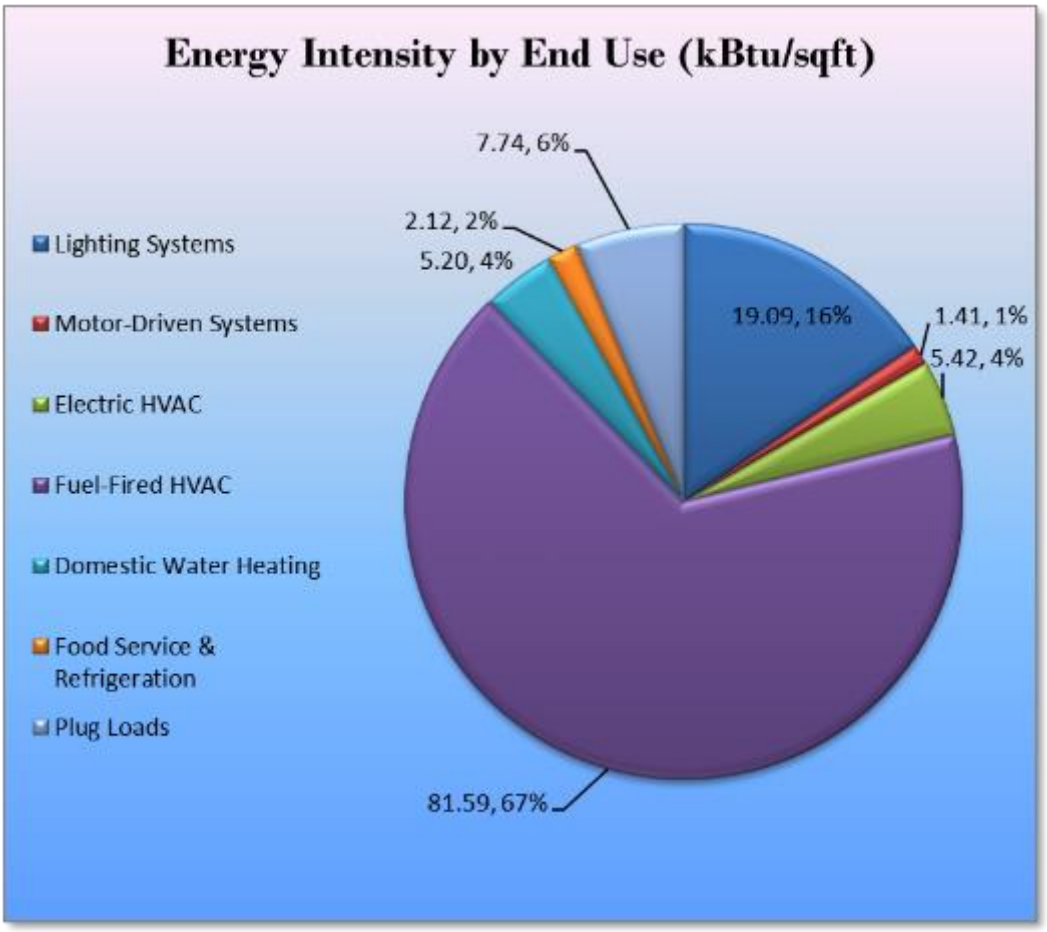
A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance. For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 15 - Energy Balance (kBtu/ft² and %)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Buzz Aldrin Middle School regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**207,198**	**51.0**	**0.0**	**$34,068.52**	**$120,707.89**	**$22,415.00**	**$98,292.89**	**2.9**	**208,647**
ECM 1	Install LED Fixtures	15,380	3.3	0.0	$2,528.88	$7,211.34	$1,200.00	$6,011.34	2.4	15,488
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	417	0.1	0.0	$68.50	$392.00	$20.00	$372.00	5.4	420
ECM 3	Retrofit Fixtures with LED Lamps	190,978	47.5	0.0	$31,401.55	$112,244.11	$21,195.00	$91,049.11	2.9	192,313
ECM 4	Install LED Exit Signs	423	0.1	0.0	$69.58	$860.44	$0.00	$860.44	12.4	426
Lighting Control Measures		**32,074**	**8.6**	**0.0**	**$5,273.74**	**$35,926.00**	**$4,245.00**	**$31,681.00**	**6.0**	**32,298**
ECM 5	Install Occupancy Sensor Lighting Controls	30,452	8.5	0.0	$5,007.14	$32,326.00	$4,245.00	$28,081.00	5.6	30,665
ECM 6	Install High/Low Lighitng Controls	1,621	0.1	0.0	$266.60	$3,600.00	$0.00	$3,600.00	13.5	1,633
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$265.03**	**$460.00**	**$0.00**	**$460.00**	**1.7**	**1,623**
ECM 7	Vending Machine Control	1,612	0.0	0.0	$265.03	$460.00	$0.00	$460.00	1.7	1,623
TOTALS		**240,884**	**59.7**	**0.0**	**$39,607.29**	**$157,093.89**	**$26,660.00**	**$130,433.89**	**3.3**	**242,568**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 17 below. below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**207,198**	**51.0**	**0.0**	**$34,068.52**	**$120,707.89**	**$22,415.00**	**$98,292.89**	**2.9**	**208,647**
ECM 1	Install LED Fixtures	15,380	3.3	0.0	$2,528.88	$7,211.34	$1,200.00	$6,011.34	2.4	15,488
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	417	0.1	0.0	$68.50	$392.00	$20.00	$372.00	5.4	420
ECM 3	Retrofit Fixtures with LED Lamps	190,978	47.5	0.0	$31,401.55	$112,244.11	$21,195.00	$91,049.11	2.9	192,313
ECM 4	Install LED Exit Signs	423	0.1	0.0	$69.58	$860.44	$0.00	$860.44	12.4	426

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	8,701	2.4	0.0	$1,430.68	$4,341.06	$0.00	$4,341.06	3.0	8,762
Exterior	6,679	0.9	0.0	$1,098.20	$2,870.28	$1,200.00	$1,670.28	1.5	6,726

Measure Description

We recommend replacing existing fixtures with HID bulbs lamps to new high-performance LED light fixtures. Also included in this measure are upgrades to recessed can ceiling lighting. We recommend that they be upgraded with retrofit kits. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tube and more than 10 times longer than many incandescent lamps.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	417	0.1	0.0	$68.50	$392.00	$20.00	$372.00	5.4	420
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing T12 fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Some linear fluorescent fixtures can be upgraded to LEDs without changing the existing ballast, but for older T12 fixtures we recommend that the ballast be changed too when the fixture is upgraded.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	187,125	47.0	0.0	$30,767.97	$111,964.30	$21,195.00	$90,769.30	3.0	188,433
Exterior	3,853	0.5	0.0	$633.58	$279.81	$0.00	$279.81	0.4	3,880

Measure Description

We recommend retrofitting most existing fixtures with linear fluorescent, compact fluorescent, or incandescent lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies.

This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 4: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	423	0.1	0.0	$69.58	$860.44	$0.00	$860.44	12.4	426
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing all incandescent or compact fluorescent exit signs with LED exit signs. Most of the school's exit signs already use LEDs, but a few still use older, less efficient incandescent or compact fluorescent bulbs.

LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**32,074**	**8.6**	**0.0**	**$5,273.74**	**$35,926.00**	**$4,245.00**	**$31,681.00**	**6.0**	**32,298**
ECM 5	Install Occupancy Sensor Lighting Controls	30,452	8.5	0.0	$5,007.14	$32,326.00	$4,245.00	$28,081.00	5.6	30,665
ECM 6	Install High/Low Lighitng Controls	1,621	0.1	0.0	$266.60	$3,600.00	$0.00	$3,600.00	13.5	1,633

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 5: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
30,452	8.5	0.0	$5,007.14	$32,326.00	$4,245.00	$28,081.00	5.6	30,665

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in many restrooms, storage rooms, classrooms, offices areas, and other areas where occupancy often changes throughout the school day.

Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 6: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,621	0.1	0.0	$266.60	$3,600.00	$0.00	$3,600.00	13.5	1,633

Measure Description

We recommend installing occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons. Typical areas for such lighting control are stairwells or other areas where building code requirements dictate that the space needs to be lit 24 hours per day.

Lighting fixtures with these controls operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and infrared sensors. The lighting systems are quickly switched to full lighting levels whenever an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period of time.

Energy savings results from only providing full lighting levels when it is required.

For this type of measure the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage needs to be provided to ensure that lights turn on in each area as an occupant approaches.

Additional savings from reduced lighting maintenance may also result from this measure, due to reduced lamp operation.

4.1.3 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment controls are summarized in Figure 19 below.

Figure 19 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$265.03**	**$460.00**	**$0.00**	**$460.00**	**1.7**	**1,623**
ECM 7	Vending Machine Control	1,612	0.0	0.0	$265.03	$460.00	$0.00	$460.00	1.7	1,623

ECM 7: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,612	0.0	0.0	$265.03	$460.00	$0.00	$460.00	1.7	1,623

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy usage of refrigerated beverage vending machines. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

4.2 ECM Evaluated but Not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 20 – Summary of Measure Evaluated, but Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**234.4**	**$2,009.23**	**$209,050.93**	**$0.00**	**$209,050.93**	**104.0**	**27,442**
Install High Efficiency Steam Boilers	0	0.0	234.4	$2,009.23	$209,050.93	$0.00	$209,050.93	104.0	27,442
TOTALS	**0**	**0.0**	**234.4**	**$2,009.23**	**$209,050.93**	**$0.00**	**$209,050.93**	**104.0**	**27,442**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Steam Boilers

Measure Description

We evaluated replacement of existing inefficient steam boilers with new high-efficiency steam boilers. Significant improvements have been made in combustion technology resulting in increases in overall boiler efficiency. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

The existing boilers were installed in 1992. The ASHRAE rated useful lifetime for this type of equipment is 25 years. Though the boilers have reached the end of their rated useful life, they are in good condition. Replacement does not appear to be a critical need at this time.

Reasons for not Recommending

Replacing the existing boilers with high-efficiency steam boilers (~85% efficient) is a significant capital expense, potentially over $200,000. Replacement will likely become more necessary in the near future, but many similar boilers last much longer than 25 years without significant decline in efficiency in later years.

This measure was not recommended for implementation at this time because the energy it would save is not sufficient by itself to justify the large capital expense of replacement.

If the school district chooses to include this measure, it would likely increase the total energy savings for the school to about 15% but would increase the payback period for all measures combined to about 8.2 years.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

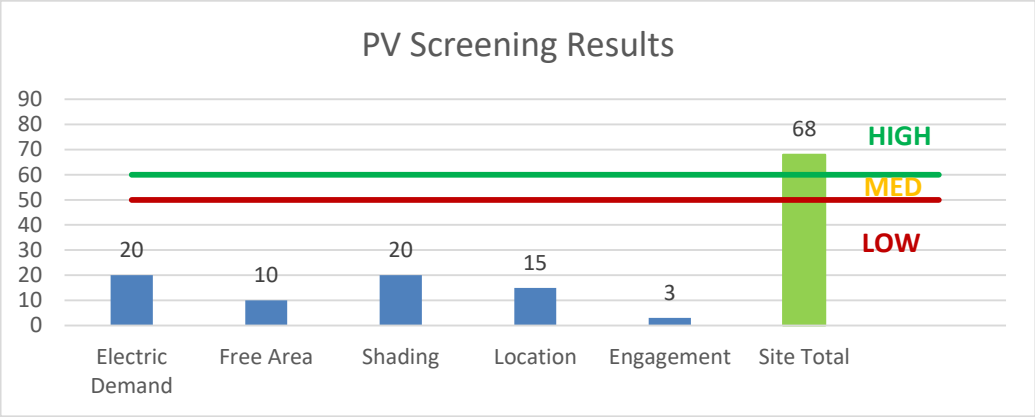
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High Potential** for installing a cost-effective rooftop PV solar array.

Estimated costs and energy savings are shown in the table below. We estimate that the building has sufficient flat, unshaded rooftop space to support a 94-kW solar array. Such an array could offset a significant portion of the school's current electric purchases.

Figure 21 - Photovoltaic Screening



Potential	High	
System Potential	94	kW DC STC
Electric Generation	111,989	kWh/yr
Displaced Cost	$9,740	/yr
Installed Cost	$268,800	

The estimated savings shown in the table above do **not** include potential SREC (Solar Renewable Energy Certificate) subsidies, which the solar project would likely be eligible to receive for up to 15 years of operation. When SREC subsidies are included, similar projects often have a payback period of 8 years or less. If Buzz Aldrin Middle School is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Solar projects must register their projects in the SREC Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.2 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar

- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

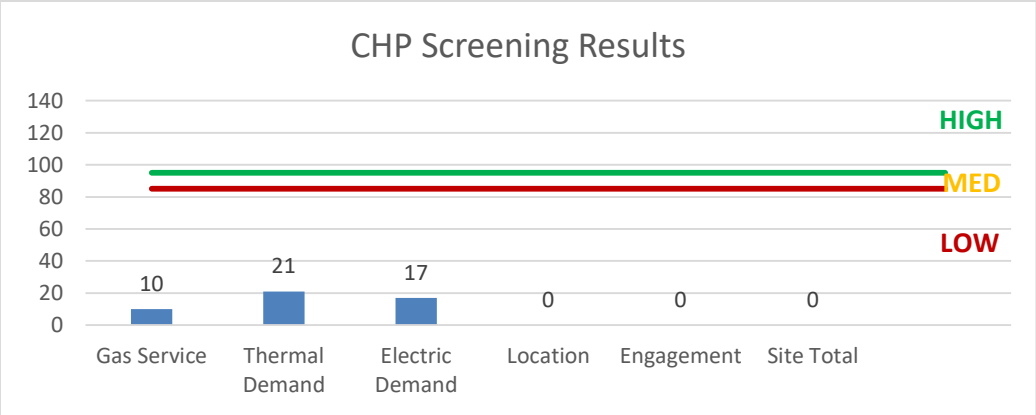
CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low Potential** for installing a cost-effective CHP system.

Low and infrequent thermal load and lack of space near the existing boilers are the most significant factors contributing to the potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in New Jersey specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 22 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion, the facility is not a good candidate for DR curtailment program.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 23 for a list of the eligible programs identified for each recommended ECM.

Figure 23 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X			
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	X			
ECM 3	Retrofit Fixtures with LED Lamps	X			
ECM 4	Install LED Exit Signs				
ECM 5	Install Occupancy Sensor Lighting Controls	X			
ECM 6	Install High/Low Lighitng Controls				
ECM 7	Vending Machine Control	X			

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Main Office	13	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	13	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.63	3,155	0.0	$518.73	$1,776.73	$330.00	2.79
Conf. Rm.	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,013	0.08	414	0.0	$68.01	$291.50	$50.00	3.55
Office Hallway	5	Incandescent: 60W Bulbs in Recessed Cans	Wall Switch	60	2,875	LED Retrofit	Yes	5	LED - Fixtures: Downlight Recessed	Occupancy Sensor	10	2,013	0.17	882	0.0	$145.01	$618.80	$35.00	4.03
Sm. Office 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.10	485	0.0	$79.80	$306.27	$60.00	3.09
Sm. Office 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.10	485	0.0	$79.80	$306.27	$60.00	3.09
Break Rm.	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.10	485	0.0	$79.80	$306.27	$60.00	3.09
Server Rm.	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,013	0.08	414	0.0	$68.01	$291.50	$50.00	3.55
Conf. Rm.	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.29	1,456	0.0	$239.41	$686.80	$140.00	2.28
Sm. Office 3	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,013	0.19	971	0.0	$159.61	$496.53	$100.00	2.48
Auditorium	36	Incandescent: 100W Screw-In Globe Bulbs	Wall Switch	100	2,000	Relamp	No	36	LED Screw-In Lamps: 14W LED Screw-In Globe Bulbs	Wall Switch	14	2,000	2.03	7,121	0.0	$1,170.84	$1,119.24	$0.00	0.96
Auditorium	5	Incandescent: 100W Incandescent in Recessed Cans	Wall Switch	100	2,000	LED Retrofit	No	5	LED - Fixtures: Downlight Recessed	Wall Switch	17	2,000	0.27	955	0.0	$156.94	$287.55	$0.00	1.83
Auditorium	16	Incandescent: 200W High-Bay Recessed Cans	Wall Switch	200	2,000	LED Retrofit	No	16	LED - Fixtures: Downlight Recessed	Wall Switch	33	2,000	1.75	6,146	0.0	$1,010.49	$3,158.88	$0.00	3.13
Auditorium	6	Exit Signs: Incandescent	None	25	2,000	Fixture Replacement	No	6	LED Exit Signs: 2 W Lamp	None	2	2,000	0.09	317	0.0	$52.19	$645.33	$0.00	12.37
Lobby	14	Incandescent: 150W Screw-In Bulbs	Wall Switch	150	2,875	Relamp	No	14	LED Screw-In Lamps: 17W LED Screw-In Bulbs	Wall Switch	17	2,875	1.22	6,156	0.0	$1,012.24	$629.86	$70.00	0.55
Boiler Rm.	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	25	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.54	2,728	0.0	$448.49	$1,462.50	$250.00	2.70
Outer Boiler Rooms	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.17	873	0.0	$143.52	$468.00	$80.00	2.70
Outer Boiler Rooms	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,875	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,875	0.05	231	0.0	$38.05	$143.60	$20.00	3.25
Outer Boiler Rooms	4	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,875	Relamp & Reballast	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,875	0.08	417	0.0	$68.50	$392.00	$20.00	5.43
Sm. Gym	14	Incandescent: 150W Screw-In Bulbs	Wall Switch	150	2,000	Relamp	No	14	LED Screw-In Lamps: 17W LED Screw-In Bulbs	Wall Switch	17	2,000	1.22	4,283	0.0	$704.17	$649.88	$70.00	0.82
Sm. Gym	2	Exit Signs: Incandescent	None	25	2,000	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	2,000	0.03	106	0.0	$17.40	$215.11	$0.00	12.37
Lg. Gym	16	Incandescent: 150W Screw-In Bulbs	Wall Switch	150	2,000	Relamp	No	16	LED Screw-In Lamps: 17W LED Screw-In Bulbs	Wall Switch	17	2,000	1.39	4,894	0.0	$804.76	$742.72	$80.00	0.82
1st Flr. Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.32	1,637	0.0	$269.10	$877.50	$150.00	2.70
Front to Back Hallway	46	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	46	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	1.00	5,019	0.0	$825.23	$2,691.00	$460.00	2.70
Rm. 110	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.55	1,918	0.0	$315.40	$1,710.00	$270.00	4.57
Back Hallway	34	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	34	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.74	3,710	0.0	$609.95	$1,989.00	$340.00	2.70

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Side Hallway	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.45	2,291	0.0	$376.74	$1,228.50	$210.00	2.70
Rm. 115	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm. 116	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm. 117	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Teachers' Lavatory	2	Incandescent: 60W Bulbs	Wall Switch	60	1,000	Relamp	Yes	2	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	700	0.07	124	0.0	$20.31	$147.00	$30.00	5.76
Girls' Rm.	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.11	384	0.0	$63.08	$504.00	$75.00	6.80
Stairwell	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,132	0.11	1,680	0.0	$276.29	$834.00	$180.00	2.37
Front Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.32	1,637	0.0	$269.10	$877.50	$150.00	2.70
Rm. 105	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm. 106	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm. 107	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm. 1087B	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm. 108	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Stairwell	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,132	0.11	1,680	0.0	$276.29	$834.00	$180.00	2.37
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	600	0.02	23	0.0	$3.74	$58.50	$10.00	12.95
Rm 111	19	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	19	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.91	3,208	0.0	$527.41	$2,347.53	$450.00	3.60
Rm 112	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 113	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 114	19	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	19	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.91	3,208	0.0	$527.41	$2,347.53	$450.00	3.60
Boys' Rm.	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.19	675	0.0	$111.03	$650.53	$115.00	4.82
Boys' Rm.	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.03	96	0.0	$15.77	$58.50	$45.00	0.86
Teachers' Lavatory	2	Incandescent: 60W Bulbs in Recessed Cans	Wall Switch	60	800	LED Retrofit	Yes	2	LED - Fixtures: Downlight Recessed	Occupancy Sensor	10	560	0.07	98	0.0	$16.14	$255.52	$20.00	14.59
Rm 201	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	No	15	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.55	1,932	0.0	$317.67	$1,427.00	$300.00	3.55
Boys' Rm.	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.05	192	0.0	$31.54	$387.00	$55.00	10.53
Rm 204 A/B	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.11	384	0.0	$63.08	$504.00	$75.00	6.80

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 204 A/B	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,400	0.03	89	0.0	$14.71	$63.20	$35.00	1.92
Rm 205	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 206	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm 209C	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.48	1,688	0.0	$277.58	$1,221.33	$235.00	3.55
Rm 210	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
2nd Flr Hallway	102	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	102	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	2.21	11,129	0.0	$1,829.86	$5,967.00	$1,020.00	2.70
2nd Flr Hallway	7	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,875	Relamp	No	7	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,875	0.26	1,296	0.0	$213.10	$665.93	$140.00	2.47
2nd Flr Hallway	3	Incandescent: 60W Bulbs in Recessed Cans	Wall Switch	60	2,875	LED Retrofit	No	3	LED - Fixtures: Downlight Recessed	Wall Switch	10	2,875	0.10	501	0.0	$82.36	$209.28	$0.00	2.54
2nd Flr Hallway	1	Compact Fluorescent: 26W CFL in Recessed Can	Wall Switch	34	2,875	LED Retrofit	No	1	LED - Fixtures: Downlight Recessed	Wall Switch	17	2,875	0.01	56	0.0	$9.24	$57.51	$0.00	6.22
Rm 202A	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	No	20	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.73	2,576	0.0	$423.56	$1,902.67	$400.00	3.55
Custodian	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,000	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,000	0.01	37	0.0	$6.05	$48.20	$10.00	6.31
Girls' Rm.	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.08	288	0.0	$47.31	$445.50	$65.00	8.04
Rm 203	17	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	17	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.82	2,870	0.0	$471.89	$2,157.27	$410.00	3.70
Rm 208	18	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	18	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.87	3,039	0.0	$499.65	$2,252.40	$430.00	3.65
Rm 207A	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.48	1,688	0.0	$277.58	$1,221.33	$235.00	3.55
Rm 207	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 209A	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm 209B	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.48	1,688	0.0	$277.58	$1,221.33	$235.00	3.55
Rm 203A	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,000	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,400	0.49	1,726	0.0	$283.86	$1,172.40	$215.00	3.37
Rm 211	17	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	17	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.82	2,870	0.0	$471.89	$2,157.27	$410.00	3.70
Girls' Rm.	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.08	288	0.0	$47.31	$445.50	$65.00	8.04
Teachers' Lavatory	2	Incandescent: 60W Bulbs in Recessed Cans	Wall Switch	60	1,000	LED Retrofit	Yes	2	LED - Fixtures: Downlight Recessed	Occupancy Sensor	10	700	0.07	123	0.0	$20.18	$255.52	$20.00	11.67
Boys' Rm.	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.11	384	0.0	$63.08	$504.00	$75.00	6.80
Rm 212	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	25	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	1.20	4,221	0.0	$693.96	$3,188.33	$605.00	3.72
Rm 213	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 213A	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.48	1,688	0.0	$277.58	$1,221.33	$235.00	3.55
Rm 214	17	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	17	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.82	2,870	0.0	$471.89	$2,157.27	$410.00	3.70
Stairwell Exit 5	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	6,132	0.07	1,101	0.0	$180.96	$779.50	$200.00	3.20
Rm 215	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm 216	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 217	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	25	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	1.20	4,221	0.0	$693.96	$3,188.33	$605.00	3.72
Stairwell Exit 8	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	6,132	0.07	1,101	0.0	$180.96	$779.50	$200.00	3.20
Stairwell 5 Exit 9	6	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	Yes	6	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	6,132	0.09	1,321	0.0	$217.16	$815.40	$240.00	2.65
Corridor 8	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	22	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	0.48	2,400	0.0	$394.68	$1,287.00	$220.00	2.70
Rm 109	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.96	3,376	0.0	$555.16	$2,442.67	$470.00	3.55
Rm 101	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.72	2,532	0.0	$416.37	$1,967.00	$370.00	3.84
Rm 102	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.48	1,688	0.0	$277.58	$1,221.33	$235.00	3.55
Stairwell 2	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	6,132	0.07	1,101	0.0	$180.96	$779.50	$200.00	3.20
Ground Flr Hallway	117	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	No	117	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,875	2.53	12,765	0.0	$2,098.96	$6,844.50	$1,170.00	2.70
Cafeteria	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	No	25	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.92	3,220	0.0	$529.45	$2,378.33	$500.00	3.55
Kitchen	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	No	10	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,000	0.37	1,288	0.0	$211.78	$951.33	$200.00	3.55
Mop Sink	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.02	38	0.0	$6.24	$58.50	$10.00	7.77
Men's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.02	38	0.0	$6.24	$58.50	$10.00	7.77
Women's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.02	38	0.0	$6.24	$58.50	$10.00	7.77
Teachers' Rm	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.60	2,110	0.0	$346.94	$2,097.00	$325.00	5.11
Rm 25	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.57	2,014	0.0	$331.17	$2,038.50	$315.00	5.20
Rm 24	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.57	2,014	0.0	$331.17	$2,038.50	$315.00	5.20
Rm 23	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.68	2,398	0.0	$394.25	$2,272.50	$355.00	4.86
Rm 20 A/B	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.55	1,918	0.0	$315.40	$1,980.00	$305.00	5.31
Rm 20 A/B	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,000	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,400	0.10	338	0.0	$55.52	$190.27	$75.00	2.08

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Men's Rm	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.14	480	0.0	$78.85	$562.50	$85.00	6.06
Women's Rm	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.14	480	0.0	$78.85	$562.50	$85.00	6.06
Teachers' Lavatory	2	Incandescent: 60W Bulbs	Wall Switch	60	1,000	Relamp	Yes	2	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	700	0.07	124	0.0	$20.31	$147.00	$30.00	5.76
Girls' Locker Rm.	19	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,000	Relamp	Yes	19	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,400	0.27	955	0.0	$157.00	$1,492.10	$200.00	8.23
Girls' Locker Rm.	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.05	192	0.0	$31.54	$117.00	$55.00	1.97
Girls' Showers	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.17	607	0.0	$99.84	$468.00	$80.00	3.89
Boys' Locker Rm.	19	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,000	Relamp	Yes	19	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,400	0.27	955	0.0	$157.00	$1,492.10	$200.00	8.23
Boys' Locker Rm.	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.05	192	0.0	$31.54	$117.00	$55.00	1.97
Boys' Showers	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.17	607	0.0	$99.84	$468.00	$80.00	3.89
Rm 18	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.49	1,726	0.0	$283.86	$1,593.00	$250.00	4.73
Elevator	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	8,760	0.02	353	0.0	$57.97	$71.80	$10.00	1.07
SGI 3	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.36	1,247	0.0	$205.01	$1,300.50	$200.00	5.37
SGI 2	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.25	863	0.0	$141.93	$796.50	$125.00	4.73
Rm 16	30	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,000	Relamp	Yes	30	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,400	0.43	1,508	0.0	$247.90	$1,887.00	$255.00	6.58
Research Area A	8	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,000	Relamp	Yes	8	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,400	0.11	402	0.0	$66.11	$557.20	$75.00	7.29
Research Area A	2	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,000	Relamp	Yes	2	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	1,400	0.02	74	0.0	$12.14	$63.80	$45.00	1.55
Rm 17	24	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,000	Relamp	Yes	24	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,400	0.34	1,206	0.0	$198.32	$1,671.60	$225.00	7.29
Rm 17	4	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,000	Relamp	Yes	4	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	1,400	0.04	148	0.0	$24.28	$127.60	$55.00	2.99
SGI 1-B	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.27	959	0.0	$157.70	$855.00	$135.00	4.57
SGI 1-A	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,000	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,400	0.27	959	0.0	$157.70	$855.00	$135.00	4.57
Custodial Storage Area	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.16	345	0.0	$56.77	$621.00	$95.00	9.27
Custodial Storage Area	6	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,200	Relamp	Yes	6	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	840	0.09	181	0.0	$29.75	$485.40	$65.00	14.13
Whole School	32	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	32	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Building Exterior	9	Incandescent: 100W Incandescent (Globe Lights)	None	100	4,380	Relamp	No	9	LED Screw-In Lamps: 14W LED Screw-In Globe Bulbs	None	15	4,380	0.50	3,853	0.0	$633.58	$279.81	$0.00	0.44

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Building Exterior	3	High-Pressure Sodium: (1) 100W Lamp	None	138	4,380	LED Retrofit	No	3	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	20	4,380	0.23	1,783	0.0	$293.19	$717.57	$300.00	1.42
Building Exterior	9	Metal Halide: (1) 100W Lamp	None	128	4,380	LED Retrofit	No	9	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	20	4,380	0.64	4,896	0.0	$805.02	$2,152.71	$900.00	1.56

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Gym	4	Exhaust Fan	1.0	75.0%	No	2,745	No	75.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Rm	Pneumatic Controls	1	Air Compressor	5.0	87.5%	No	4,957	No	87.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
BAMS	Classrooms	4	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	8	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Rm 215	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	2	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Rm 204	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	3	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	2	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	6	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Rm 208	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Main Office	9	Packaged Terminal AC	1.17		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Nurse's Office	2	Packaged Terminal AC	1.17		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	5	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Rm 214	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	SGI-2, Rm 201	2	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
BAMS	Classrooms	7	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Rm	BAMS	2	Natural Draft Steam Boiler	6,100.00	Yes	2	Natural Draft Steam Boiler	6,100.00	85.00%	Et	0.00	0	234.4	$2,009.23	$209,050.93	$0.00	104.05

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Rm	BAMS	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Cond	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (>50 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teachers' Rm	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Break Rm	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 110	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Cafeteria	1	Stand-Up Freezer, Glass Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Electric Convection Oven (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	3	Insulated Food Holding Cabinet (Full Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
BAMS	187	Computers & Monitors	229.0	Yes
BAMS	6	TVs (Lg. Flat Screens)	200.0	Yes
BAMS	7	Microwave Ovens	800.0	No
BAMS	5	Coffee Makers	900.0	No
BAMS	2	Toaster Oven	1,000.0	No
BAMS	4	Lg. Copy Machines	494.0	No
BAMS	3	Electric Range	400.0	No
BAMS	6	Server	450.0	No
BAMS	12	Sm Printers	80.0	Yes
BAMS	1	Washer & Dryer	5,300.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teachers' Rm	1	Refrigerated	Yes	0.00	1,612	0.0	$265.03	$230.00	$0.00	0.87
Teachers' Rm	1	Non-Refrigerated	No	0.00	0	0.0	$0.00	$230.00	$0.00	0.00

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

38

ENERGY STAR® Score[1]

Mount Hebron (Buzz Aldrin) Middle School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 126,568
Built: 1909

For Year Ending: April 30, 2016
Date Generated: December 25, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Mount Hebron (Buzz Aldrin) Middle School 173 Bellevue Avenue Montclair, New Jersey 07043	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724942

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
59.7 kBtu/ft²

Source EUI
98.8 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	2,186,053 (29%)
Natural Gas (kBtu)	5,367,632 (71%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	54
National Median Source EUI (kBtu/ft²)	89.3
% Diff from National Median Source EUI	11%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	528

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Administration Building

Montclair Board of Education

22 Valley Road

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Administration Building.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey educational facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

The Administration Building is a 15,714 square foot facility founded in 1879. The building is a three-story educational support facility including but not limited to offices, hallways, restrooms, and conference areas.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 40-Watt and 75-Watt T12 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several incandescent and compact fluorescent lamps. Exterior lighting is provided by a combination of 100-Watt and 150-Watt high pressure sodium and 200-Watt incandescent lamps. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation is primarily provided by window AC units. Heating is provided by the Central Heating Plant.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated six measures and recommended five measures which together represent an opportunity for the Administration Building to reduce annual energy costs by roughly $3,219 and annual greenhouse gas emissions by 21,260 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 4.8 years. TRC has defined high priority measures as the evaluated measures that have a simple payback less than the typical equipment life of the proposed equipment. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Administration Building's annual energy use by 10%.

Figure 1 – Previous 12 Month Utility Costs

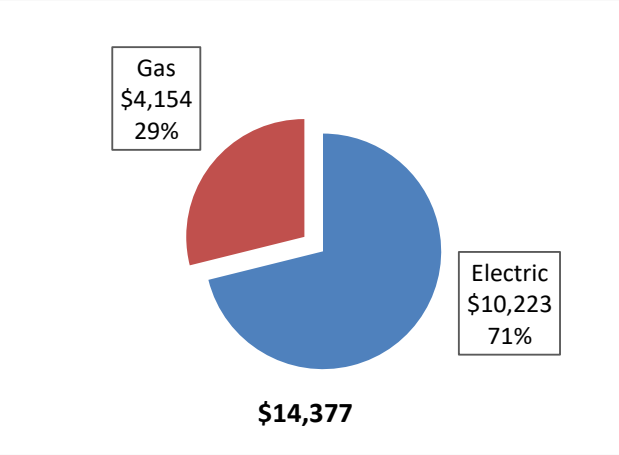
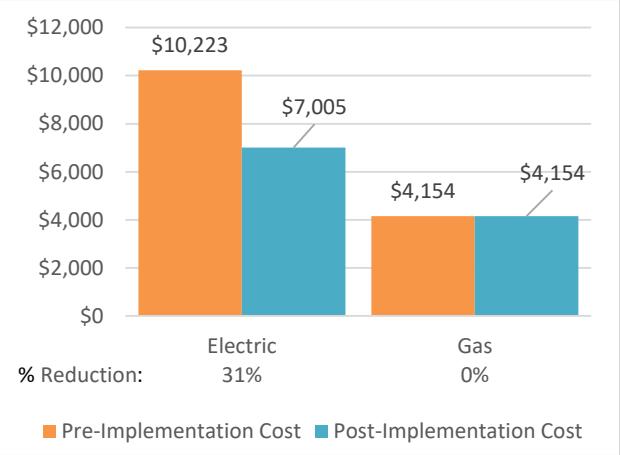


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Administration Building's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the evaluated energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		High Priority?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**19,051**	**4.8**	**0.0**	**$2,904.34**	**$15,256.16**	**$2,565.00**	**$12,691.16**	**4.4**	**19,184**
ECM 1	Install LED Fixtures	Yes	2,165	0.3	0.0	$329.99	$1,562.71	$400.00	$1,162.71	3.5	2,180
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,461	0.3	0.0	$222.73	$1,758.00	$5.00	$1,753.00	7.9	1,471
ECM 3	Retrofit Fixtures with LED Lamps	Yes	15,425	4.2	0.0	$2,351.62	$11,935.45	$2,160.00	$9,775.45	4.2	15,533
Lighting Control Measures			**2,061**	**0.5**	**0.0**	**$314.21**	**$3,030.00**	**$280.00**	**$2,750.00**	**8.8**	**2,076**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	1,846	0.4	0.0	$281.45	$2,430.00	$280.00	$2,150.00	7.6	1,859
ECM 5	Install High/Low Lighitng Controls	Yes	215	0.0	0.0	$32.76	$600.00	$0.00	$600.00	18.3	216
Electric Unitary HVAC Measures			**5,213**	**4.1**	**0.0**	**$794.78**	**$33,388.64**	**$0.00**	**$33,388.64**	**42.0**	**5,250**
	Install High Efficiency Electric AC	No	5,213	4.1	0.0	$794.78	$33,388.64	$0.00	$33,388.64	42.0	5,250
TOTALS FOR HIGH PRIORITY MEASURES			**21,112**	**5.3**	**0.0**	**$3,218.56**	**$18,286.16**	**$2,845.00**	**$15,441.16**	**4.8**	**21,260**
TOTALS FOR ALL EVALUATED MEASURES			**26,325**	**9.4**	**0.0**	**$4,013.33**	**$51,674.80**	**$2,845.00**	**$48,829.80**	**12.2**	**26,510**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Electric Unitary HVAC measures generally involve replacing older inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide equivalent cooling to older air condition systems at a reduced energy cost. These measures save energy by reducing the power used by the air conditioning systems, due to improved electrical efficiency.

Energy Efficient Practices

TRC also identified five low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at the Administration Building include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Clean Evaporator/Condenser Coils on AC Systems
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for the Administration Building. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.2 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Thomas Page	Auditor	MTraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 09, 2016, TRC performed an energy audit at the Administration Building located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

The Administration Building is a 15,714 square foot facility founded in 1879. The building is a three-story educational support facility including but not limited to offices, hallways, restrooms, and conference areas.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Administration Building	Weekday	8:00 AM - 6:00 PM
Administration Building	Weekend	unoccupied

2.4 Building Envelope

The Administration Building is a three-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with operable frames. The slanted roof is constructed of tile roofing material.

Figure 6 – Building Façade



2.5 On-Site Generation

The Administration Building does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

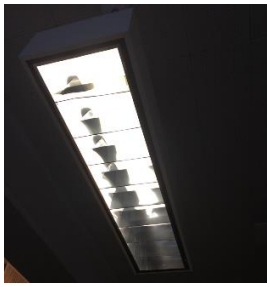
Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the Administration Building consists mainly of 32-Watt T8 linear fluorescent fixtures with a few 40-Watt and 75-Watt T12 linear fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. The linear fluorescent fixtures are 4-foot or 8-foot long, mainly troffers with diffusers having 1, 2, 3, or 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 17-Watt compact fluorescent lamps and 60-Watt incandescent lamps. All the exit signs are LED fixtures.

Interior lighting control in the building is provided by a combination of manual switches and occupancy sensors.

Figure 7 - Building Lighting Systems

Linear Fluorescent Fixture	*Exterior Fixture*
	

Exterior lighting is provided by a combination of 100-Watt and 150-Watt high pressure sodium fixtures, and 200-Watt incandescent fixtures.

Heating System

The Central Heating Plant has two natural gas fired Weil McLain steam boilers with an input rating of 7,938 MBh each and a nominal efficiency of 80%. These boilers provide space heating for the Hillside School, the Montclair Community Pre-K, and the district Administration Building.

Figure 8 – Heating System

Steam Boiler



Direct Expansion Air Conditioning System (DX)

Air conditioning (AC) at the facility is primarily provided by window AC units with capacities ranging between 0.42 ton and 2 tons and with efficiencies of around 10.0 EER.

Figure 9 – DX Air Conditioning System



Domestic Hot Water Heating System

The domestic hot water heating system for the facility is provided by the Central Heating Plant.

Building Plug Load

The facility contains several plug-load systems which contribute to plug load electric use including but not limited to printers, copiers and microwave.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

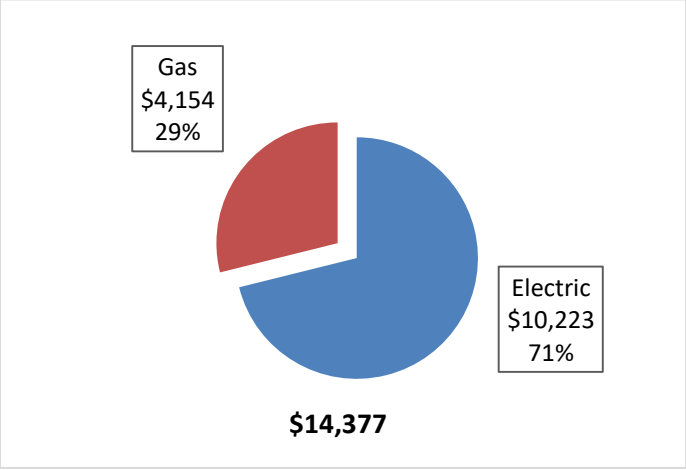
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 10 - Utility Summary

Utility Summary for Administration Building		
Fuel	**Usage**	**Cost**
Electricity	67,061 kWh	$10,223
Natural Gas	5,180 Therms	$4,154
Total		**$14,377**

The current annual energy cost for this facility is $14,377 as shown in the chart below.

Figure 11 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.152/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Electric usage estimation and calibration methodology:

1. The Montclair BOE buildings Hillside School, Administration, Montclair Community Pre-K, and Central Heating Plant are served by three electric meters 65 795 083 02, 67 125 896 06, and 42 007 763 08. There is not a clear delineation of loads served by the meters, therefore demand (kW) was not prorated.
2. Total energy use from all the meters combined is around 638,475 kWh for a 12-month period.
3. Monthly "calculated" energy use from the LGEA analysis tools were used to calculate the percentage contribution of each building. The percentages are:
    a. Hillside School – 70%
    b. Administration Building – 11%
    c. Montclair Community Pre-K – 18%
    d. Central Heating Plant – 1%

The above percentages were applied to the "actual" total monthly energy use from bills to estimate monthly utility energy use to which all the tools were then calibrated.

Figure 12 - Electric Usage & Demand

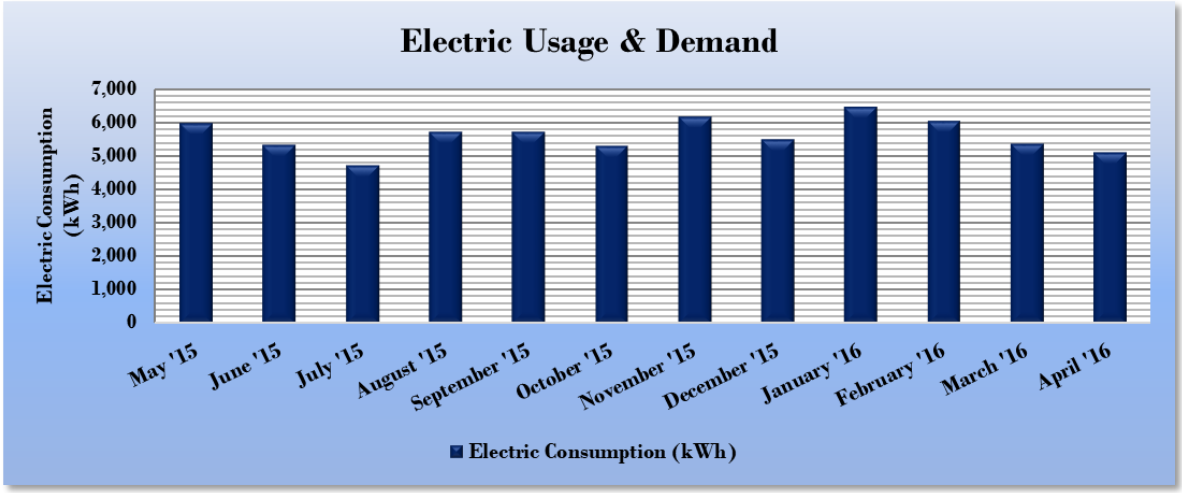


Figure 13 - Electric Usage & Demand

Electric Billing Data for Administration Building				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
6/15/15	33	5,955	$1,158	Yes
7/14/15	29	5,311	$1,021	Yes
8/12/15	29	4,697	$897	Yes
9/14/15	33	5,710	$1,048	Yes
10/13/15	29	5,700	$841	Yes
11/10/15	28	5,290	$744	Yes
12/11/15	31	6,172	$846	Yes
1/13/16	33	5,471	$714	Yes
2/11/16	29	6,445	$828	Yes
3/14/16	32	6,026	$774	Yes
4/13/16	30	5,367	$722	Yes
5/13/16	30	5,100	$659	Yes
Totals	**366**	**67,245**	**$10,251**	12
Annual	**365**	**67,061**	**$10,223**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.802/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Natural gas use was allocated to the sites served by the Central Heating Plant using the following method:

1. The Administration Building, Hillside School, Montclair Community Pre-K, and Central Heating Plant are served by two gas meters: 65 795 083 02 and 67 125 896 06. There is not a clear delineation of which buildings and equipment are served by each meter.
2. Total annual gas use for both of the meters combined is 59,235 therms.
3. The calculated gas use from the LGEA analysis for each building was used to determine the percentage of the total historical gas use to be assigned to each building. Total gas use was allocated to the three buildings served by the Central Heating Plant as follows:
    a. Hillside School - 75%
    b. Administration Building - 9%
    c. Montclair Community Pre-K - 16%
4. The above percentages were applied to the total monthly gas use from the utility bills to estimate the monthly gas use for the individual buildings. This estimated monthly gas use is what is provided in each of the reports.

Figure 14 - Natural Gas Usage

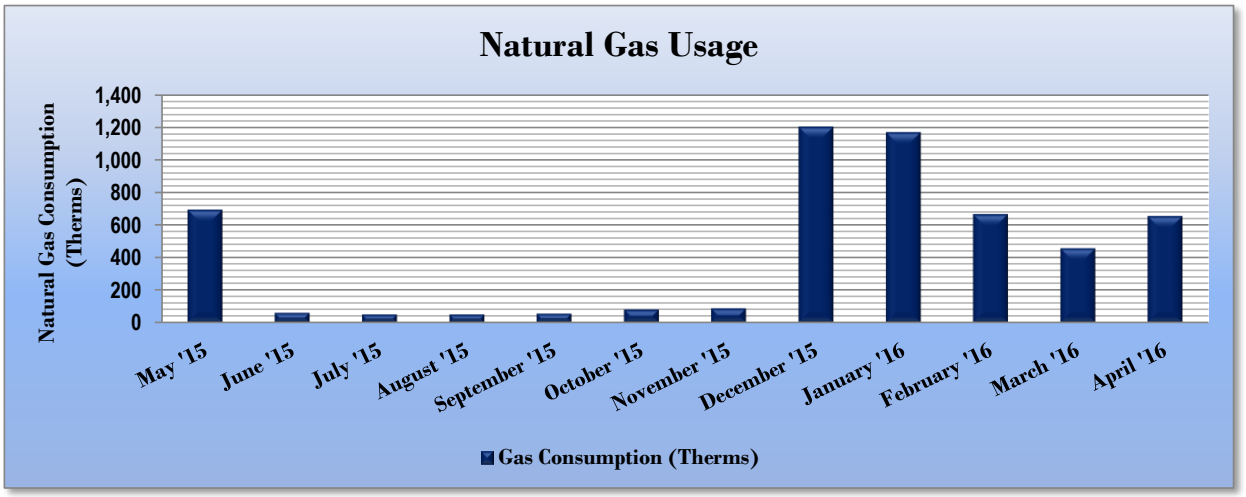


Figure 15 - Natural Gas Usage

Gas Billing Data for Administration Building				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/15/15	33	691	$373	Yes
7/14/15	29	58	$117	Yes
8/12/15	29	49	$49	Yes
9/14/15	33	49	$121	Yes
10/13/15	29	54	$75	Yes
11/10/15	28	79	$84	Yes
12/11/15	31	85	$109	Yes
1/13/16	33	1,198	$1,122	Yes
2/11/16	29	1,165	$1,068	Yes
3/14/16	32	663	$452	Yes
4/13/16	30	454	$247	Yes
5/13/16	30	651	$349	Yes
Totals	**366**	**5,194**	**$4,165**	12
Annual	**365**	**5,180**	**$4,154**	

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 16 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Administration Building	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	80.3	141.4
Site Energy Use Intensity (kBtu/ft^2)	47.5	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 17 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Administration Building	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	65.9	141.4
Site Energy Use Intensity (kBtu/ft^2)	42.9	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. The Central Heating Plant and the three buildings served by it have a combined score of 74.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

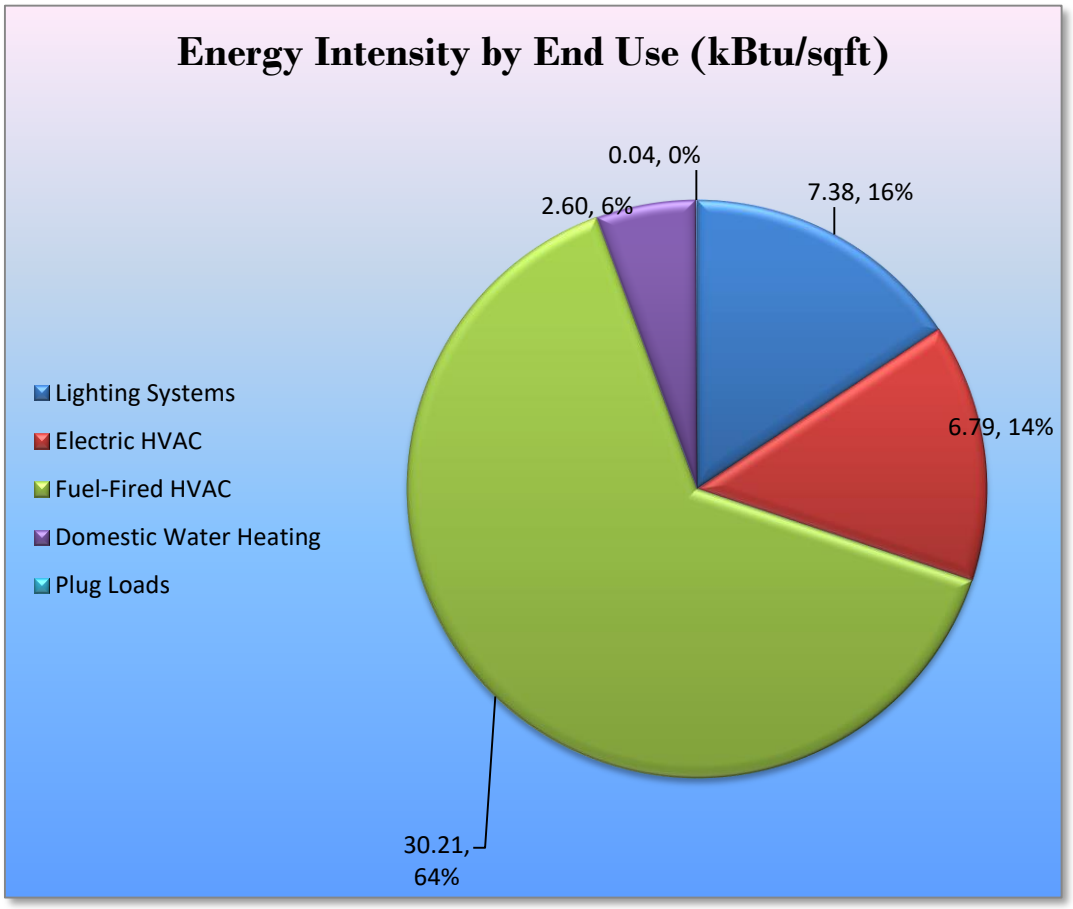
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 18 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Administration Building regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 High Priority ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 19 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**19,051**	**4.8**	**0.0**	**$2,904.34**	**$15,256.16**	**$2,565.00**	**$12,691.16**	**4.4**	**19,184**
ECM 1	Install LED Fixtures	2,165	0.3	0.0	$329.99	$1,562.71	$400.00	$1,162.71	3.5	2,180
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,461	0.3	0.0	$222.73	$1,758.00	$5.00	$1,753.00	7.9	1,471
ECM 3	Retrofit Fixtures with LED Lamps	15,425	4.2	0.0	$2,351.62	$11,935.45	$2,160.00	$9,775.45	4.2	15,533
Lighting Control Measures		**2,061**	**0.5**	**0.0**	**$314.21**	**$3,030.00**	**$280.00**	**$2,750.00**	**8.8**	**2,076**
ECM 4	Install Occupancy Sensor Lighting Controls	1,846	0.4	0.0	$281.45	$2,430.00	$280.00	$2,150.00	7.6	1,859
ECM 5	Install High/Low Lighitng Controls	215	0.0	0.0	$32.76	$600.00	$0.00	$600.00	18.3	216
TOTALS		**21,112**	**5.3**	**0.0**	**$3,218.56**	**$18,286.16**	**$2,845.00**	**$15,441.16**	**4.8**	**21,260**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 20 below.

Figure 20 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**19,051**	**4.8**	**0.0**	**$2,904.34**	**$15,256.16**	**$2,565.00**	**$12,691.16**	**4.4**	**19,184**
ECM 1	Install LED Fixtures	2,165	0.3	0.0	$329.99	$1,562.71	$400.00	$1,162.71	3.5	2,180
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,461	0.3	0.0	$222.73	$1,758.00	$5.00	$1,753.00	7.9	1,471
ECM 3	Retrofit Fixtures with LED Lamps	15,425	4.2	0.0	$2,351.62	$11,935.45	$2,160.00	$9,775.45	4.2	15,533

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Exterior	2,165	2,165	0	0.3	0.0	$329.99	$1,562.71	$400.00	$1,162.71	3.5	2,180

Measure Description

We recommend replacing exterior fixtures containing high pressure sodium lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a high-pressure sodium fixture.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,461	1,461	0	0.3	0.0	$222.73	$1,758.00	$5.00	$1,753.00	7.9	1,471

Measure Description

We recommend retrofitting existing T12 fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tube.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	14,681	4.1	0.0	$2,238.10	$11,881.70	$2,155.00	$9,726.70	4.3	14,783
Exterior	745	0.1	0.0	$113.51	$53.75	$5.00	$48.75	0.4	750

Measure Description

We recommend retrofitting existing T8 linear fluorescent, incandescent, and compact fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 21 below.

Figure 21 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**2,061**	**0.5**	**0.0**	**$314.21**	**$3,030.00**	**$280.00**	**$2,750.00**	**8.8**	**2,076**
ECM 4	Install Occupancy Sensor Lighting Controls	1,846	0.4	0.0	$281.45	$2,430.00	$280.00	$2,150.00	7.6	1,859
ECM 5	Install High/Low Lighitng Controls	215	0.0	0.0	$32.76	$600.00	$0.00	$600.00	18.3	216

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,846	0.4	0.0	$281.45	$2,430.00	$280.00	$2,150.00	7.6	1,859

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in conference rooms, storage rooms, offices areas, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
215	0.0	0.0	$32.76	$600.00	$0.00	$600.00	18.3	216

Measure Description

We recommend installing occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors, parking lots, and parking garages.

Lighting fixtures with these controls operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared sensors. The lighting systems are switched to full lighting levels whenever an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period. Energy savings results from only providing full lighting levels when it is required.

For this type of measure the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage needs to be provided to ensure that lights turn on in each area as an occupant approaches.

Additional savings from reduced lighting maintenance may also result from this measure, due to reduced lamp operation.

4.2 Other Evaluated ECM

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 22 – Summary of Other Evaluated ECM

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures	**5,213**	**4.1**	**0.0**	**$794.78**	**$33,388.64**	**$0.00**	**$33,388.64**	**42.0**	**5,250**
Install High Efficiency Electric AC	5,213	4.1	0.0	$794.78	$33,388.64	$0.00	$33,388.64	42.0	5,250
TOTALS	**5,213**	**4.1**	**0.0**	**$794.78**	**$33,388.64**	**$0.00**	**$33,388.64**	**42.0**	**5,250**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Air Conditioning Units

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
5,213	4.1	0.0	$794.78	$33,388.64	$0.00	$33,388.64	42.0	5,250

Measure Description

We recommend replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units when cost effective. There have been significant improvements in both compressor and fan motor efficiencies over the past several years. Therefore, electricity savings can be achieved by replacing older units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling load, and the estimated annual operating hours.

Reasons for not Recommending

This measure has a long payback, more than the rated useful life of the replacement equipment. The measure is not recommended for implementation on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility does not have a potential for installing a PV array.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility does not have a potential for installing a cost-effective CHP system.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion this building is not is a good candidate for DR.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 23 for a list of the eligible programs identified for each recommended ECM.

Figure 23 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x					
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x					
ECM 3	Retrofit Fixtures with LED Lamps	x					
ECM 4	Install Occupancy Sensor Lighting Controls	x					
ECM 5	Install High/Low Lighitng Controls						

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
exterior	2	High-Pressure Sodium: (1) 100W Lamp	Wall Switch	138	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	41	4,380	0.11	846	0.0	$129.01	$781.35	$200.00	4.51
exterior	1	Incandescent: INC-200W	Wall Switch	200	4,380	Relamp	No	1	LED Screw-In Lamps: LED-30W	Wall Switch	30	4,380	0.11	856	0.0	$130.54	$53.75	$5.00	0.37
exterior	2	High-Pressure Sodium: (1) 150W Lamp	Wall Switch	215	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	65	4,380	0.20	1,516	0.0	$231.14	$781.35	$200.00	2.52
Main office	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.26	787	0.0	$120.04	$702.00	$120.00	4.85
personnel	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.39	1,181	0.0	$180.06	$1,053.00	$180.00	4.85
Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.09	262	0.0	$40.01	$234.00	$40.00	4.85
Registration	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.11	474	0.0	$72.23	$504.00	$75.00	5.94
Vault Storage	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,470	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,470	0.02	89	0.0	$13.64	$98.00	$5.00	6.82
Director of operations	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.13	394	0.0	$60.02	$351.00	$60.00	4.85
Small Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.09	262	0.0	$40.01	$234.00	$40.00	4.85
Small Office	2	Incandescent: INC-60W	Occupancy Sensor	60	1,729	Relamp	No	1	LED Screw-In Lamps: LED-9W	Occupancy Sensor	9	1,729	0.07	221	0.0	$33.65	$53.75	$5.00	1.45
Pupil Services	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.11	474	0.0	$72.23	$504.00	$75.00	5.94
Sm. Conf Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.11	474	0.0	$72.23	$504.00	$75.00	5.94
Sm. Conf Rm	2	Incandescent: INC-60W	Wall Switch	60	2,470	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,470	0.07	315	0.0	$48.07	$53.75	$5.00	1.01
Sm Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.09	262	0.0	$40.01	$234.00	$40.00	4.85
Hallway	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,729	0.11	474	0.0	$72.23	$434.00	$40.00	5.45
Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,470	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,470	0.04	159	0.0	$24.25	$95.13	$20.00	3.10
Front Hallway	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,729	0.08	355	0.0	$54.17	$375.50	$30.00	6.38
Superintendent Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,729	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,729	0.15	445	0.0	$67.90	$380.53	$80.00	4.43
Superintendent Office	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.29	886	0.0	$135.04	$676.80	$135.00	4.01
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,470	0.02	94	0.0	$14.29	$58.50	$10.00	3.39
Basement	3	Incandescent: INC-60W	Wall Switch	60	2,470	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,470	0.11	486	0.0	$74.05	$53.75	$5.00	0.66
Basement	10	Linear Fluorescent - T12: 8' T12 (75W) - 1L	Wall Switch	92	2,470	Relamp & Reballast	Yes	10	LED - Linear Tubes: (1) 8' Lamp	Occupancy Sensor	36	1,729	0.44	1,897	0.0	$289.27	$1,930.00	$35.00	6.55
2nd Floor Landing	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,729	0.08	355	0.0	$54.17	$375.50	$30.00	6.38
2nd Floor Landing	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
2nd Floor Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.13	394	0.0	$60.02	$351.00	$60.00	4.85
DB1 Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.09	262	0.0	$40.01	$234.00	$40.00	4.85
Sm Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.06	197	0.0	$30.01	$150.40	$30.00	4.01
Open Office	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.15	459	0.0	$70.02	$409.50	$70.00	4.85
Sm Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.04	131	0.0	$20.01	$117.00	$20.00	4.85
Sm Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.06	197	0.0	$30.01	$175.50	$30.00	4.85
2nd Floor Transportation Office	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,729	Relamp	No	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.28	853	0.0	$130.04	$760.50	$130.00	4.85
2nd Floor Transportation Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	1,729	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,729	0.02	70	0.0	$10.61	$71.80	$10.00	5.83
Payroll 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.06	197	0.0	$30.01	$150.40	$30.00	4.01
Payroll 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.06	197	0.0	$30.01	$150.40	$30.00	4.01
Sm Office 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,470	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.12	533	0.0	$81.26	$495.60	$80.00	5.11
Sm Office 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.10	295	0.0	$45.01	$225.60	$45.00	4.01
Sm Office 3	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,729	Relamp	No	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,729	0.10	295	0.0	$45.01	$225.60	$45.00	4.01
Copy Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,470	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,470	0.03	141	0.0	$21.44	$75.20	$15.00	2.81
Open Office Back	11	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,470	Relamp	Yes	11	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,729	0.53	2,293	0.0	$349.63	$1,316.47	$255.00	3.04
Open Office Front	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,470	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,729	0.58	2,502	0.0	$381.42	$1,411.60	$275.00	2.98
Open Office Front	1	Compact Fluorescent: CFL-2L-17W	Wall Switch	34	2,470	Relamp	No	1	LED Screw-In Lamps: LED-24W	Wall Switch	24	2,470	0.01	29	0.0	$4.42	$107.51	$0.00	24.34
3rd Floor Hall	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,470	0.02	94	0.0	$14.29	$58.50	$10.00	3.39
3rd Floor Hall	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
3rd Floor Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,470	0.02	94	0.0	$14.29	$58.50	$10.00	3.39
3rd Floor Back Office	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.14	592	0.0	$90.29	$562.50	$85.00	5.29
3rd Floor Back Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,470	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,470	0.01	50	0.0	$7.58	$35.90	$5.00	4.08
Attic Storage	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,470	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,729	0.16	711	0.0	$108.35	$621.00	$60.00	5.18

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
2nf Flr Tec Off	2nf Flr Tec Off	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.13	170	0.0	$25.92	$1,088.76	$0.00	42.01
2nfd Flr Brd Rm	2nfd Flr Brd Rm	1	Window AC	1.67		Yes	1	Window AC	1.67		12.00		No	0.22	283	0.0	$43.19	$1,814.60	$0.00	42.01
2nfd Flr Brd Rm	2nfd Flr Brd Rm	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
2nfd Flr Brd Rm	2nfd Flr Brd Rm	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
2nfd Flr Brd Rm	2nfd Flr Brd Rm	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
2nfd Flr Brd Rm	2nfd Flr Brd Rm	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.13	170	0.0	$25.92	$1,088.76	$0.00	42.01
2nd Flr Office Closet	2nd Flr Office Closet	1	Window AC	2.08		Yes	1	Window AC	2.08		12.00		No	0.28	354	0.0	$53.99	$2,268.25	$0.00	42.01
A DelGurcio Off 2nd Flr	A DelGurcio Off 2nd Flr	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.11	142	0.0	$21.60	$907.30	$0.00	42.01
Bookkeeping 2nd Flr	Bookkeeping 2nd Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
Comm Relations 1st Flr	Comm Relations 1st Flr	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.11	142	0.0	$21.60	$907.30	$0.00	42.01
D Sullivan Off 2nd Flr	D Sullivan Off 2nd Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
DOI 2nd Flr	DOI 2nd Flr	1	Window AC	1.67		Yes	1	Window AC	1.67		12.00		No	0.22	283	0.0	$43.19	$1,814.60	$0.00	42.01
DOI 2nd Flr	DOI 2nd Flr	1	Window AC	1.67		Yes	1	Window AC	1.67		12.00		No	0.22	283	0.0	$43.19	$1,814.60	$0.00	42.01
Dr. Patterson Off 1st Flr	Dr. Patterson Off 1st Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
Guy Whtilock 2nd Flr	Guy Whtilock 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01
Hallway 1st Flr	Hallway 1st Flr	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
Hallway 2nd Flr	Hallway 2nd Flr	1	Window AC	1.67		Yes	1	Window AC	1.67		12.00		No	0.22	283	0.0	$43.19	$1,814.60	$0.00	42.01
Jean Wuensch Off 2nd Flr	Jean Wuensch Off 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01
Payroll Off 2nd Flr	Payroll Off 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01
Payroll Spvsr 2nd Flr	Payroll Spvsr 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Personnel Off 1st Flr	Personnel Off 1st Flr	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
Pupil Svc 1st Flr	Pupil Svc 1st Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
Rebecca Roth 1st Flr	Rebecca Roth 1st Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
Registration 1st Flr	Registration 1st Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01
Superintendent Off 1st Flr	Superintendent Off 1st Flr	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.13	170	0.0	$25.92	$1,088.76	$0.00	42.01
Supt Board Rm 1st Flr	Supt Board Rm 1st Flr	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
Supt Board Rm 1st Flr	Supt Board Rm 1st Flr	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.17	213	0.0	$32.40	$1,360.95	$0.00	42.01
Supt. Secretary 1st Flr	Supt. Secretary 1st Flr	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.09	113	0.0	$17.28	$725.84	$0.00	42.01
Sylvia Bryant 2nd Flr	Sylvia Bryant 2nd Flr	1	Window AC	0.42		Yes	1	Window AC	0.42		12.00		No	0.06	71	0.0	$10.80	$453.65	$0.00	42.01
Terry Scales Off 2nd Flr	Terry Scales Off 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01
Terry Scales Off 2nd Flr	Terry Scales Off 2nd Flr	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.08	99	0.0	$15.12	$635.11	$0.00	42.01

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Administration	1	Natural Draft Steam Boiler	290.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Administration	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Admin	1	Small Printer	20.0	No
Admin	1	Small Copier	20.0	No
Admin	1	Microwave	1,000.0	No
Admin	1	Large Copier	515.0	No

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Montclair Valley Road Campus (4 Buildings)

Primary Property Type: K-12 School
Gross Floor Area (ft²): 172,102
Built: 1879

For Year Ending: April 30, 2016
Date Generated: June 20, 2018

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Montclair Valley Road Campus (4 Buildings) 22 Valley Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 6364554

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
47.1 kBtu/ft²

Source EUI
76 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	5,917,390 (73%)
Electric - Grid (kBtu)	2,187,666 (27%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	60.1
National Median Source EUI (kBtu/ft²)	97
% Diff from National Median Source EUI	-22%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	557

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Bradford Elementary School

Montclair Board of Education

87 Mount Hebron Road
Montclair, New Jersey 07403

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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Appendix A: Equipment Inventory & Recommendations

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Bradford Elementary School.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey higher education facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

Bradford Elementary School is a 58,129 square foot facility constructed in 1927. The building is a three-story educational facility including classrooms, library areas, offices, hallways and mechanical rooms.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 28-Watt T5 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several compact fluorescent and incandescent lamps, as well as metal halide fixtures in the gym. Exterior lighting is provided primarily by 100-Watt and 250-Watt metal halide fixtures, with a few building mounted compact fluorescent and incandescent fixtures. Interior lighting control is provided by manual switches.

Cooling and ventilation is provided by a combination of rooftop packaged AC, window AC, split system AC, and package terminal AC systems. Heating hot water is distributed to the building's rooftop unit from natural draft steam boiler via a heat exchanger.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated eight and recommended seven measures which together represent an opportunity for Bradford Elementary School to reduce annual energy costs by roughly $18,773 and annual greenhouse gas emissions by 115,272 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 6.3 years. TRC has defined high priority measures as the evaluated measures that have a simple payback less than the typical equipment life of the proposed equipment. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Bradford Elementary School's annual energy use by 12%.

Figure 1 – Previous 12 Month Utility Costs

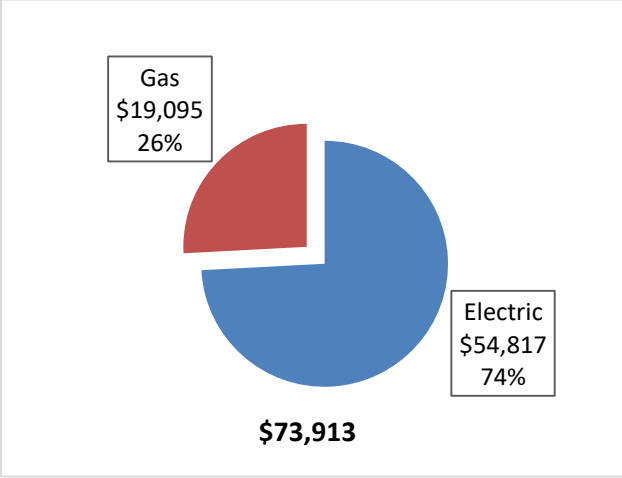
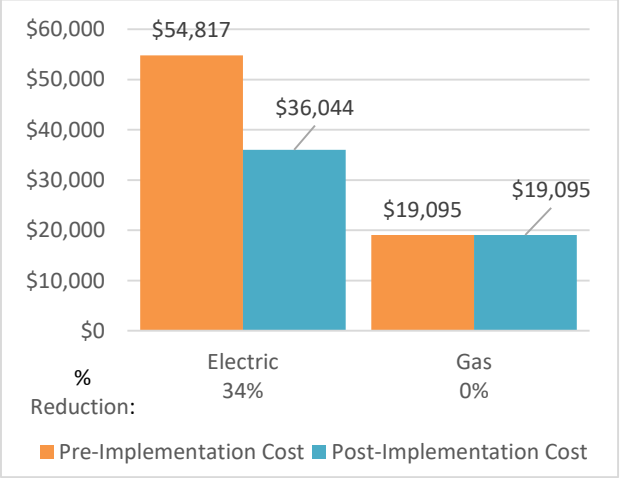


Figure 2 – Potential Post-Implementation Costs



A detailed description of Bradford Elementary School's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the evaluated energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**96,779**	**29.4**	**$15,871.49**	**$104,403.19**	**$11,630.00**	**$92,773.19**	**5.8**	**97,455**
ECM 1	Install LED Fixtures	Yes	25,461	4.6	$4,175.59	$55,418.56	$3,690.00	$51,728.56	12.4	25,639
ECM 2	Retrofit Fixtures with LED Lamps	Yes	68,305	24.6	$11,201.92	$47,586.42	$7,940.00	$39,646.42	3.5	68,783
ECM 3	Install LED Exit Signs	Yes	3,012	0.2	$493.98	$1,398.22	$0.00	$1,398.22	2.8	3,033
Lighting Control Measures			**12,934**	**4.0**	**$2,121.22**	**$20,834.00**	**$2,575.00**	**$18,259.00**	**8.6**	**13,025**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	12,934	4.0	$2,121.22	$20,834.00	$2,575.00	$18,259.00	8.6	13,025
Motor Upgrades			**161**	**0.1**	**$26.35**	**$1,752.72**	**$0.00**	**$1,752.72**	**66.5**	**162**
ECM 5	Premium Efficiency Motors	Yes	161	0.1	$26.35	$1,752.72	$0.00	$1,752.72	66.5	162
Variable Frequency Drive (VFD) Measures			**2,986**	**0.8**	**$489.67**	**$6,015.30**	**$0.00**	**$6,015.30**	**12.3**	**3,007**
ECM 6	Install VFDs on Hot Water Pumps	Yes	2,986	0.8	$489.67	$6,015.30	$0.00	$6,015.30	12.3	3,007
Electric Unitary HVAC Measures			**3,502**	**2.3**	**$574.38**	**$15,067.21**	**$0.00**	**$15,067.21**	**26.2**	**3,527**
	Install High Efficiency Electric AC	No	3,502	2.3	$574.38	$15,067.21	$0.00	$15,067.21	26.2	3,527
Plug Load Equipment Control - Vending Machine			**1,612**	**0.0**	**$264.34**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 7	Vending Machine Control	Yes	1,612	0.0	$264.34	$230.00	$0.00	$230.00	0.9	1,623
TOTALS FOR RECOMMENDED MEASURES			**114,471**	**34.3**	**$18,773.07**	**$133,235.21**	**$14,205.00**	**$119,030.21**	**6.3**	**115,272**
TOTALS FOR ALL MEASURES			**117,974**	**36.6**	**$19,347.45**	**$148,302.43**	**$14,205.00**	**$134,097.43**	**6.9**	**118,799**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing older standard efficiency motors with high efficiency standard (IHP 2014). Motors replacements generally assume the same size motors, just higher efficiency. Although occasionally additional savings can be achieved by downsizing motors to better meet current load requirements. This measure saves energy by reducing the power used by the motors, due to improved electrical efficiency.

Variable Frequency Drives (VFDs) are motor control devices. These measures control the speed of a motor so that the motor spins at peak efficiency during partial load conditions. Sensors adapt the speed to flow, temperature, or pressure settings which is much more efficient than using a valve or damper to control flow rates, or running the motor at full speed when only partial power is needed. These measures save energy by controlling motor usage more efficiently.

Electric Unitary HVAC measures generally involve replacing older inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide equivalent cooling to older air condition systems at a reduced energy cost. These measures save energy by reducing the power used by the air conditioning systems, due to improved electrical efficiency.

Plug Load Equipment control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.

Energy Efficient Practices

TRC also identified seven low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Bradford Elementary School include:

- Close Doors and Windows
- Ensure Economizers are Functioning Properly
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient Practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Bradford Elementary School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	90	kW DC STC
Electric Generation	107,224	kWh/yr
Displaced Cost	$9,330	/yr
Installed Cost	$257,400	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

This facility may also qualify for the Direct Install program which can provide turnkey installation of multiple measures, through an authorized network of participating contractors. This program can provide substantially higher incentives than SmartStart, up to 70% of the cost of selected measures, although measure eligibility will have to be assessed and be verified by the designated Direct Install contractor and, in most cases, they will perform the installation work.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Tom Page	Auditor	tpag@TRCsolutions.com	(732) 855-0033

2.2 General Site Information

On November 16, 2016, TRC performed an energy audit at Bradford Elementary School located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Bradford Elementary School is a 58,129 square foot facility constructed in 1927. The building is a three-story educational facility including classrooms, library areas, offices, hallways and mechanical rooms.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 28-Watt T5 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several compact fluorescent and incandescent lamps, as well as metal halide fixtures in the gym. Exterior lighting is provided primarily by 100-Watt and 250-Watt metal halide fixtures, with a few building mounted compact fluorescent and incandescent fixtures. Interior lighting control is provided by manual switches.

Cooling and ventilation is provided by a combination of rooftop packaged AC, window AC, split system AC, and package terminal AC systems. Heating hot water is distributed to the building's rooftop unit from natural draft steam boiler via a heat exchanger.

2.3 Building Occupancy

The typical schedule is presented in the table below, with usage primarily in the non-summer months.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Bradford Elementary School	Weekday	7:00 am - 3:30 pm
Bradford Elementary School	Weekend	CLOSED

2.4 Building Envelope

Bradford Elementary School is a three-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with operable frames. The flat roof is constructed of built-up roofing material.

Figure 7 – Building Façade



2.5 On-Site Generation

TRC evaluated the potential for installing on-site generation for Bradford Elementary School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 8 – Photovoltaic Potential

Potential	High	
System Potential	90	kW DC STC
Electric Generation	107,224	kWh/yr
Displaced Cost	$9,330	/yr
Installed Cost	$257,400	

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at Bradford Elementary School consists mainly of 32-Watt T8 fluorescent fixtures with a few 28-Watt T5 fluorescent fixtures in the library. These sources are inefficient in performance when compared to the latest lighting technology available in the market. Most linear fixtures are 2-foot or 4-foot long troffers with diffusers having 1, 2, 3, and 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 17-Watt compact fluorescent lamps and 60-Watt, 75-Watt, and 200-Watt incandescent lamps. Metal halide sources provide illumination for the gymnasium. All the exit signs are LED based fixtures.

Interior lighting control in the building is provided by manual switches.

Figure 9 - Building Lighting Systems

Fluorescent Fixture	*Exterior Metal Halide Fixture*
	

The building's exterior lighting consists primarily of 100-Watt and 250-Watt metal halide fixtures, although a few incandescent and compact fluorescent fixtures are mounted to the building. Exterior lamps are generally controlled by photocells.

Steam to Hot Water System

The hot water system consists of two Weil-McLain 2,274 kBtu/hr output, natural draft steam boilers. The boilers have a nominal combustion efficiency of 83%. The boilers are configured with a steam to water heat exchanger to convert steam to heating hot water. The hot water is circulated with two hot water pumps. Each boiler is supplied by a dedicated 3 hp pump operating at constant speed. The boilers are in good condition and well maintained.

Figure 10 – Hot Water System

Natural Gas Boiler	*Heating Hot Water Pumps*
	

Direct Expansion Air Conditioning System (DX)

The facility also has several window AC units with capacities ranging between 0.67 tons and 1.25 tons. There are two rooftop package units having capacities of 40-tons and 13-tons. In addition to the window AC units and package units, there are split systems serving the building.

Figure 11 – DX Air Conditioning System

Window AC	*Split Systems*
	

Domestic Hot Water Heating System

The domestic hot water heating system for the facility consists of two A.O. Smith gas fired hot water heaters with an input rating of 75 kBtu/hr and 150 kBtu/hr and nominal efficiencies of 80% and 88% respectively. Storage tank capacities are 75 gallons and 100 gallons.

Figure 12 – Domestic Hot Water System

DHW Heater	*DHW Heater Nameplate*
	

Food Service Equipment

The school has two electric convention ovens (half size) manufactured by Vulcan which has an electric demand of approximately 4.71 kW.

Refrigeration

The school has three stand-up refrigerators. Two refrigerators have 42 cu. ft, and one refrigerator has 22 cu. ft. capacities. Two of the larger units are in the kitchen and the smaller unit is in the break room.

Building Plug Load

There are roughly 80 computer work stations throughout the facility. All the computers are desktop units with LCD monitors. There is no centralized PC power management software installed.

The facility contains other systems which contribute to plug load including printers, microwaves, and televisions. In addition to the typical plug load equipment, the facility also has a refrigerated vending machine in the teacher's lounge.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

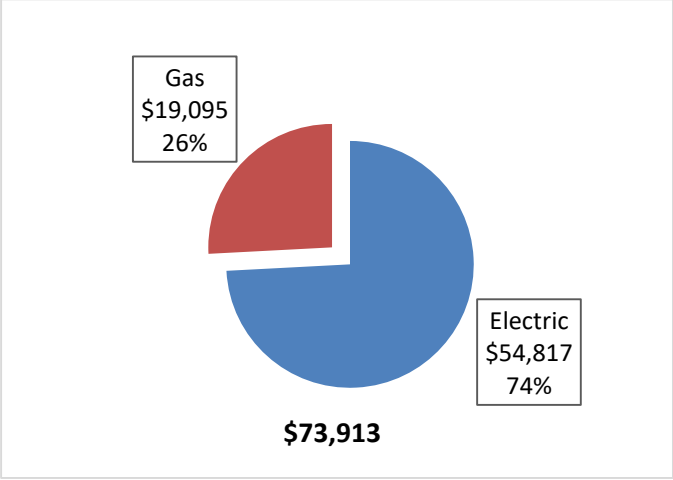
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 13 - Utility Summary

Utility Summary for Bradford Elementary School		
Fuel	**Usage**	**Cost**
Electricity	334,257 kWh	$54,817
Natural Gas	21,688 Therms	$19,095
Total		**$73,913**

The current annual energy cost for this facility is $73,913 as shown in the chart below.

Figure 14 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.164/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 15 - Electric Usage & Demand

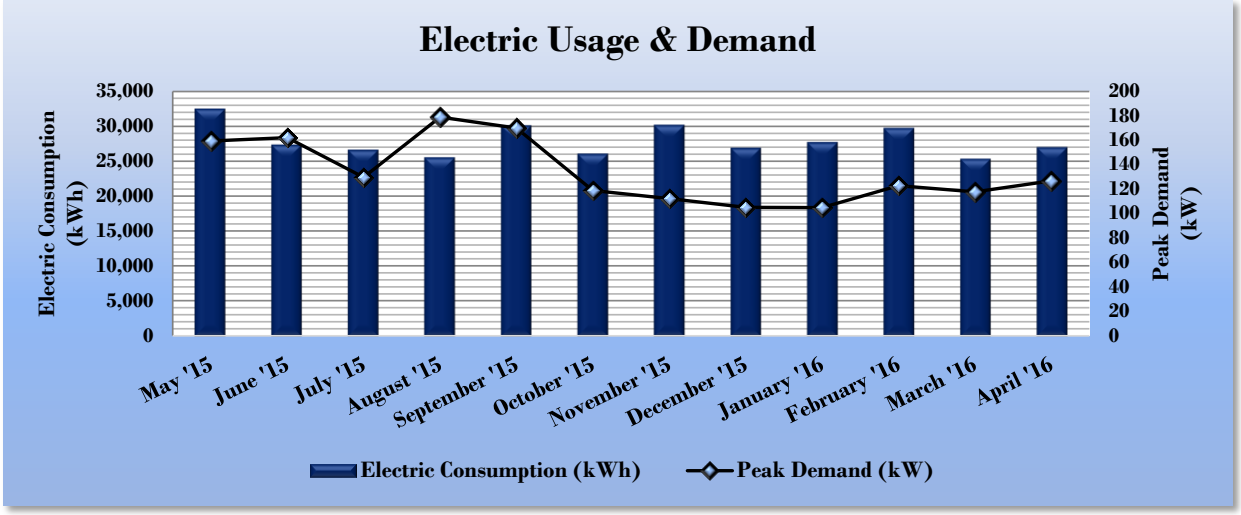


Figure 16 - Electric Usage & Demand

Electric Billing Data for Bradford Elementary School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Total Electric Cost	TRC Estimated Usage?
6/15/15	32	32,388	159	$6,367	No
7/15/15	30	27,300	162	$5,749	No
8/13/15	29	26,550	130	$5,217	No
9/14/15	32	25,483	179	$5,636	No
10/13/15	29	30,032	170	$4,605	No
11/11/15	29	25,988	119	$3,915	No
12/14/15	33	30,113	112	$4,286	No
1/15/16	32	26,860	105	$3,752	No
2/12/16	28	27,645	105	$3,787	No
3/15/16	32	29,678	123	$4,097	No
4/14/16	30	25,278	118	$3,595	No
5/13/16	29	26,942	127	$3,812	No
Totals	**365**	**334,257**	**179**	**$54,817**	0
Annual	**365**	**334,257**	**179**	**$54,817**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.880/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Figure 17 - Natural Gas Usage

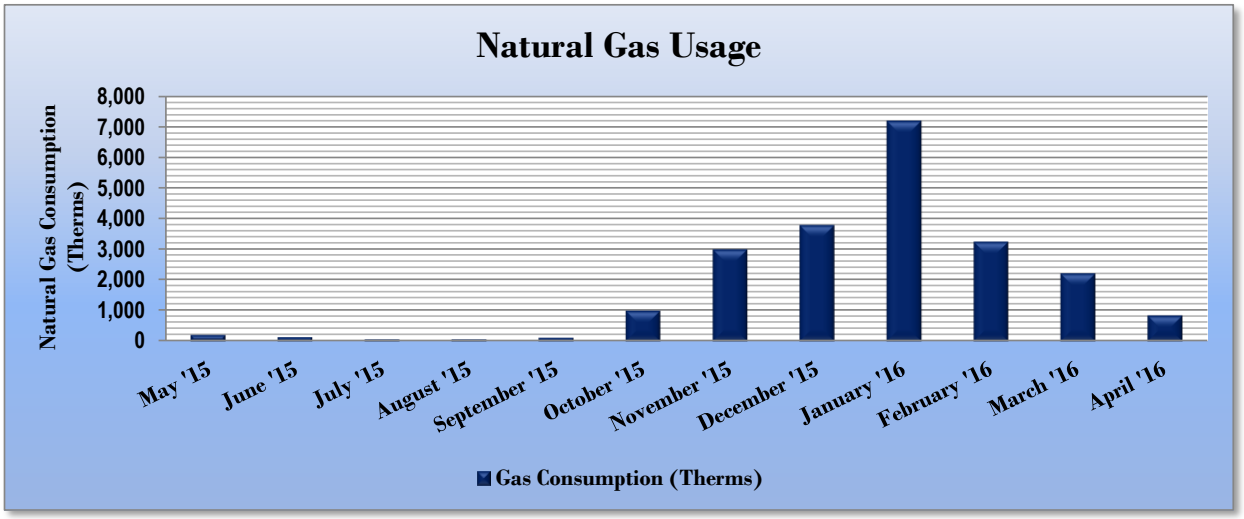


Figure 18 - Natural Gas Usage

Gas Billing Data for Bradford Elementary School			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
6/16/15	32	209	$220
7/20/15	34	133	$178
8/17/15	28	63	$139
9/15/15	29	61	$139
10/14/15	29	112	$168
11/12/15	29	1,003	$1,824
12/15/15	33	2,999	$3,036
1/15/16	31	3,789	$3,516
2/18/16	34	7,186	$5,284
3/16/16	27	3,248	$2,879
4/15/16	30	2,216	$1,304
5/17/16	32	845	$565
Totals	**368**	**21,866**	**$19,252**
Annual	**365**	**21,688**	**$19,095**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 19 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Bradford Elementary School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	100.8	141.4
Site Energy Use Intensity (kBtu/ft^2)	56.9	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 20 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Bradford Elementary School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	79.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	50.2	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This facility has a current score of 65.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

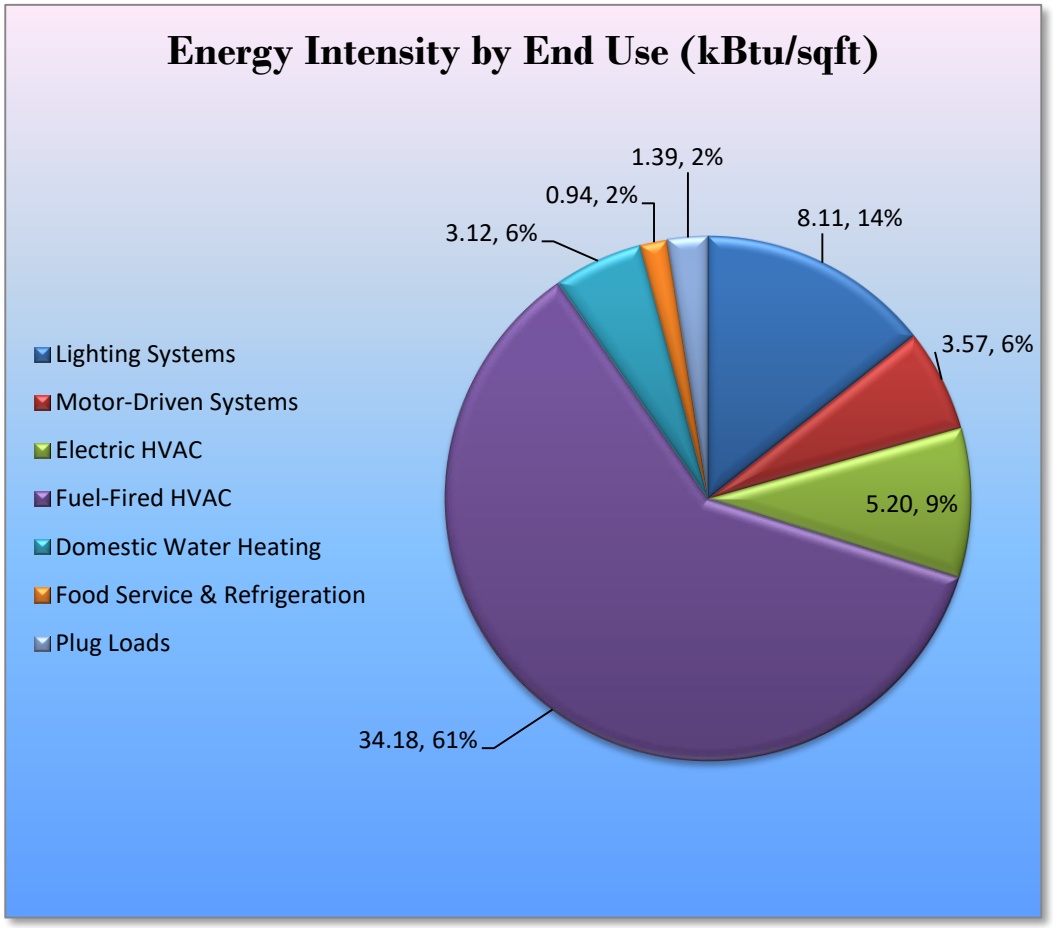
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 21 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Bradford Elementary School regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 High Priority ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 22 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**96,779**	**29.4**	**0.0**	**$15,871.49**	**$104,403.19**	**$11,630.00**	**$92,773.19**	**5.8**	**97,455**
ECM 1	Install LED Fixtures	25,461	4.6	0.0	$4,175.59	$55,418.56	$3,690.00	$51,728.56	12.4	25,639
ECM 2	Retrofit Fixtures with LED Lamps	68,305	24.6	0.0	$11,201.92	$47,586.42	$7,940.00	$39,646.42	3.5	68,783
ECM 3	Install LED Exit Signs	3,012	0.2	0.0	$493.98	$1,398.22	$0.00	$1,398.22	2.8	3,033
Lighting Control Measures		**12,934**	**4.0**	**0.0**	**$2,121.22**	**$20,834.00**	**$2,575.00**	**$18,259.00**	**8.6**	**13,025**
ECM 4	Install Occupancy Sensor Lighting Controls	12,934	4.0	0.0	$2,121.22	$20,834.00	$2,575.00	$18,259.00	8.6	13,025
Motor Upgrades		**161**	**0.1**	**0.0**	**$26.35**	**$1,752.72**	**$0.00**	**$1,752.72**	**66.5**	**162**
ECM 5	Premium Efficiency Motors	161	0.1	0.0	$26.35	$1,752.72	$0.00	$1,752.72	66.5	162
Variable Frequency Drive (VFD) Measures		**2,986**	**0.8**	**0.0**	**$489.67**	**$6,015.30**	**$0.00**	**$6,015.30**	**12.3**	**3,007**
ECM 6	Install VFDs on Hot Water Pumps	2,986	0.8	0.0	$489.67	$6,015.30	$0.00	$6,015.30	12.3	3,007
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$264.34**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 7	Vending Machine Control	1,612	0.0	0.0	$264.34	$230.00	$0.00	$230.00	0.9	1,623
TOTALS		**114,471**	**34.3**	**0.0**	**$18,773.07**	**$133,235.21**	**$14,205.00**	**$119,030.21**	**6.3**	**115,272**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 23 below.

Figure 23 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**96,779**	**29.4**	**0.0**	**$15,871.49**	**$104,403.19**	**$11,630.00**	**$92,773.19**	**5.8**	**97,455**
ECM 1	Install LED Fixtures	25,461	4.6	0.0	$4,175.59	$55,418.56	$3,690.00	$51,728.56	12.4	25,639
ECM 2	Retrofit Fixtures with LED Lamps	68,305	24.6	0.0	$11,201.92	$47,586.42	$7,940.00	$39,646.42	3.5	68,783
ECM 3	Install LED Exit Signs	3,012	0.2	0.0	$493.98	$1,398.22	$0.00	$1,398.22	2.8	3,033

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	9,791	2.6	0.0	$1,605.72	$48,333.60	$2,700.00	$45,633.60	28.4	9,860
Exterior	15,670	2.0	0.0	$2,569.87	$7,084.96	$990.00	$6,094.96	2.4	15,780

Measure Description

We recommend replacing existing fixtures containing HID lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output. Exterior fixtures are pole mounted or along the building exterior. Interior fixtures are located in the gymnasiums.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a HID lamp.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	67,252	24.4	0.0	$11,029.27	$47,348.10	$7,920.00	$39,428.10	3.6	67,723
Exterior	1,053	0.1	0.0	$172.65	$238.32	$20.00	$218.32	1.3	1,060

Measure Description

We recommend retrofitting existing incandescent, compact fluorescent, and linear fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	3,012	0.2	0.0	$493.98	$1,398.22	$0.00	$1,398.22	2.8	3,033
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing all incandescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 24 below.

Figure 24 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**12,934**	**4.0**	**0.0**	**$2,121.22**	**$20,834.00**	**$2,575.00**	**$18,259.00**	**8.6**	**13,025**
ECM 4	Install Occupancy Sensor Lighting Controls	12,934	4.0	0.0	$2,121.22	$20,834.00	$2,575.00	$18,259.00	8.6	13,025

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
12,934	4.0	0.0	$2,121.22	$20,834.00	$2,575.00	$18,259.00	8.6	13,025

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in many classrooms, restrooms, teacher's lounge, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.1.3 Motor Upgrades

Our recommendations for motor upgrades are summarized in Figure 25 below.

Figure 25 - Summary of Motor Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**161**	**0.1**	**0.0**	**$26.35**	**$1,752.72**	**$0.00**	**$1,752.72**	**66.5**	**162**
ECM 5	Premium Efficiency Motors	161	0.1	0.0	$26.35	$1,752.72	$0.00	$1,752.72	66.5	162

ECM 5: Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
161	0.1	0.0	$26.35	$1,752.72	$0.00	$1,752.72	66.5	162

Measure Description

We recommend replacing standard efficiency motors with IHP 2014 efficiency motors. Our evaluation assumes that existing motors will be replaced with motors of equivalent size and type. Although occasionally additional savings can be achieved by downsizing motors to better meet the motor's current load requirements. The base case motor efficiencies are estimated from nameplate information and our best estimates of motor run hours. Efficiencies of proposed motor upgrades are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the assumed annual operating hours.

This long payback measure is recommended in conjunction with the variable frequency drive measure, ECM 6 in order to assure that an inverter rated motor is in place so that the VFD can function properly.

4.1.4 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 26 below.

Figure 26 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**2,986**	**0.8**	**0.0**	**$489.67**	**$6,015.30**	**$0.00**	**$6,015.30**	**12.3**	**3,007**
ECM 6	Install VFDs on Hot Water Pumps	2,986	0.8	0.0	$489.67	$6,015.30	$0.00	$6,015.30	12.3	3,007

ECM 6: Install VFDs on Hot Water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,986	0.8	0.0	$489.67	$6,015.30	$0.00	$6,015.30	12.3	3,007

Measure Description

We recommend installing a variable frequency drives (VFD) to control the hot water pumps. This measure requires that a majority of the hot water coils be served by 2-way valves and that a differential pressure sensor is installed in the hot water loop. As the hot water valves close, the differential pressure increases. The VFD modulates pump speed to maintain a differential pressure setpoint. Energy savings results from reducing pump motor speed (and power) as hot water valves close. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

4.1.5 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment measures are summarized in Figure 27 below.

Figure 27-Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$264.34**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 7	Vending Machine Control	1,612	0.0	0.0	$264.34	$230.00	$0.00	$230.00	0.9	1,623

ECM 7: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,612	0.0	0.0	$264.34	$230.00	$0.00	$230.00	0.9	1,623

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy use. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

4.2 ECM Evaluated but not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 28 – Summary of Measure Evaluated, But Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures	**3,502**	**2.3**	**0.0**	**$574.38**	**$15,067.21**	**$0.00**	**$15,067.21**	**26.2**	**3,527**
Install High Efficiency Electric AC	3,502	2.3	0.0	$574.38	$15,067.21	$0.00	$15,067.21	26.2	3,527
TOTALS	**3,502**	**2.3**	**0.0**	**$574.38**	**$15,067.21**	**$0.00**	**$15,067.21**	**26.2**	**3,527**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Air Conditioning Units

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
3,502	2.3	0.0	$574.38	$15,067.21	$0.00	$15,067.21	26.2	3,527

Measure Description

We considered and evaluated replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units. There have been significant improvements in both compressor and fan motor efficiencies over the past several years. Therefore, electricity savings can be achieved by replacing older units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling load, and the estimated annual operating hours.

Reasons for not Recommending

This measure was evaluated but not recommended due to long payback, which exceeds the useful life of the proposed equipment.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Ensure Economizers are Functioning Properly

Economizers, when properly configured, can be used to significantly reduce mechanical cooling. However, if the outdoor thermostat or enthalpy control is malfunctioning or the damper is stuck or improperly adjusted, benefits from the economizer may not be fully realized. As such, periodic inspection and maintenance is required to ensure proper operation. This maintenance should be scheduled with maintenance of the facility's air conditioning system and should include proper setting of the outdoor thermostat/enthalpy control, inspection of control and damper operation, lubrication of damper connections, and adjustment of minimum damper position. A malfunctioning economizer can significantly increase the amount of heating and mechanical cooling required by introducing excess amounts of cold or hot outside air.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

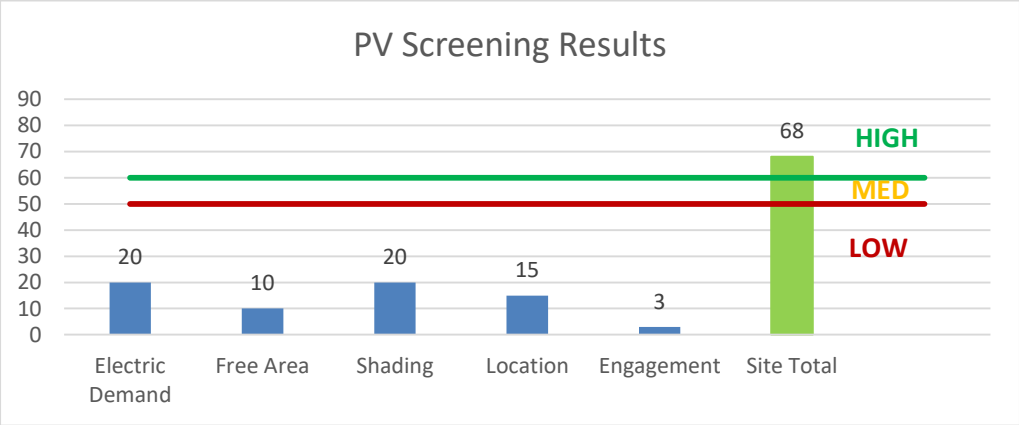
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the building may be feasible. If Bradford Elementary School is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 29 - Photovoltaic Screening



Potential	High	
System Potential	90	kW DC STC
Electric Generation	107,224	kWh/yr
Displaced Cost	$9,330	/yr
Installed Cost	$257,400	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

A low or infrequent thermal load is the most significant factor contributing to the potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion this building is not is a good candidate for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 30 for a list of the eligible programs identified for each recommended ECM.

Figure 30 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X		X	
ECM 2	Retrofit Fixtures with LED Lamps	X		X	
ECM 3	Install LED Exit Signs			X	
ECM 4	Install Occupancy Sensor Lighting Controls	X		X	
ECM 5	Premium Efficiency Motors			X	
ECM 6	Install VFDs on Hot Water Pumps			X	
ECM 7	Vending Machine Control			X	

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. This facility does not meet all of the criteria for participating in the P4P program based on the measures identified in this study. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to medium-sized facilities with a peak electric demand that does not exceed 200 kW for any recent 12-month period. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to **70%** of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor who the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Since Direct Install offers a free assessment of eligible measures, Direct Install is also available to small businesses and other commercial facilities too that may not be eligible for the more detailed facility audits provided by LGEA.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and com are prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Main Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,505	0.16	619	0.0	$101.45	$621.00	$95.00	5.18
Boiler Rm Area	23	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,075	Relamp	No	23	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,075	0.26	498	0.0	$81.60	$825.70	$115.00	8.71
Boiler Rm Area	3	Incandescent: Standard 60W Bulbs	Wall Switch	60	1,075	Relamp	No	3	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	1,075	0.10	189	0.0	$31.02	$161.26	$15.00	4.72
Teacher Work Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,800	Relamp	Yes	3	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,260	0.04	136	0.0	$22.25	$223.70	$15.00	9.38
1st Flr Corridor	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.13	490	0.0	$80.29	$351.00	$60.00	3.62
1st Flr Corridor	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.05	173	0.0	$28.38	$143.60	$20.00	4.35
Stairwell	3	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	3	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.03	130	0.0	$21.29	$107.70	$15.00	4.35
Stairwell	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.02	82	0.0	$13.38	$58.50	$10.00	3.62
Classroom 1	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.27	863	0.0	$141.56	$855.00	$135.00	5.09
Teachers' Lounge	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$387.00	$55.00	11.73
Teachers' Lounge	1	Incandescent: Standard 60W Bulbs	Wall Switch	60	1,800	Relamp	Yes	1	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	1,260	0.04	111	0.0	$18.23	$53.75	$40.00	0.75
Teachers' Lounge	1	Linear Fluorescent - T9: 32W Circline Lamps	Wall Switch	32	1,800	Relamp	Yes	1	LED - Linear Tubes: 17W LED replacement for T9 Circline	Occupancy Sensor	17	1,260	0.01	42	0.0	$6.82	$82.16	$35.00	6.91
Music Rm	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,800	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,260	0.86	2,719	0.0	$445.92	$2,389.20	$420.00	4.42
Music Rm Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,600	0.02	61	0.0	$9.96	$58.50	$10.00	4.87
Child Study	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,800	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,260	0.16	518	0.0	$84.94	$416.80	$80.00	3.97
2nd Flr Fan Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	500	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	500	0.01	10	0.0	$1.65	$35.90	$5.00	18.72
2nd Flr Electrical Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	500	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.02	19	0.0	$3.11	$58.50	$10.00	15.59
Tech Lab Rm 22	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.67	2,127	0.0	$348.85	$1,871.87	$350.00	4.36
2nd Flr Back Corridor	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,150	Relamp	No	11	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,150	0.36	1,346	0.0	$220.79	$827.20	$165.00	3.00
Stair 6, 2nd Flr	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	8,760	Relamp	No	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	8,760	0.10	1,496	0.0	$245.34	$225.60	$45.00	0.74
Art Rm 23	18	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	18	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.87	2,735	0.0	$448.52	$2,252.40	$430.00	4.06
Rm 23 Supply Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,800	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,260	0.16	518	0.0	$84.94	$416.80	$80.00	3.97
Office	3	Incandescent: Standard 60W Bulbs	Wall Switch	60	1,800	Relamp	Yes	3	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	1,260	0.11	333	0.0	$54.69	$277.26	$35.00	4.43
Rm 21	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.58	1,823	0.0	$299.01	$1,411.60	$275.00	3.80
SGI-A	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.29	912	0.0	$149.51	$686.80	$140.00	3.66

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
SGI-B	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.29	912	0.0	$149.51	$686.80	$140.00	3.66
Boys' Rm	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.19	604	0.0	$99.09	$679.50	$105.00	5.80
Girls' Rm	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.19	604	0.0	$99.09	$679.50	$105.00	5.80
Rm 17	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
Rm 18	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
2nd Flr Corridor	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,150	Relamp	No	5	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,150	0.18	692	0.0	$113.54	$475.67	$100.00	3.31
2nd Flr Corridor	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	7	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.08	303	0.0	$49.67	$251.30	$35.00	4.35
2nd Flr Corridor	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,150	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,150	0.06	245	0.0	$40.14	$150.40	$30.00	3.00
2nd Flr Front Corridor	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	8,760	0.11	1,662	0.0	$272.60	$292.50	$50.00	0.89
Stairwell Exit 8	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	8,760	0.04	665	0.0	$109.04	$117.00	$20.00	0.89
Stairwell 2nd Flr	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	8,760	0.01	176	0.0	$28.91	$35.90	$5.00	1.07
Stairwell 2nd Flr	1	Linear Fluorescent - T9: 32W Circline Lamps	Wall Switch	32	8,760	Relamp	No	1	LED - Linear Tubes: 17W LED replacement for T9 Circline	Wall Switch	17	8,760	0.01	151	0.0	$24.78	$82.16	$0.00	3.32
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$233.00	$20.00	7.52
Rm 16	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.48	1,519	0.0	$249.18	$1,221.33	$235.00	3.96
Rm 15	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.49	1,554	0.0	$254.81	$1,593.00	$250.00	5.27
Rm 14	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
Rm 13	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.49	1,554	0.0	$254.81	$1,593.00	$250.00	5.27
Rm 13	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,800	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,800	0.01	36	0.0	$5.94	$35.90	$5.00	5.20
Rm 12	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
Rm 14A	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.10	304	0.0	$49.84	$306.27	$60.00	4.94
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$233.00	$20.00	7.52
Stairwell 2nd Flr	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	8,760	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	8,760	0.02	353	0.0	$57.82	$71.80	$10.00	1.07
Attic	2	Incandescent: Standard 60W Bulbs	Wall Switch	60	600	Relamp	No	2	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	600	0.07	70	0.0	$11.54	$107.51	$10.00	8.45
Rm 20	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
Sm. Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,075	Relamp	Yes	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	753	0.01	27	0.0	$4.43	$151.90	$5.00	33.16

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 19A	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$387.00	$55.00	11.73
Back Stairwell	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	8,760	0.02	332	0.0	$54.52	$58.50	$10.00	0.89
Rm 19	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.66	2,072	0.0	$339.75	$2,214.00	$345.00	5.50
Sm. Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,075	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,075	0.01	22	0.0	$3.55	$35.90	$5.00	8.71
Back Entrance, 1st Flr	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.01	43	0.0	$7.10	$35.90	$5.00	4.35
Rm 2	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.44	1,381	0.0	$226.50	$1,476.00	$230.00	5.50
Sm. Restroom & Closet	2	Incandescent: Standard 60W Bulbs	Wall Switch	60	600	Relamp	No	2	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	600	0.07	70	0.0	$11.54	$107.51	$10.00	8.45
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,600	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,120	0.05	153	0.0	$25.17	$233.00	$20.00	8.46
Custodian Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	500	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	500	0.01	8	0.0	$1.27	$31.90	$5.00	21.13
2nd Main Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$233.00	$20.00	7.52
Sm. Restroom	2	Incandescent: Standard 60W Bulbs	Wall Switch	60	1,075	Relamp	Yes	2	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	753	0.07	133	0.0	$21.77	$223.51	$10.00	9.81
Rm 3	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.49	1,554	0.0	$254.81	$1,593.00	$250.00	5.27
Rm 4	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.49	1,554	0.0	$254.81	$1,593.00	$250.00	5.27
Rm 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,800	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,800	0.02	72	0.0	$11.88	$71.80	$10.00	5.20
Rm 5	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.49	1,554	0.0	$254.81	$1,593.00	$250.00	5.27
Rm 6	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.66	2,072	0.0	$339.75	$2,214.00	$345.00	5.50
Rm 7	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.57	1,813	0.0	$297.28	$2,038.50	$315.00	5.80
Kitchen	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,075	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,075	0.22	415	0.0	$68.12	$570.80	$120.00	6.62
Nurse's Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$233.00	$20.00	7.52
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.05	173	0.0	$28.31	$233.00	$20.00	7.52
Exit 6 Stairwell, 1st Flr	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.02	82	0.0	$13.38	$58.50	$10.00	3.62
1st Flr Corridor (front to back)	6	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	6	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.07	260	0.0	$42.58	$215.40	$30.00	4.35
1st Flr Corridor (front to back)	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.04	163	0.0	$26.76	$117.00	$20.00	3.62
Gym 1	9	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,150	Fixture Replacement	Yes	9	LED - Fixtures: High-Bay	Occupancy Sensor	75	1,505	1.43	5,396	0.0	$884.97	$24,436.80	$1,385.00	26.05
Gym 2	9	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,150	Fixture Replacement	Yes	9	LED - Fixtures: High-Bay	Occupancy Sensor	75	1,505	1.43	5,396	0.0	$884.97	$24,436.80	$1,385.00	26.05

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Stage	6	Compact Fluorescent: 17W CFL Bulbs	Wall Switch	17	500	Relamp	No	6	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	500	0.03	28	0.0	$4.53	$93.00	$0.00	20.55
Stage	1	Incandescent: Standard 60W Bulbs	Wall Switch	60	500	Relamp	No	1	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	500	0.03	29	0.0	$4.81	$53.75	$5.00	10.14
Stage	60	Incandescent: 200W Bulbs	Wall Switch	200	500	Relamp	No	60	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	30	500	6.69	5,865	0.0	$961.85	$2,236.80	$0.00	2.33
Back Corridor	6	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	No	6	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,150	0.07	260	0.0	$42.58	$215.40	$30.00	4.35
1st Flr Back Hall (New Sec.)	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,150	Relamp	No	14	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,150	0.45	1,713	0.0	$281.00	$1,052.80	$210.00	3.00
1st Flr Back Hall (New Sec.)	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.02	82	0.0	$13.38	$58.50	$10.00	3.62
Boys' Rm	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,600	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,120	0.19	537	0.0	$88.08	$679.50	$105.00	6.52
Water Heater Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	500	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	500	0.03	28	0.0	$4.67	$75.20	$15.00	12.90
Guidance Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.19	608	0.0	$99.67	$496.53	$100.00	3.98
Girls' Rm	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,600	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,120	0.19	537	0.0	$88.08	$679.50	$105.00	6.52
Rm 8	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.33	1,036	0.0	$169.87	$972.00	$155.00	4.81
Rm 9	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,800	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,260	0.33	1,036	0.0	$169.87	$972.00	$155.00	4.81
Sm. Restroom	10	Incandescent: Standard 60W Bulbs	Wall Switch	60	1,600	Relamp	Yes	10	LED Screw-In Lamps: 9W LED Bulbs	Occupancy Sensor	9	1,120	0.35	988	0.0	$162.04	$807.53	$85.00	4.46
Sm. Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,600	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,120	0.04	115	0.0	$18.87	$191.20	$15.00	9.34
Rm 10	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.58	1,823	0.0	$299.01	$1,411.60	$275.00	3.80
Rm 11	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,800	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,260	0.58	1,823	0.0	$299.01	$1,411.60	$275.00	3.80
Faculty Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,075	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	753	0.03	52	0.0	$8.45	$174.50	$10.00	19.46
Library	32	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,150	Relamp	Yes	32	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,505	0.46	1,729	0.0	$283.52	$2,228.80	$300.00	6.80
Library	22	Incandescent: 75W Spotlight Bulbs	Wall Switch	75	2,150	Relamp	Yes	22	LED Screw-In Lamps: 12W LED Spotlight Bulbs	Occupancy Sensor	12	1,505	0.96	3,623	0.0	$594.12	$1,884.77	$215.00	2.81
Library	18	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,150	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,505	0.47	1,767	0.0	$289.76	$1,593.00	$250.00	4.63
Library Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,600	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,120	0.10	270	0.0	$44.30	$306.27	$60.00	5.56
Stairwell 6	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	8,760	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	8,760	0.06	997	0.0	$163.56	$150.40	$30.00	0.74
Stairwell 5	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	8,760	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	8,760	0.04	665	0.0	$109.04	$117.00	$20.00	0.89
Elevator	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.02	82	0.0	$13.38	$58.50	$10.00	3.62
Elevator Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	500	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.02	19	0.0	$3.11	$58.50	$10.00	15.59

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
2nd Basement	2	Incandescent: Standard 60W Bulbs	Wall Switch	60	600	Relamp	No	2	LED Screw-In Lamps: 9W LED Bulbs	Wall Switch	9	600	0.07	70	0.0	$11.54	$107.51	$10.00	8.45
Whole School	24	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	24	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Whole School	13	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	13	LED Exit Signs: 2 W Lamp	None	2	8,760	0.20	3,012	0.0	$493.98	$1,398.22	$0.00	2.83
Exterior Front	4	Incandescent: Standard 60W Bulbs	None	60	4,380	Relamp	No	4	LED Screw-In Lamps: 9W LED Bulbs	None	9	4,380	0.13	1,028	0.0	$168.52	$215.01	$20.00	1.16
Exterior Front	1	Compact Fluorescent: 17W CFL Bulbs	None	17	4,380	Relamp	No	1	LED Screw-In Lamps: 9W LED Bulbs	None	12	4,380	0.00	25	0.0	$4.13	$23.31	$0.00	5.64
Exterior Front	4	Metal Halide: (1) 100W Lamp	None	128	4,380	Fixture Replacement	No	4	LED - Fixtures: Wall-Wash Lights	None	20	4,380	0.28	2,176	0.0	$356.86	$952.76	$120.00	2.33
Exterior Side	1	Metal Halide: (1) 100W Lamp	None	128	4,380	Fixture Replacement	No	1	LED - Fixtures: Wall-Wash Lights	None	20	4,380	0.07	544	0.0	$89.21	$238.19	$30.00	2.33
Exterior Back	9	Metal Halide: (1) 100W Lamp	None	128	4,380	Fixture Replacement	No	9	LED - Fixtures: Wall-Wash Lights	None	20	4,380	0.64	4,896	0.0	$802.93	$2,143.71	$270.00	2.33
Exterior Side	9	Metal Halide: (1) 100W Lamp	None	128	4,380	Fixture Replacement	No	9	LED - Fixtures: Wall-Wash Lights	None	20	4,380	0.64	4,896	0.0	$802.93	$2,143.71	$270.00	2.33
Parking Lot	3	Metal Halide: (1) 250W Lamp	None	295	4,380	Fixture Replacement	No	3	LED - Fixtures: Parking Garage Fixture	None	86	4,380	0.41	3,158	0.0	$517.94	$1,606.59	$300.00	2.52

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Heating System / Newer Section	2	Heating Hot Water Pump	3.0	86.5%	No	1,373	Yes	89.5%	Yes	2	0.84	3,147	0.0	$516.03	$7,768.02	$0.00	15.05
Boiler Room	Steam System	2	Condenser Water Pump	0.3	77.0%	No	2,745	No	77.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Pneumatic Controls	2	Air Compressor	2.0	84.0%	No	4,957	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Gym	1	Exhaust Fan	1.0	82.5%	No	2,745	No	82.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Various Locations	5	Exhaust Fan	0.1	74.0%	No	2,745	No	74.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Various Locations	1	Exhaust Fan	2.5	82.0%	No	2,745	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Various Locations	3	Exhaust Fan	0.3	77.0%	No	2,745	No	77.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Various Locations	2	Supply Fan	7.5	89.5%	No	2,745	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Various Locations	1	Supply Fan	3.0	86.5%	No	2,745	No	86.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Bradford ES	Copy Rm & Wire Rm	2	Ductless Mini-Split AC	0.75		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 1	1	Window AC	0.83		Yes	1	Ductless Mini-Split AC	0.75		18.00		No	0.35	520	0.0	$85.35	$2,054.62	$0.00	24.07
Bradford ES	Rm 1	1	Window AC	0.83		Yes	1	Ductless Mini-Split AC	0.75		18.00		No	0.29	426	0.0	$69.85	$2,054.62	$0.00	29.41
Bradford ES	Rm 2	2	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 3	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 4	1	Window AC	1.00		Yes	1	Ductless Mini-Split AC	1.00		18.00		No	0.37	558	0.0	$91.48	$2,739.49	$0.00	29.95
Bradford ES	Rm 5	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 6	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 7	1	Window AC	0.83		Yes	1	Ductless Mini-Split AC	0.75		18.00		No	0.35	520	0.0	$85.35	$2,054.62	$0.00	24.07
Bradford ES	Rm 5A	1	Packaged Terminal AC	1.22		Yes	1	Ductless Mini-Split AC	1.00		18.00		No	0.51	765	0.0	$125.41	$2,739.49	$0.00	21.84
Bradford ES	Rm 17	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm18	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 19	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Rm 20	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Main Office	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Nurse's Office	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Principal's Office	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Teacher's Lounge	1	Window AC	1.25		Yes	1	Ductless Mini-Split AC	1.25		18.00		No	0.48	713	0.0	$116.94	$3,424.37	$0.00	29.28
Bradford ES	Roof - RTU#1	1	Packaged AC	40.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Bradford ES	Roof - RTU#2	1	Packaged AC	13.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Bradford ES	Roof - RTU#3	1	Split-System AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Bradford ES	Whole School	2	Natural Draft Steam Boiler	2,274.45	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
1st Flr Water Heater Closet	1st Floor	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2nd Floor	2nd Floor	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Break Room	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Electric Convection Oven (Half Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Bradford ES	80	Desktop Computer + Monitor	150.0	Yes
Bradford ES	6	TVs (med. CRT)	150.0	No
Bradford ES	7	Printers (sm.)	80.0	Yes
Bradford ES	3	Copy Machine (Lg.)	240.0	Yes
Bradford ES	1	Server Rack	360.0	No
Bradford ES	3	Microwave Ovens (med.)	1,000.0	No
Bradford ES	22	Smart Boards	316.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teachers' Lounge	1	Refrigerated	Yes	0.00	1,612	0.0	$264.34	$230.00	$0.00	0.87

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Bradford Elementary School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 58,129
Built: 1927

For Year Ending: April 30, 2016
Date Generated: December 25, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Bradford Elementary School 87 Mt. Hebron Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724465

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
56.8 kBtu/ft²

Source EUI
100.7 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	1,141,148 (34%)
Natural Gas (kBtu)	2,163,240 (66%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	65.6
National Median Source EUI (kBtu/ft²)	116.2
% Diff from National Median Source EUI	-13%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	242

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp
(if applicable)

Local Government Energy Audit:
Energy Audit Report



Central Heating Plant

22 Valley Road

Montclair, New Jersey 07042

Montclair Board of Education

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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Appendix A: Equipment Inventory & Recommendations

Appendix B: ENERGY STAR® Statement of Energy Performance

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Central Heating Plant.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local governments in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

The Central Heating Plant is a 2,078 square foot facility constructed in 1931. The building is a one story central plant type facility including a large mechanical space.

Lighting at the facility consists mainly of 32-Watt T8 linear fluorescent fixtures which is inefficient in performance when compared to the latest lighting technology available in the market. Exterior lighting is provided by 100-Watt incandescent fixtures. Interior lighting control is provided by manual switches.

The Central Heating Plant consists of forced draft steam boilers that provide heating the buildings on the campus.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated one measure which represent an opportunity for the Central Heating Plant to reduce annual energy costs by roughly $333 and annual greenhouse gas emissions by 2,200 lbs CO_2e. We estimate that if all measures were implemented as recommended, the project would pay for itself in 2.4 years. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce the Central Heating Plant's annual energy use by 29%.

Figure 1 – Previous 12 Month Utility Costs

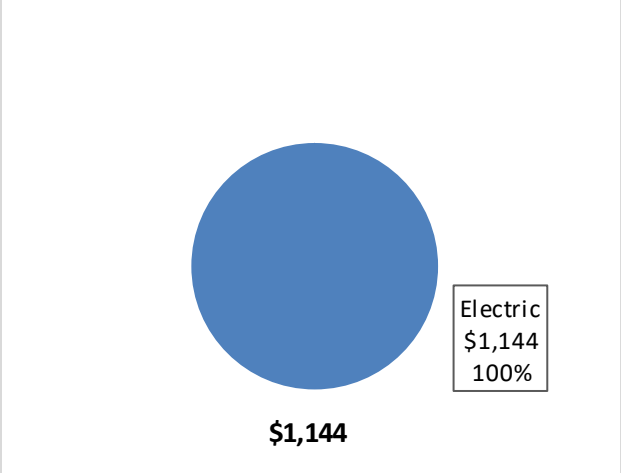
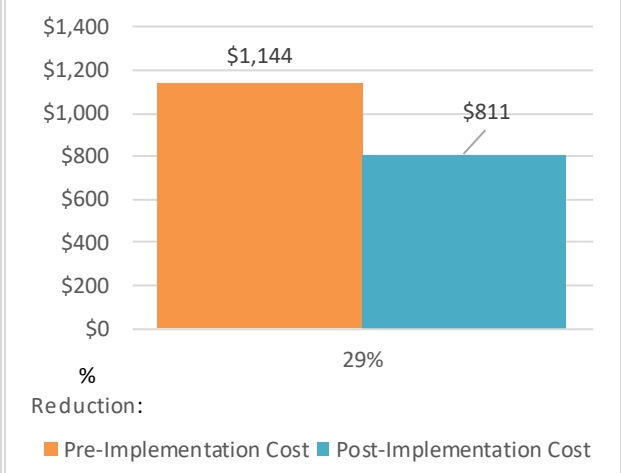


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Central Heating Plant's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**2,184**	**0.3**	**0.0**	**$333.01**	**$979.95**	**$165.00**	**$814.95**	**2.4**	**2,200**
ECM 1	Retrofit Fixtures with LED Lamps	Yes	2,184	0.3	0.0	$333.01	$979.95	$165.00	$814.95	2.4	2,200
TOTALS			**2,184**	**0.3**	**0.0**	**$333.01**	**$979.95**	**$165.00**	**$814.95**	**2.4**	**2,200**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Energy Efficient Practices

TRC also identified five low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Central Heating Plant include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Proper Boiler Maintenance
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for the Central Heating Plant. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.2 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Thomas Page	Auditor	MTraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 09, 2016, TRC performed an energy audit of Montclair Board of Education's Central Heating Plant located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Central Heating Plant is a 2,078 square foot facility constructed in 1931. The building is a one-story central plant type facility including a large mechanical space.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Central Heating Plant	Weekday	12:00 AM - 12:00 PM
Central Heating Plant	Weekend	12:00 AM - 12:00 PM

2.4 Building Envelope

The Central Heating Plant is a one-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with fixed frames. The flat roof is constructed of built-up roofing material.

Figure 6 – Building Façade



2.5 On-Site Generation

The Central Heating Plant does not have any on-site electric generation capacity.

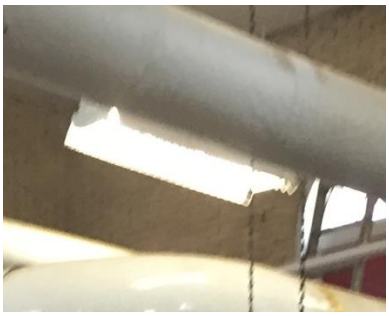
2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the Central Heating Plant consists mainly of 32-Watt T8 linear fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. The linear fluorescent fixtures are 4-foot long, mainly troffers with diffusers having 2-lamp configurations. Interior lighting control in the building is provided by manual switches.

Figure 7 - Building Lighting Systems

Linear Fluorescent Fixture	*Exterior Fixture*
	

Exterior lighting is provided by a 100-Watt incandescent fixture.

Heating System

The Central Heating Plant has two natural gas fired Weil McLain steam boilers with an input rating of 7,938 MBh each and a nominal efficiency of 80%. These boilers provide space heating for Hillside School, the Montclair Community Pre-K, and the district Administration Building. According to the audit, the boilers were in good shape and performing well.

Figure 8 - Building Heating Systems



3 SITE ENERGY USE AND COSTS

Utility data for electricity was analyzed to identify opportunities for savings. In addition, data for Electricity was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

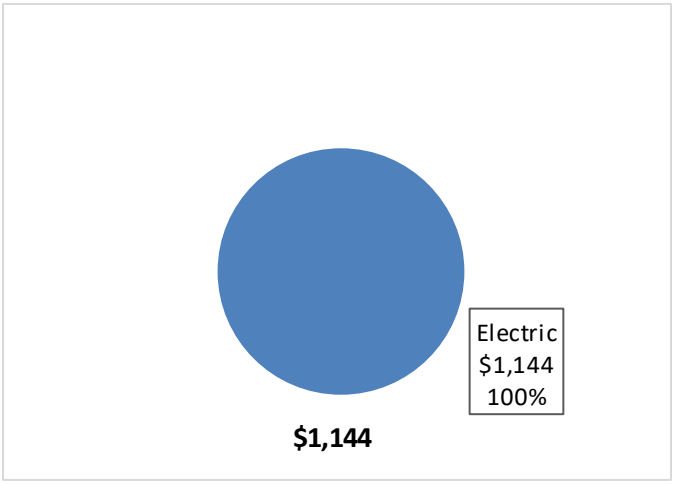
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 9 - Utility Summary

Utility Summary for Central Heating Plant		
Fuel	**Usage**	**Cost**
Electricity	7,506 kWh	$1,144
Total		**$1,144**

The current annual energy cost for this facility is $1,144 as shown in the chart below.

Figure 10 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.152/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Electric usage estimation and calibration methodology:

1. The Montclair BOE buildings Hillside, Administration, Montclair Community Pre-K, and Central Heating Plant are served by three electric meters 65 795 083 02, 67 125 896 06, and 42 007 763 08. There is not a clear delineation of loads served by the meters. Based on this, demand (kW) data was not prorated.
2. Total energy use from all the meters combined is around 638,475 kWh for a 12-month period.
3. Monthly "calculated" energy use from the LGEA analysis tools were used to calculate the percentage contribution of each building. The percentages are:
    a. Hillside School – 70%
    b. Administration Building – 11%
    c. Montclair Community Pre-K – 18%
    d. CHP – 1%
4. The above percentages were applied to the "actual" total monthly energy use from bills to estimate monthly utility energy use to which all the tools were then calibrated.

Figure 11 - Electric Usage & Demand

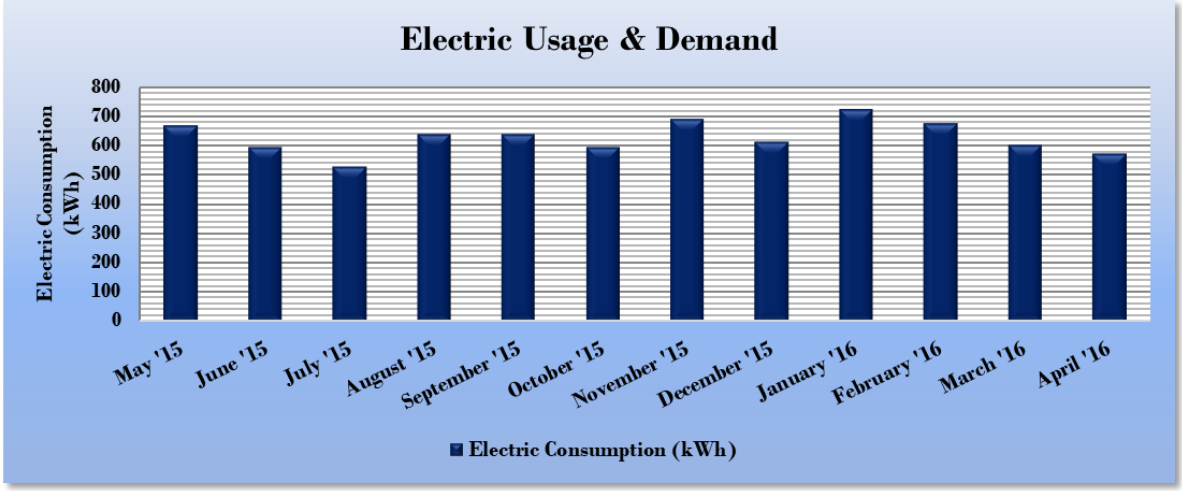


Figure 12 - Electric Usage & Demand

Electric Billing Data for Central Heating Plant				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
6/15/15	33	667	$130	Yes
7/14/15	29	594	$114	Yes
8/12/15	29	526	$100	Yes
9/11/15	30	639	$117	Yes
10/12/15	31	638	$94	Yes
11/10/15	29	592	$83	Yes
12/11/15	31	691	$95	Yes
1/13/16	33	612	$80	Yes
2/11/16	29	721	$93	Yes
3/14/16	32	674	$87	Yes
4/13/16	30	601	$81	Yes
5/13/16	30	571	$74	Yes
Totals	**366**	**7,526**	**$1,147**	12
Annual	**365**	**7,506**	**$1,144**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.802/therm, which is the blended rate used throughout the analyses in this report.

Natural gas use was allocated to the sites served by the Central Heating Plant using the following method:

1. The Administration Building, Hillside School, Montclair Community Pre-K, and Central Heating Plant are served by two gas meters: 65 795 083 02 and 67 125 896 06. There is not a clear delineation of which buildings and equipment are served by each meter.
2. Total annual gas use for both of the meters combined is 59,235 therms.
3. The calculated gas use from the LGEA analysis for each building was used to determine the percentage of the total historical gas use to be assigned to each building. Total gas use was allocated to the three buildings served by the Central Heating Plant as follows:
    a. Hillside School - 75%
    b. Administration Building - 9%
    c. Montclair Community Pre-K - 16%
4. The above percentages were applied to the total monthly gas use from the utility bills to estimate the monthly gas use for the individual buildings. This estimated monthly gas use is what is provided in each of the reports.

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Central Heating Plant	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	38.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	12.3	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Central Heating Plant	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	27.4	141.4
Site Energy Use Intensity (kBtu/ft^2)	8.7	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. The Central Heating Plant and the three buildings served by it have a combined score of 74.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

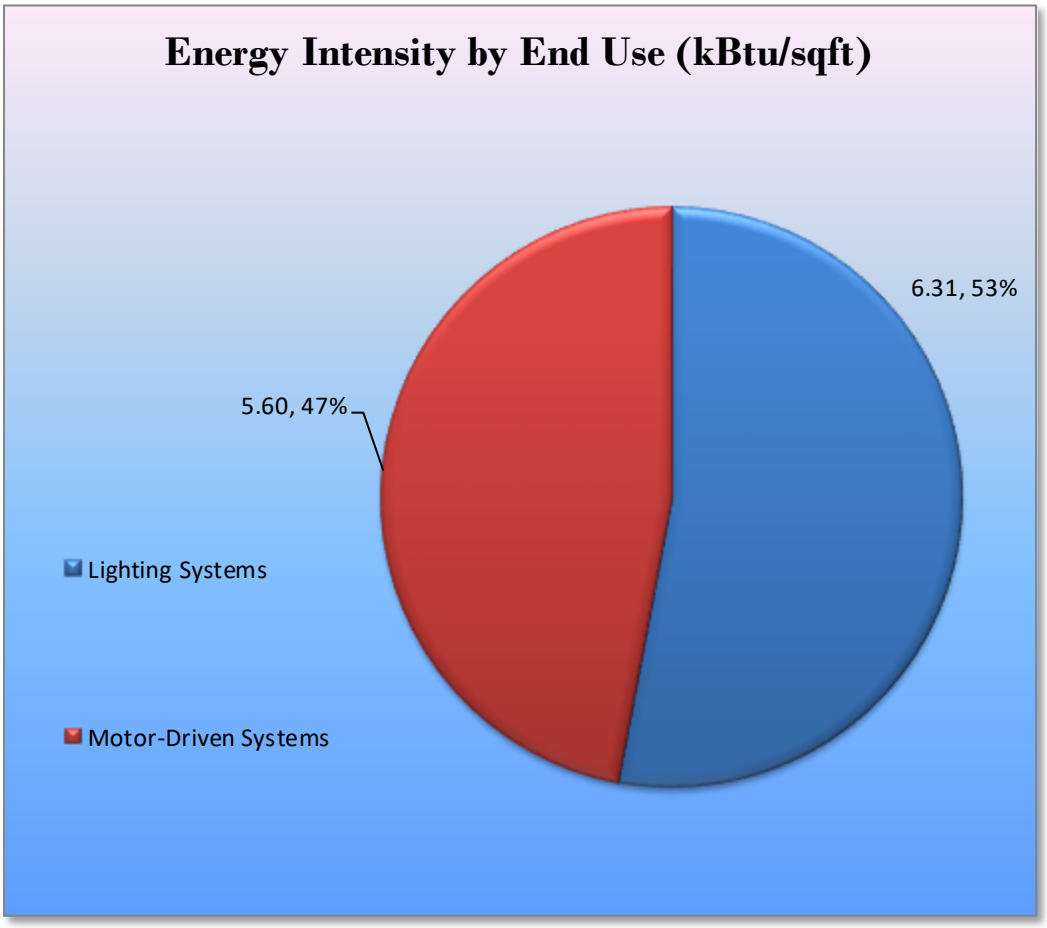
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 15 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Central Heating Plant regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**2,184**	**0.3**	**0.0**	**$333.01**	**$979.95**	**$165.00**	**$814.95**	**2.4**	**2,200**
ECM 1	Retrofit Fixtures with LED Lamps	2,184	0.3	0.0	$333.01	$979.95	$165.00	$814.95	2.4	2,200
TOTALS		**2,184**	**0.3**	**0.0**	**$333.01**	**$979.95**	**$165.00**	**$814.95**	**2.4**	**2,200**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**2,184**	**0.3**	**0.0**	**$333.01**	**$979.95**	**$165.00**	**$814.95**	**2.4**	**2,200**
ECM 1	Retrofit Fixtures with LED Lamps	2,184	0.3	0.0	$333.01	$979.95	$165.00	$814.95	2.4	2,200

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,812	0.3	0.0	$276.26	$936.00	$160.00	$776.00	2.8	1,825
Exterior	372	0.0	0.0	$56.76	$43.95	$5.00	$38.95	0.7	375

Measure Description

We recommend retrofitting existing linear fluorescent and incandescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a no potential for installing a PV array.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a No potential for installing a cost-effective CHP system.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 18 for a list of the eligible programs identified for each recommended ECM.

Figure 18 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Retrofit Fixtures with LED Lamps	X					

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install (DI) caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	3,432	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,432	0.30	1,812	0.0	$276.26	$936.00	$160.00	2.81
Central Plant	1	Incandescent: INC-100W	Wall Switch	100	4,380	Relamp	No	1	LED Screw-In Lamps: LED-15W	Wall Switch	15	4,380	0.06	428	0.0	$65.27	$43.95	$5.00	0.60

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Central Plant	4	Boiler Feed Water Pump	0.5	90.0%	Yes	2,745	No	90.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Central Plant	2	Forced Draft Steam Boiler	6,390.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Montclair Valley Road Campus (4 Buildings)

Primary Property Type: K-12 School
Gross Floor Area (ft²): 172,102
Built: 1879

For Year Ending: April 30, 2016
Date Generated: June 20, 2018

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Montclair Valley Road Campus (4 Buildings) 22 Valley Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 6364554

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
47.1 kBtu/ft²

Source EUI
76 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	5,917,390 (73%)
Electric - Grid (kBtu)	2,187,666 (27%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	60.1
National Median Source EUI (kBtu/ft²)	97
% Diff from National Median Source EUI	-22%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	557

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Charles H. Bullock School

55 Washington Street

Montclair, New Jersey 07042

Montclair Board of Education

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Charles H. Bullock School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local government in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

Charles H. Bullock School is an 84,017 square foot facility constructed in 2010. The building is a two-story educational facility including but not limited to classrooms, library areas, offices, hallways and conference areas.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures and 28-Watt T5 linear fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several incandescent, and compact fluorescent lamps. Exterior lighting is provided by a combination of 250-Watt metal halide fixtures, 28-Watt and 14-Watt T5 linear fluorescent fixtures, and 26-Watt compact fluorescent lamps. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation are provided by a combination of package units and water source heat pumps. Heating is provided by a gas furnace and non-condensing hot water boilers.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

Natural gas billing data was not available when the analysis for this report was done. In addition, the electricity production from the sites solar panels was not available. Therefore, the calculated energy use was checked against typical values for schools located in the same geographical area.

TRC evaluated five projects which represent an opportunity for Charles H. Bullock School to reduce annual energy costs by approximately $20,436 and annual greenhouse gas emissions by 138,873 lbs CO_2e. The measures would pay for themselves in 8.67 years. Figures 1 and 2 present the cost of electricity purchased from PSE&G before and after the measures are implemented. These projects represent an opportunity to reduce Charles H. Bullock School's annual energy use by approximately 11%.

Figure 1 – Previous 12 Month Electricity Costs

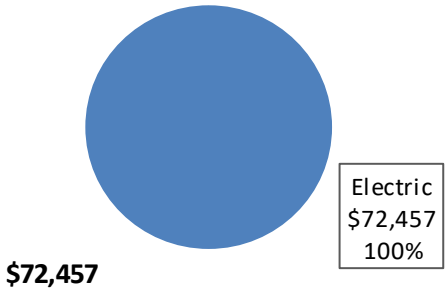
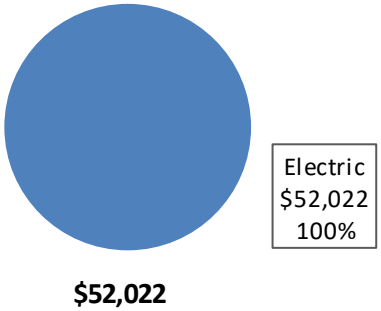


Figure 2 – Potential Post-Implementation Electricity Costs



A description of Charles H. Bullock School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**122,972**	**63.9**	**0.0**	**$18,222.21**	**$174,653.75**	**$19,125.00**	**$155,528.75**	**8.54**	**123,832**
ECM 1	Install LED Fixtures	Yes	44,072	37.8	0.0	$6,530.68	$87,588.98	$5,720.00	$81,868.98	12.54	44,380
ECM 2	Retrofit Fixtures with LED Lamps	Yes	78,900	26.0	0.0	$11,691.53	$87,064.77	$13,405.00	$73,659.77	6.30	79,451
Lighting Control Measures			**13,325**	**4.1**	**0.0**	**$1,974.54**	**$21,714.00**	**$1,435.00**	**$20,279.00**	**10.27**	**13,418**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	8,310	2.6	0.0	$1,231.36	$11,114.00	$1,435.00	$9,679.00	7.86	8,368
ECM 4	Install High/Low Lighitng Controls	Yes	5,015	1.5	0.0	$743.18	$10,600.00	$0.00	$10,600.00	14.26	5,050
Plug Load Equipment Control - Vending Machine			**1,612**	**0.0**	**0.0**	**$238.85**	**$1,437.60**	**$0.00**	**$1,437.60**	**6.02**	**1,623**
ECM 5	Vending Machine Control	Yes	1,612	0.0	0.0	$238.85	$1,437.60	$0.00	$1,437.60	6.02	1,623
TOTALS			**137,909**	**68.0**	**0.0**	**$20,435.60**	**$197,805.35**	**$20,560.00**	**$177,245.35**	**8.67**	**138,873**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measure save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Plug Load Equipment control measures generally involve installing automation that limits the power use or operation of equipment plugged into an electrical receptacle based on occupancy.

Energy Efficient Practices

TRC also identified 11 low cost (or no) cost energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at Charles H. Bullock School include:

- Reduce Air Leakage
- Close Doors and Windows
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Check for and Seal Duct Leakage
- Perform Proper Boiler Maintenance
- Perform Proper Furnace Maintenance
- Perform Proper Water Heater Maintenance
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for Charles H. Bullock School. Based on the configuration of the site and its loads there is a low potential for installing additional PV or combined heat and power self-generation measures.

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.2 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	(973) 509-4050
Designated Representative			
Robertz Eles	Head Custodian		(973) 809-2921 Ext.4582
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	(732) 855-2879

2.2 General Site Information

On November 07, 2016, TRC performed an energy audit at Charles H. Bullock School located in Montclair, NewJersey. TRC's team met with Robertz Eles to review the facility operations and focus the investigation on specific energy-using systems.

Charles H. Bullock School is a 74,180 square foot facility constructed in 2010. The building is a two-story educational facility including but not limited to classrooms, library areas, offices, hallways and conference areas.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Charles H. Bullock School	Weekday	8:00 AM - 5:30 PM
Charles H. Bullock School	Weekend	unoccupied

2.4 Building Envelope

Charles. H. Bullock School is a two-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with fixed frames. The flat roof is constructed of built-up roofing material.

Figure 6 – Building Façade



2.5 On-site Generation

The school uses electricity produced from solar panels on-site in addition to utility purchased electricity. Since incomplete historical utility data was provided for the Charles H. Bullock school, calculated energy use was used as the baseline energy use for savings evaluations.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the School consists mainly of 32-Watt T8 fluorescent fixtures and 28-Watt T5 linear fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. The linear fluorescent fixtures are 2-foot and 4-foot long, mainly troffers with diffusers having 2, 3, or 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 13-Watt, 26-Watt, and 32-Watt compact fluorescent lamps, 75-Watt halogen incandescent lamps, and 575-Watt incandescent flood lamps used for stage lighting.

Interior lighting control in the building is provided by a combination of manual switches and occupancy sensors.

Figure 7 - Building Lighting Systems

Linear Fluorescent Fixture	*Exterior Fixture*
	

Exterior lighting is provided by a combination of 250-Watt metal halide fixtures, 26-Watt compact fluorescent lamps, and 14-Watt and 28-Watt T5 linear fluorescent fixtures.

Heating System

The hot water system consists of two Lochinvar 1,739 kBtu/hr output, non-condensing hot water boilers. The boilers have a nominal combustion efficiency of 84%. The hot water system has two 5 hp hot water circulation pumps that circulate hot water from boilers through the water source heat pump units.

The boilers are in good condition and appear to be well maintained.

Figure 8 – Heating Systems

Hot Water Boilers	*Hot Water Pumps*
	

Air Conditioning (DX)

There are approximately 77 water-source heat pump units (WSHPs) supplying heating, cooling, and ventilation to the facility. As needed, heat is added to the water loop by a boiler or removed with a cooling geothermal source. The WSHPs are constant air volume units with cooling capacities between 0.83 tons to 23 tons. All of the WSHPs use direct-expansion (DX) coils.

Figure 9 – Air Conditioning (DX) Systems

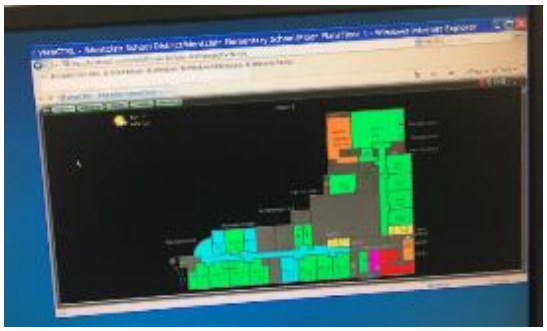


The facility also has a 5 ton Reznor direct-expansion (DX) package unit with a gas fired furnace. The unit provides constant air volume. The unit utilize a scroll compressor and a DX coil. The gas fired furnace provides heating as needed.

Building Energy Management System

The majority of the facility is controlled with an Automated Logic Corporation's WebCtrl building energy management system (BEMS). The BEMS aggregates the DDC points from throughout the building. The system is capable of providing advanced controls and trends for individual HVAC system.

Figure 10 – Building Energy Management System (BEMS)

Energy Management System (EMS)	*EMS Controller*
	

Domestic Hot Water

The domestic hot water system for the facility consists of one A.O. Smith gas fired domestic hot water heaters with an input rating of 399 kBtu/hr and a nominal efficiency of 84%. The water heater has a 200 gallon storage tank.

Figure 11 – DHW System



Food Service

The facility has several food service equipment including full sized gas convection oven, gas combination/steam cooker, insulated food holding cabinet, and a gas fryer. All equipment was shown to be in good condition and well maintained.

Figure 12 – Steam Cooker and Gas burners



Refrigeration

The facility has five stand up refrigerators with solid door, one low-temperature freezer, one medium temperature freezer, and one ice making head producing around 450 pounds of ice per day.

Figure 13 – Refrigeration Systems

Stand-up Refrigerator	*Ice Maker*
	

Plug load & Vending Machines

The facility contains several systems which contribute to plug load electric use including but not limited to desktop computers, printers, microwaves, and copiers. In addition to the typical plug load equipment, the facility also has one refrigerated and non-refrigerated vending machines.

3 SITE ENERGY USE AND COSTS

Historical utility data was only provided for purchased electricity. The school also uses electricity produced from solar panels on-site. PSE&G also delivers natural gas to the school. Since incomplete historical utility data was provided for the Charles H. Bullock School, the calculated energy use was used as the baseline energy use for savings evaluations. The calculated energy use was compared to the energy use of a typical school in this geographical area as a reasonableness check.

There are a number of factors that could cause the energy use of this building to vary from the "typical" energy use for other schools. Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open.

3.1 Total Cost of Energy

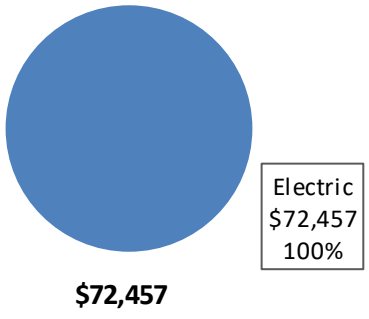
The following energy consumption and cost data is based on the last 12 month period of utility usage data that was provided for each utility.

Figure 14 - Utility Summary

Utility Summary for Charles H. Bullock School		
Fuel	**Usage**	**Cost**
Electricity	488,976 kWh	$72,457
Total		**$72,457**

The current electricity cost for this site is $72,457 as shown in the chart below.

Figure 15 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by the South Jersey Energy Company and transmission is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.148/kWh, which is the blended rate used throughout the analyses in this report. The Charles H. Bullock school also generates electricity with solar panels. The analysis assumes that the savings will come from the utility supplied electricity.

Only records of purchased electricity were provided by the school district. The graph below represents the monthly electricity purchases and does not include any electricity generated on-site.

Figure 16 - Purchased Electric Usage & Demand

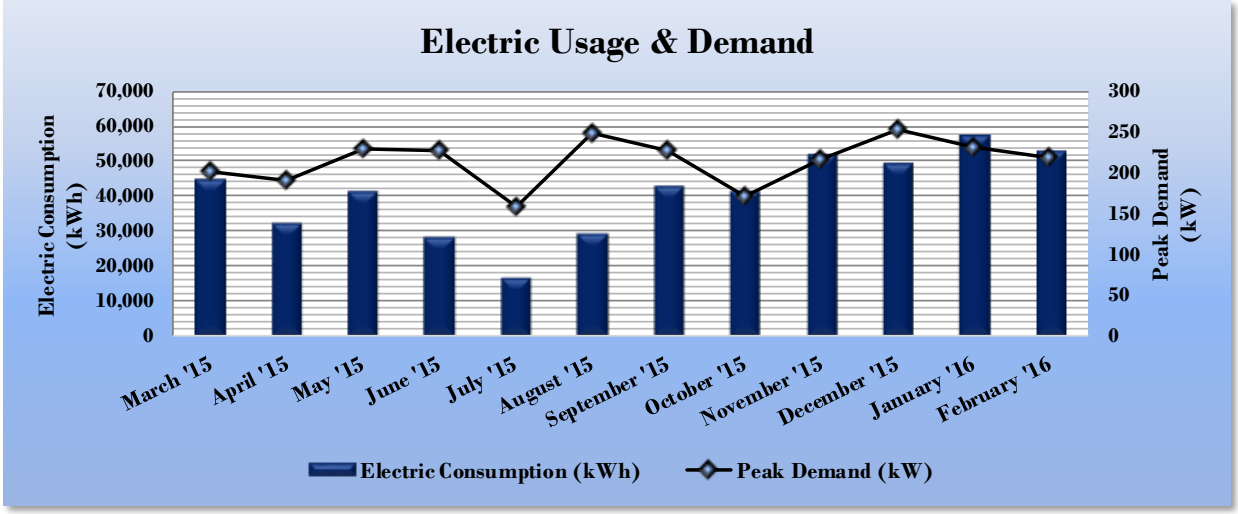


Figure 17 - Electric Usage & Demand

Electric Billing Data for Charles H. Bullock School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
4/15/15	30	44,810	201		$6,352
5/14/15	29	32,242	191		$4,757
6/15/15	32	41,531	230		$7,410
7/15/15	30	28,492	228		$5,777
8/13/15	29	17,008	159		$3,002
9/14/15	32	29,157	248		$5,784
10/13/15	29	42,903	228		$5,912
11/11/15	29	41,309	171		$5,716
12/14/15	33	51,946	215		$6,946
1/14/16	31	49,325	254		$6,710
2/12/16	29	57,470	231		$7,453
3/15/16	32	52,783	218		$6,639
Totals	**365**	**488,976**	**253.9**	**$0**	**$72,457**
Annual	**365**	**488,976**	**253.9**	**$0**	**$72,457**

3.3 Benchmarking

Since complete historical utility data was not provided this facility could not be benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the energy use intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 18 - Energy Use Intensity Comparison – Calculated Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Charles H. Bullock School	National Median Building Type: School (K-12)
Site Energy Use Intensity (kBtu/ft²)	50.8	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 19 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

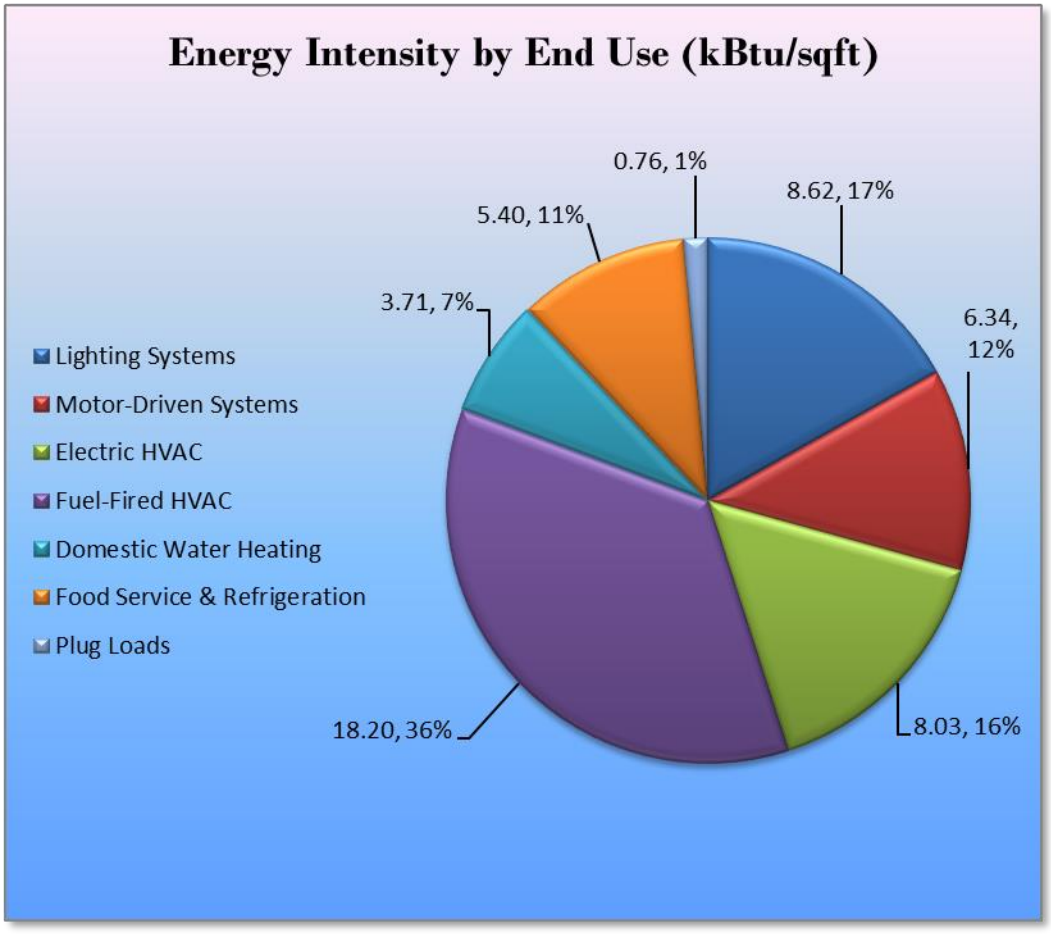
Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Charles H. Bullock School	National Median Building Type: School (K-12)
Site Energy Use Intensity (kBtu/ft²)	45.2	58.2

Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification.

3.4 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 20 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set Charles H. Bullock School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJ prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures. As shown, the facilities ECM recommendations primarily include lighting and vending machine controls. HVAC, food service and refrigeration equipment were evaluated however no ECM recommendations have been identified for two primary reasons.

1. The facility and associated equipment are less than eight years old.
2. The equipment's respective efficiency is acceptable leaving minimal opportunity for improvement and a cost-effective payback for early retirement.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 21 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**122,972**	**63.9**	**0.0**	**$18,222.21**	**$174,653.75**	**$19,125.00**	**$155,528.75**	**8.54**	**123,832**
ECM 1	Install LED Fixtures	44,072	37.8	0.0	$6,530.68	$87,588.98	$5,720.00	$81,868.98	12.54	44,380
ECM 2	Retrofit Fixtures with LED Lamps	78,900	26.0	0.0	$11,691.53	$87,064.77	$13,405.00	$73,659.77	6.30	79,451
Lighting Control Measures		**13,325**	**4.1**	**0.0**	**$1,974.54**	**$21,714.00**	**$1,435.00**	**$20,279.00**	**10.27**	**13,418**
ECM 3	Install Occupancy Sensor Lighting Controls	8,310	2.6	0.0	$1,231.36	$11,114.00	$1,435.00	$9,679.00	7.86	8,368
ECM 4	Install High/Low Lighitng Controls	5,015	1.5	0.0	$743.18	$10,600.00	$0.00	$10,600.00	14.26	5,050
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$238.85**	**$1,437.60**	**$0.00**	**$1,437.60**	**6.02**	**1,623**
ECM 5	Vending Machine Control	1,612	0.0	0.0	$238.85	$1,437.60	$0.00	$1,437.60	6.02	1,623
TOTALS		**137,909**	**68.0**	**0.0**	**$20,435.60**	**$197,805.35**	**$20,560.00**	**$177,245.35**	**8.67**	**138,873**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting upgrades are summarized in Figure 22 below.

Figure 22 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**122,972**	**63.9**	**0.0**	**$18,222.21**	**$174,653.75**	**$19,125.00**	**$155,528.75**	**8.54**	**123,832**
ECM 1	Install LED Fixtures	44,072	37.8	0.0	$6,530.68	$87,588.98	$5,720.00	$81,868.98	12.54	44,380
ECM 2	Retrofit Fixtures with LED Lamps	78,900	26.0	0.0	$11,691.53	$87,064.77	$13,405.00	$73,659.77	6.30	79,451

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	24,800	35.3	0.0	$3,674.92	$74,588.98	$3,720.00	$70,868.98	19.28	24,973
Exterior	19,272	2.5	0.0	$2,855.77	$13,000.00	$2,000.00	$11,000.00	3.85	19,407

Measure Description

This measure evaluates replacing existing fixtures containing incandescent and metal halide lamps with new high performance LED light fixtures. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output. Typical areas at this facility include the stage lighting, the parking lot lighting, and the roof top mounted exterior fixture.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	73,159	25.3	0.0	$10,840.90	$83,627.46	$13,165.00	$70,462.46	6.50	73,671
Exterior	5,740	0.7	0.0	$850.63	$3,437.32	$240.00	$3,197.32	3.76	5,781

Measure Description

This measure evaluates replacing T5 and T8 linear fluorescent lamps with LED tube lamps and replacing compact fluorescent and incandescent lamps screw-in/plug-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in/plug-in LED lamps can be used as a direct replacement for most other screw-in/plug-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 23 below.

Figure 23 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**13,325**	**4.1**	**0.0**	**$1,974.54**	**$21,714.00**	**$1,435.00**	**$20,279.00**	**10.27**	**13,418**
ECM 3	Install Occupancy Sensor Lighting Controls	8,310	2.6	0.0	$1,231.36	$11,114.00	$1,435.00	$9,679.00	7.86	8,368
ECM 4	Install High/Low Lighitng Controls	5,015	1.5	0.0	$743.18	$10,600.00	$0.00	$10,600.00	14.26	5,050

ECM 3: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
8,310	2.6	0.0	$1,231.36	$11,114.00	$1,435.00	$9,679.00	7.86	8,368

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in classrooms, restrooms and storage rooms. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 4: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
5,015	1.5	0.0	$743.18	$10,600.00	$0.00	$10,600.00	14.26	5,050

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors, parking lots and parking garages. At this facility, the measure has been recommended for corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period.

For this application the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.1.3 Plug Load Equipment Control - Vending Machine

Our recommendations for plug load equipment control measures are summarized in Figure 24 below.

Figure 24-Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$238.85**	**$1,437.60**	**$0.00**	**$1,437.60**	**6.02**	**1,623**
ECM 5	Vending Machine Control	1,612	0.0	0.0	$238.85	$1,437.60	$0.00	$1,437.60	6.02	1,623

ECM 5: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,612	0.0	0.0	$238.85	$1,437.60	$0.00	$1,437.60	6.02	1,623

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor based controls to reduce the energy use. These controls power down the machine when the surrounding area is vacant, then monitor the surrounding temperature and power up the cooling system at regular intervals to keep the product cool. Savings are a function of the activity level around the vending machine. We recommend the measure for the refrigerated vending machine located in the staff room.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Perform Routine Motor Maintenance

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

Check for and Seal Duct Leakage

Duct leakage in commercial buildings typically accounts for 5% to 25% of the supply airflow. In the case of rooftop air handlers, duct leakage can occur to the outside of the building, significantly increasing cooling and heating costs. By sealing sources of leakage, cooling, heating, and ventilationenergy use can be reduced significantly, depending on the severity of air leakage.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Furnace Maintenance

Preventative furnace maintenance can extend the life of the system, maintain energy efficiency, and ensure safe operation. Following the manufacturer's instructions, a yearly tune-up should include tasks such as checking for gas / carbon monoxide leaks; changing the air and fuel filters; checking components for cracks, corrosion, dirt, or debris build-up; ensuring the ignition system is working properly; testing and adjusting operation and safety controls; inspecting the electrical connections; and ensuring proper lubrication for motors and bearings.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

6.1 Photovoltaic

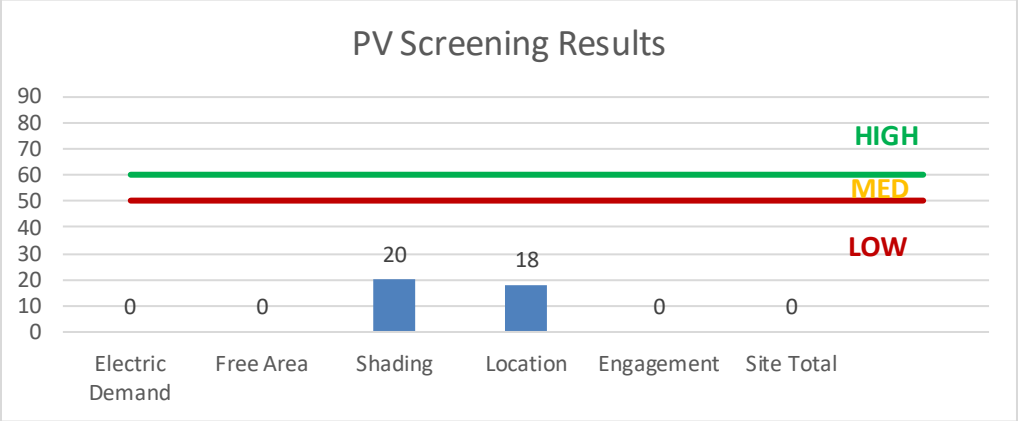
Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

The school already uses electricity produced from solar panels on-site.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a no potential for installing additional PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear not meet these minimum criteria for an additional cost-effective PV installation.

Figure 25 - Photovoltaic Screening



Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a no potential for installing a cost-effective CHP system.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 26 for a list of the eligible programs identified for each recommended ECM.

Figure 26 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	X					
ECM 2	Retrofit Fixtures with LED Lamps	X					
ECM 3	Install Occupancy Sensor Lighting Controls	X					
ECM 4	Install High/Low Lighitng Controls						
ECM 5	Vending Machine Control						

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program is comprised of new construction and retrofit components that offer incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives for various energy efficiency equipment based on national/market trends, new technologies or changes in efficiency baselines.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

All customer sizes and types may be served by this program. This program provides an effective mechanism for securing incentives for individual projects that may be completed at once or over several years.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: **www.state.nj.us/bpu/commercial/shopping.html**.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: **www.state.nj.us/bpu/commercial/shopping.html**.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.22	152	0.0	$22.49	$585.00	$100.00	21.56
1st Floor main hallway	41	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	Yes	41	LED Screw-In Lamps: Downlight Solid State Retrofit	High/Low Control	22	1,330	0.44	1,462	0.0	$216.65	$3,206.09	$0.00	14.80
1st Floor main hallway	96	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	1,900	Relamp	Yes	96	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,330	2.50	8,327	0.0	$1,233.98	$8,816.00	$960.00	6.37
1st Floor main hallway	11	Compact Fluorescent: recessed 2x 13W 4-pin	Wall Switch	26	1,900	Relamp	Yes	11	LED Screw-In Lamps: Downlight Solid State Retrofit	High/Low Control	18	1,330	0.10	319	0.0	$47.23	$884.56	$0.00	18.73
1st Floor main hallway	7	Halogen Incandescent: MR16 75 W	Wall Switch	75	1,900	Relamp	Yes	7	LED Screw-In Lamps: Downlight Solid State Retrofit	High/Low Control	10	1,330	0.31	1,040	0.0	$154.12	$575.55	$70.00	3.28
1st Floor main hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,900	Relamp	Yes	5	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,330	0.24	802	0.0	$118.83	$675.67	$100.00	4.84
Cafeteria	26	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,330	Relamp	No	26	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,330	0.95	2,227	0.0	$329.99	$2,473.47	$520.00	5.92
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.05	182	0.0	$27.00	$387.00	$55.00	12.29
Boys Bathroom	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	135	0.0	$20.07	$117.00	$20.00	4.83
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.05	182	0.0	$27.00	$233.00	$20.00	7.89
Girls Bathroom	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Room 105	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.12	410	0.0	$60.76	$341.60	$65.00	4.55
Room 112	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 112	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Room 110	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 110	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Gym Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,900	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,330	0.29	962	0.0	$142.59	$770.80	$120.00	4.56
Multipurpose Room	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.17	577	0.0	$85.48	$468.00	$80.00	4.54
Stage	28	Incandescent: 575W Flood Light	Wall Switch	575	400	Fixture Replacement	No	28	LED - Fixtures: Track or Mono-Point Directional Lighting Fixtures	Wall Switch	75	400	9.18	6,440	0.0	$954.29	$16,842.67	$840.00	16.77
Stage	96	Incandescent: 575W 2-pin Flood Light	Wall Switch	575	400	Fixture Replacement	No	96	LED - Fixtures: Track or Mono-Point Directional Lighting Fixtures	Wall Switch	75	400	31.46	22,080	0.0	$3,271.86	$57,746.30	$2,880.00	16.77
Gymnasium	30	Compact Fluorescent: 26W	Wall Switch	26	1,900	Relamp	No	30	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	18	1,900	0.15	511	0.0	$75.76	$1,612.59	$0.00	21.28
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	280	0.05	38	0.0	$5.68	$233.00	$20.00	37.47
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Room 108	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 108	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 106	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 106	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Room 102	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.16	547	0.0	$81.01	$467.00	$80.00	4.78
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Bathroom	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,900	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,900	0.02	70	0.0	$10.36	$96.40	$20.00	7.37
Room 104	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Room 100	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.19	638	0.0	$94.51	$525.50	$90.00	4.61
Conference Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.11	364	0.0	$54.01	$350.00	$60.00	5.37
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Work Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Principal	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Principal	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Copy Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.12	410	0.0	$60.76	$341.60	$65.00	4.55
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Reception Area	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.15	505	0.0	$74.79	$409.50	$70.00	4.54
Teacher & Data Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.11	364	0.0	$54.01	$350.00	$60.00	5.37
Room 114	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 114	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Room 116	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 116	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Boys Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.06	151	0.0	$22.44	$175.50	$30.00	6.48
Boys Bathroom	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	1,330	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.04	95	0.0	$14.05	$117.00	$20.00	6.90
Girls Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.06	151	0.0	$22.44	$175.50	$30.00	6.48
Girls Bathroom	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Occupancy Sensor	60	1,330	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.04	95	0.0	$14.05	$117.00	$20.00	6.90
Room 118	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 118	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Room 120	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.55	1,822	0.0	$270.03	$1,710.00	$270.00	5.33
Room 120	3	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.02	63	0.0	$9.32	$132.15	$0.00	14.17
Custodian Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.02	15	0.0	$2.25	$58.50	$10.00	21.56
Mechanical Room	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.22	152	0.0	$22.49	$585.00	$100.00	21.56
Staff Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Room 124	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.32	757	0.0	$112.19	$877.50	$150.00	6.48
Room 124	4	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.03	59	0.0	$8.70	$176.20	$0.00	20.25
Room 126	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.32	757	0.0	$112.19	$877.50	$150.00	6.48
Room 126	4	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.03	59	0.0	$8.70	$176.20	$0.00	20.25
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Room 131	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.26	606	0.0	$89.75	$702.00	$120.00	6.48
Room 131	2	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.01	29	0.0	$4.35	$88.10	$0.00	20.25
Room 133A	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.22	729	0.0	$108.01	$584.00	$100.00	4.48
Room 133A	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Room 133B	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.22	729	0.0	$108.01	$584.00	$100.00	4.48
Room 133B	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Room 135	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.33	1,093	0.0	$162.02	$972.00	$155.00	5.04
Room 135	2	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	42	0.0	$6.22	$88.10	$0.00	14.17
Room 128	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.32	757	0.0	$112.19	$877.50	$150.00	6.48
Room 128	4	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.03	59	0.0	$8.70	$176.20	$0.00	20.25
Room 130	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.32	757	0.0	$112.19	$877.50	$150.00	6.48
Room 130	4	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.03	59	0.0	$8.70	$176.20	$0.00	20.25
Front Entrance	11	Incandescent: 75W	Wall Switch	75	1,900	Relamp	No	11	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,900	0.46	1,538	0.0	$227.94	$591.28	$110.00	2.11
Front Entrance	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.24	793	0.0	$117.53	$643.50	$110.00	4.54

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Electrical Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.09	61	0.0	$9.00	$234.00	$40.00	21.56
2nd Floor Hallway	29	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	Yes	29	LED Screw-In Lamps: Downlight Solid State Retrofit	High/Low Control	22	1,330	0.31	1,034	0.0	$153.24	$2,077.48	$0.00	13.56
2nd Floor Hallway	117	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	1,900	Relamp	Yes	117	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,330	3.04	10,149	0.0	$1,503.92	$10,844.50	$1,170.00	6.43
2nd Floor Hallway	8	Compact Fluorescent: recessed 2x13W 4-pin	Wall Switch	26	1,900	Relamp	Yes	8	LED Screw-In Lamps: Downlight Solid State Retrofit	High/Low Control	18	1,330	0.07	232	0.0	$34.35	$552.41	$0.00	16.08
Library	17	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,900	Relamp	Yes	17	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,330	0.82	2,726	0.0	$404.01	$1,887.27	$375.00	3.74
Library	55	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	55	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	2.26	7,517	0.0	$1,113.88	$4,946.00	$930.00	3.61
Library	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Room 205C	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.16	547	0.0	$81.01	$416.80	$80.00	4.16
Room 205A	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.16	547	0.0	$81.01	$416.80	$80.00	4.16
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Mechanical Room	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	22	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.48	334	0.0	$49.49	$1,287.00	$220.00	21.56
Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	280	0.11	77	0.0	$11.37	$350.00	$40.00	27.27
Room 203	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.66	2,187	0.0	$324.04	$1,944.00	$310.00	5.04
Tech Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.12	410	0.0	$60.76	$341.60	$65.00	4.55
Room 210	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 210	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 208	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 208	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 206	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 206	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 204	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 204	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 207	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	144	0.0	$21.37	$117.00	$20.00	4.54
Room 202	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.60	2,005	0.0	$297.03	$1,827.00	$290.00	5.17
Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	280	0.11	77	0.0	$11.37	$350.00	$40.00	27.27

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 200	42	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	42	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	1.15	3,827	0.0	$567.06	$3,267.00	$525.00	4.84
Room 200	2	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.01	29	0.0	$4.35	$88.10	$0.00	20.25
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.04	30	0.0	$4.50	$117.00	$20.00	21.56
Room 212	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,330	Relamp	No	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.29	681	0.0	$100.97	$676.80	$135.00	5.37
Room 212	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.19	454	0.0	$67.31	$526.50	$90.00	6.48
Room 214	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.39	909	0.0	$134.63	$1,053.00	$180.00	6.48
Elevator Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	200	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.04	15	0.0	$2.25	$117.00	$20.00	43.12
Room 216	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 216	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 218	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 218	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Storage	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	280	0.27	192	0.0	$28.42	$701.00	$100.00	21.14
Staff Room	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,900	Relamp	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.45	1,503	0.0	$222.78	$1,097.20	$200.00	4.03
Men Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Women Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Room 223A	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.22	729	0.0	$108.01	$584.00	$100.00	4.48
Room 223A	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Room 223B	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.22	729	0.0	$108.01	$584.00	$100.00	4.48
Room 223B	8	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	8	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.05	168	0.0	$24.87	$352.41	$0.00	14.17
Room 228	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 228	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 230	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Rooom 230	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 225	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.33	1,093	0.0	$162.02	$972.00	$155.00	5.04
Room 225	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 224	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 224	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Room 226	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,330	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.43	1,009	0.0	$149.59	$1,170.00	$200.00	6.48
Room 226	3	Compact Fluorescent: recessed 32W 4-pin	Occupancy Sensor	32	1,330	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	22	1,330	0.02	44	0.0	$6.53	$132.15	$0.00	20.25
Kitchen	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	26	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.56	1,875	0.0	$277.80	$1,521.00	$260.00	4.54
Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,330	Relamp	No	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,330	0.03	76	0.0	$11.22	$75.20	$15.00	5.37
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.02	72	0.0	$10.68	$58.50	$10.00	4.54
Dish Room	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.14	456	0.0	$67.51	$408.50	$70.00	5.01
Storage - Pump Room	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.17	121	0.0	$18.00	$468.00	$80.00	21.56
Perimeter Light	17	Compact Fluorescent: 26W 4-pin Wall Sconce	Daylight Dimming	26	4,380	Relamp	No	17	LED Screw-In Lamps: Downlight Solid State Retrofit	Daylight Dimming	18	4,380	0.09	668	0.0	$98.97	$748.87	$0.00	7.57
Perimeter Light	8	Linear Fluorescent - T5: 2' T5 (14W) - 2L	Daylight Dimming	34	4,380	Relamp	No	8	LED - Linear Tubes: (2) 2' Lamps	Daylight Dimming	17	4,380	0.09	685	0.0	$101.51	$385.60	$80.00	3.01
Perimeter Light	8	Linear Fluorescent - T5: 4' T5 (28W) - 4L	Daylight Dimming	120	4,380	Relamp	No	8	LED - Linear Tubes: (4) 4' Lamps	Daylight Dimming	58	4,380	0.33	2,498	0.0	$370.21	$761.07	$160.00	1.62
Perimeter Light	35	Compact Fluorescent: 2x26W 4-pin	Daylight Dimming	52	4,380	Relamp	No	35	LED Screw-In Lamps: Downlight Solid State Retrofit	Daylight Dimming	36	4,380	0.36	2,750	0.0	$407.53	$1,541.79	$0.00	3.78
Parking Lot Pole Lighting	19	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,380	Fixture Replacement	No	19	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Daylight Dimming	75	4,380	2.74	21,055	0.0	$3,119.92	$12,350.00	$1,900.00	3.35
Boys Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.08	273	0.0	$40.50	$445.50	$65.00	9.39
Boys Bathroom	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	1,900	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.04	135	0.0	$20.07	$117.00	$20.00	4.83
Boys Bathroom	1	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	21	0.0	$3.11	$44.05	$0.00	14.17
Girls Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,330	0.08	273	0.0	$40.50	$445.50	$65.00	9.39
Girls Bathroom	2	Compact Fluorescent: recessed 32W 4-pin	Wall Switch	32	1,900	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	22	1,900	0.01	42	0.0	$6.22	$88.10	$0.00	14.17
Girls Bathroom	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	1,900	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	1,900	0.02	57	0.0	$8.42	$76.53	$20.00	6.72
Custodian	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	400	0.02	13	0.0	$1.91	$76.53	$20.00	29.62
Tech Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	1,900	0.02	61	0.0	$9.07	$76.53	$20.00	6.24
Mechanical Room	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,900	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	1,900	0.22	734	0.0	$108.79	$918.40	$240.00	6.24
Roof Top	1	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Daylight Dimming	75	4,380	0.14	1,108	0.0	$164.21	$650.00	$100.00	3.35

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Boilers & Heat Pump	2	Water-Source Heat Pump Circulation Pump	0.8	78.0%	No	1,000	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers & Heat Pump	2	Water-Source Heat Pump Circulation Pump	5.0	90.2%	No	1,000	No	90.2%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers & Heat Pump	2	Water Supply Pump	1.0	75.5%	No	1,000	No	75.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers & Heat Pump	2	Other	0.3	80.0%	No	1,000	No	80.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	1	Exhaust Fan	0.2	71.0%	No	2,000	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	1	Exhaust Fan	0.5	72.0%	No	2,000	No	72.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Room	School	16	Ventilation Fan	5.0	87.0%	No	2,000	No	87.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers & Heat Pump	1	Water-Source Heat Pump Circulation Pump	0.5	78.0%	No	2,000	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Room	Geothermal System	2	Water-Source Heat Pump Circulation Pump	25.0	94.1%	Yes	1,000	No	94.1%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Room	McQuay Air Handler	1	Supply Fan	7.5	86.0%	Yes	2,000	No	86.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mechanical Room	McQuay Air Handler	1	Return Fan	2.0	82.0%	No	2,000	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
School Facility	School Facility	40	Water Source HP	2.92	35.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	16	Water Source HP	2.00	24.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	6	Water Source HP	2.50	30.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	3	Water Source HP	3.33	40.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	2	Water Source HP	3.92	47.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	5	Water Source HP	0.83	10.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	2	Water Source HP	1.08	13.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	2	Water Source HP	15.00	180.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School Facility	School Facility	1	Water Source HP	22.92	275.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	1	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Non-Condensing Hot Water Boiler	1,739.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	1	Furnace	324.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Storage Room	School Building	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions		Proposed Conditions			Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Low Temp Freezer (-35F to -5F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Medium Temp Freezer (0F to 30F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Ice Making Head (<450 lbs/day), Batch	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Gas Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$9,290.04	$500.00	0.00
Kitchen	1	Gas Combination Oven/Steam Cooker (<15 Pans)	Yes	No	0.00	0	0.0	$0.00	$16,598.81	$750.00	0.00
Kitchen	1	Gas Fryer	Yes	No	0.00	0	0.0	$0.00	$5,620.63	$749.00	0.00
Kitchen	1	Gas Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$9,290.04	$500.00	0.00
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Yes	No	0.00	0	0.0	$0.00	$2,878.43	$300.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	45	Desktop Computer	191.0	Yes
School	2	Copy Machine	850.0	Yes
School	5	Microwave	800.0	No
School	5	Printer	125.0	Yes
Staff Room	1	Refrigerator	225.0	Yes

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Staff Room	1	Refrigerated	Yes	0.00	1,612	0.0	$238.85	$718.80	$0.00	3.01
Staff Room	1	Non-Refrigerated	No	0.00	0	0.0	$0.00	$718.80	$0.00	0.00

Appendix B: ENERGY STAR® Statement of Energy Performance

Statement of Energy Performance was not generated for this facility due to incomplete utility data information.

Local Government Energy Audit:
Energy Audit Report



Edgemont School

Montclair Board of Education

20 Edgemont Road

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Edgemont School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey district schools in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

Edgemont School is a three-story building totaling 34,638 square foot facility originally constructed in 1925. The building has a pitched roof and exterior walls are finished with brick masonry. Interior lighting consists mainly of linear fluorescent fixtures which are mostly controlled with manual wall switches. Heating is provided by two steam boilers and the cooling system consists of window air conditioners.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated eight measures. Five measures were recommended for implementation which represent an opportunity for Edgemont School to reduce annual energy costs by roughly $5,176 and annual greenhouse gas emissions by 38,286 lbs CO_2e. The measures would pay for themselves in roughly 9.12 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce Edgemont School's annual energy use by 5.4%.

Figure 1 – Previous 12 Month Utility Costs

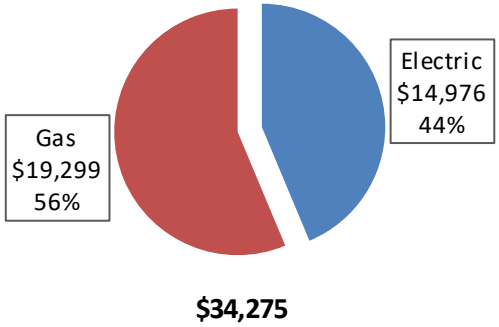
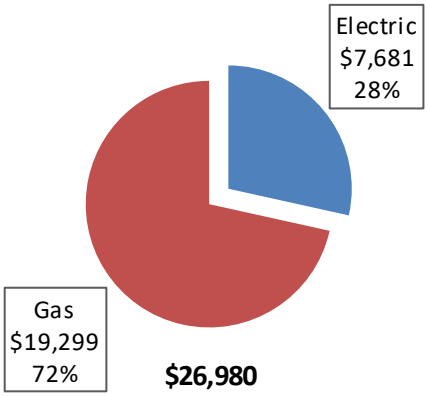


Figure 2 – Potential Post-Implementation Costs



A detailed description of Edgemont School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4. Measures without an "ECM #" in the table below have been evaluated, but are not recommended for implementation.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**32,804**	**14.6**	**$4,465.58**	**$44,872.25**	**$6,060.00**	**$38,812.25**	**8.69**	**33,033**
ECM 1	Install LED Fixtures	Yes	7,516	3.6	$1,023.13	$15,687.69	$1,000.00	$14,687.69	14.36	7,568
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,558	0.7	$212.04	$2,123.50	$200.00	$1,923.50	9.07	1,568
ECM 3	Retrofit Fixtures with LED Lamps	Yes	23,730	10.2	$3,230.42	$27,061.06	$4,860.00	$22,201.06	6.87	23,896
Lighting Control Measures			**5,217**	**2.3**	**$710.13**	**$9,744.00**	**$1,360.00**	**$8,384.00**	**11.81**	**5,253**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	4,688	2.0	$638.22	$8,544.00	$1,360.00	$7,184.00	11.26	4,721
ECM 5	Install High/Low Lighitng Controls	Yes	528	0.2	$71.91	$1,200.00	$0.00	$1,200.00	16.69	532
Motor Upgrades			**177**	**0.3**	**$24.05**	**$1,547.10**	**$0.00**	**$1,547.10**	**64.32**	**178**
	Premium Efficiency Motors	No	177	0.3	$24.05	$1,547.10	$0.00	$1,547.10	64.32	178
Variable Frequency Drive (VFD) Measures			**1,579**	**1.1**	**$214.94**	**$6,015.30**	**$0.00**	**$6,015.30**	**27.99**	**1,590**
	Install VFDs on Boiler Feedwater Pumps	No	1,579	1.1	$214.94	$6,015.30	$0.00	$6,015.30	27.99	1,590
Electric Unitary HVAC Measures			**431**	**0.4**	**$58.66**	**$2,536.81**	**$0.00**	**$2,536.81**	**43.24**	**434**
	Install High Efficiency Electric AC	No	431	0.4	$58.66	$2,536.81	$0.00	$2,536.81	43.24	434
TOTALS FOR RECOMMENDED MEASURES			**38,020**	**16.8**	**$5,175.71**	**$54,616.25**	**$7,420.00**	**$47,196.25**	**9.12**	**38,286**
TOTALS FOR EVALUATED MEASURES			**40,207**	**18.6**	**$5,473.36**	**$64,715.46**	**$7,420.00**	**$57,295.46**	**10.47**	**40,488**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing old standard efficiency motors with motors of the current efficiency standard (EISA 2007). Motors will be replaced with the same size motors. This measure saves energy by reducing the power used by the motors due to improved electrical efficiency.

Variable Frequency Drives measures generally involve controlling the speed of a motor to achieve a flow or temperature rather than using a valve, damper, or no means at all. These measures save energy by slowing a motor which is an extremely efficient method of control.

Electric Unitary HVAC measures generally involve replacing old inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide cooling equivalent to older air condition systems, but use less energy. These measures save energy by reducing the power used by the air condition system due to improved electrical efficiency.

Energy Efficient Practices

TRC Energy Services also identified 12 low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at Edgemont School include:

- Reduce Air Leakage
- Close Doors and Windows
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Perform Routine Motor Maintenance
- Clean and/or Replace HVAC Filters
- Repair/Replace Steam Traps
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for Edgemont School. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program, you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

This facility also qualifies for the Direct Install program which, through an authorized network of participating contractors, can assist with the implementation of a group of measures versus installing individual measures or phasing implementation. This program is designed to be turnkey and will provide an incentive up to 70% of the cost of the project identified by the designated contractor.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	973-509-4050
Designated Representative			
Ronald Jones	Custodian		973-509-4044
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	732-855-0033

2.2 General Site Information

On November 09, 2016, TRC performed an energy audit at Edgemont School located in Montclair, New Jersey. TRC's auditor met with Ronald Jones to review the facility operations and focus the investigation on specific energy-using systems.

The 34,638-square foot facility is a three-story building comprised of classrooms, administrative offices, library, multipurpose room, and storage spaces. The building has a mid-level basement which houses mechanical equipment. The original building was constructed in 1925. In 1949, a new section was built to accommodate additional classrooms and the auditorium was built in 1950. The building is used primarily for primary school programs.

2.3 Building Occupancy

The school operates on a 10-month schedule and is open Monday through Friday. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 310 students and staff.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Edgemont School	Weekday	8:00 AM - 3:30 PM
Edgemont School	Weekend	Closed

2.4 Building Envelope



The three-story building with a mid-level basement has a reinforced concrete foundation. The roofing system consists of a pitched concrete tile that is in good condition. The exterior walls are finished with brick masonry. The windows throughout the facility are double-pane, operable with aluminum frames, and are in good condition. Exterior doors are constructed of metal and are in good condition as well. Overall, the building's envelope is in good condition.

Image 1 – Building Envelope

2.5 On-site Generation

Edgemont School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Lighting at the facility is provided predominately by 32-Watt linear fluorescent T8 lamps with electronic ballasts. Most of the building classrooms use 2-lamp or 4-lamp, 2-foot wide by 4-foot long troffers with diffusers. The multipurpose room is illuminated with 250-Watt metal halide lamps while the library office and the boiler room are illuminated with a combination of 32-Watt linear fluorescent T8 and 40-Watt T12 lamps. A small number of compact fluorescent and incandescent lamps are located in spaces such as stairwells and storage rooms. The remaining building spaces are illuminated with linear 32-Watt fluorescent T8 lamps. Exit signs throughout the facility are LED. Lighting control is provided mostly by manual wall switches. The facility exterior lighting system consists of 250-Watt metal halide outdoor wall-mounted area fixtures which are controlled by photocells.

Steam Heating System

The steam heating system consists of two 1,189 MBh steam boilers, each with a nominal combustion efficiency of 83%, plus the associated distribution system. Each boiler has a 3 hp combustion air fan. The boiler also has two 3 hp feed water pumps and a control valve that maintains the boiler water level. Steam is supplied to the radiators and heating unit ventilators at 15 psi. The Nestbitt unit ventilators serving rooms 13, 14, 114, and 115 appear in poor condition. The boilers operate in a lead/lag configuration. Local thermostats are used to control the temperatures in spaces. The boilers are two years old and are well maintained.



Image 2 – Steam Heating System

Air Conditioning

Cooling is provided by 15 window air conditioners with capacity ranging from 0.5 to 1.83 ton, and are relatively in good condition except for the two older less efficient units serving room 9 and the teacher room.

Two air handlers, each equipped with a 1 hp supply fan, provide fresh air to the facility from their location in the fan room.

Domestic Hot Water

The domestic hot water system for the facility consists of one Bradford White gas fired non-condensing hot water heater with an input rating of 76 MBh and a nominal efficiency of 82%. It has a 75-gallon storage tank and is located in the boiler room. The water heater is seven years old and appears in good condition.

Food Service & Refrigeration

The school includes a small institutional kitchen which includes a gas rack convection oven and insulated food holding cabinets, and three stand-up refrigerators. The kitchen is well maintained.

Plug Load & Vending Machines

The building has approximately 35 computers with LCD monitors that are used daily, plus servers, three large photocopiers, and four printers. There is no centralized PC power management software installed. The facility has no refrigerated beverage vending machines.

2.7 Water-Using Systems

There are several restrooms at this facility. A sampling of restrooms found that all the faucets are rated as low flow.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are many factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants regarding operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

The following energy consumption and cost data is based on the last 12-month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Edgemont School		
Fuel	**Usage**	**Cost**
Electricity	95,970 kWh	$14,976
Natural Gas	22,103 Therms	$19,299
Total		**$34,275**

The current utility cost for this site is $34,275 as shown in the chart below.

Figure 7 - Energy Cost Breakdown



$34,275

3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.136/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects lower occupancy in the summer months confirming the 10 months facility operation.

Figure 8 - Electric Usage & Demand

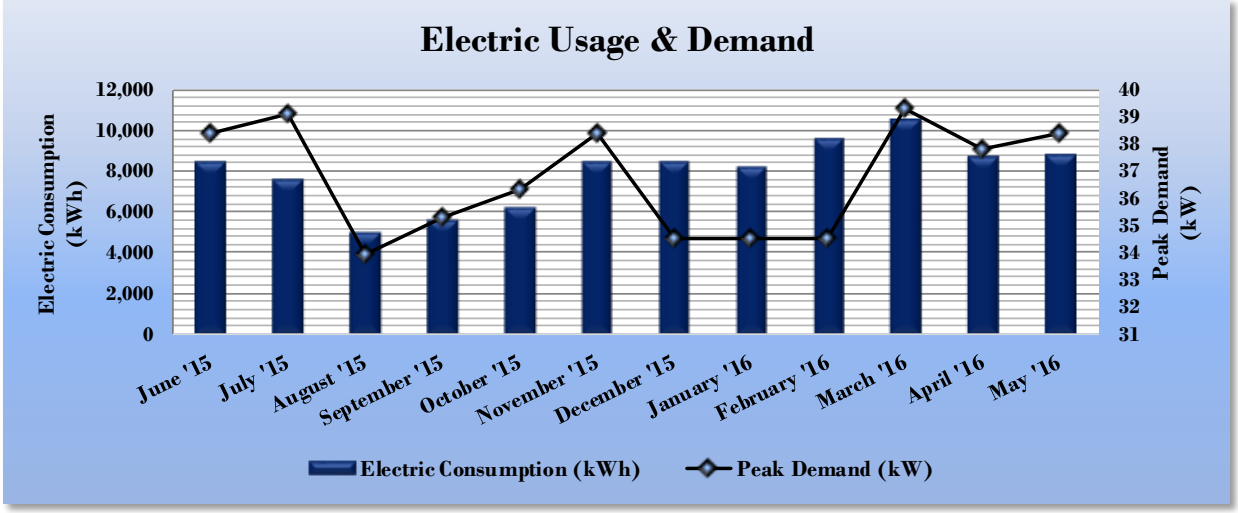


Figure 9 - Electric Usage & Demand

Electric Billing Data for Edgemont School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
6/16/15	30	8,520	38	$167	$1,335
7/18/15	31	7,620	39	$165	$1,508
8/17/15	30	4,990	34	$147	$1,096
9/16/15	31	5,660	35	$149	$1,209
10/16/15	31	6,240	36	$158	$1,273
11/17/15	30	8,490	38	$168	$1,224
12/16/15	31	8,490	35	$151	$1,202
1/16/16	30	8,250	35	$151	$1,115
2/16/16	31	9,600	35	$151	$1,298
3/16/16	31	10,590	39	$171	$1,375
4/16/16	29	8,730	38	$166	$1,166
5/17/16	30	8,790	38	$169	$1,176
Totals	**365**	**95,970**	**39.3**	**$1,912**	**$14,976**
Annual	**365**	**95,970**	**39.3**	**$1,912**	**$14,976**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.873/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 10 - Natural Gas Usage

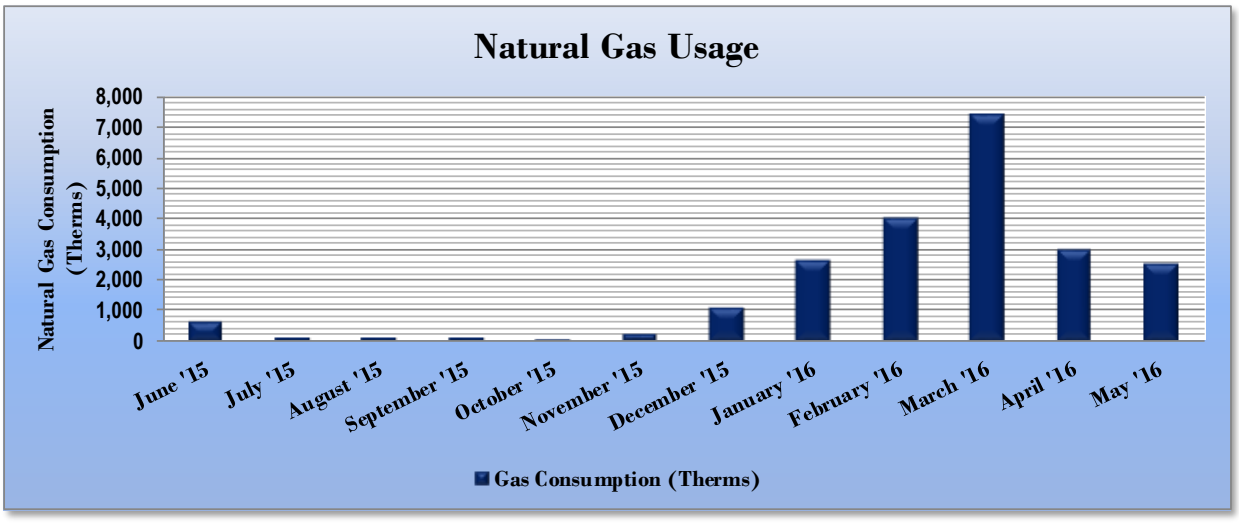


Figure 11 - Natural Gas Usage

Gas Billing Data for Edgemont School				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/16/15	30	625	$429	No
7/18/15	31	133	$177	Yes
8/17/15	30	114	$162	No
9/16/15	31	114	$191	No
10/16/15	31	33	$150	No
11/17/15	30	248	$241	No
12/16/15	31	1,096	$1,831	Yes
1/16/16	30	2,678	$2,554	No
2/16/16	31	4,046	$3,860	No
3/16/16	31	7,420	$5,435	No
4/16/16	29	3,024	$2,769	Yes
5/17/16	30	2,574	$1,497	No
Totals	**365**	**22,103**	**$19,299**	3
Annual	**365**	**22,103**	**$19,299**	

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the energy use intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Edgemont School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	96.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	73.3	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Edgemont School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	84.9	141.4
Site Energy Use Intensity (kBtu/ft^2)	69.5	58.2

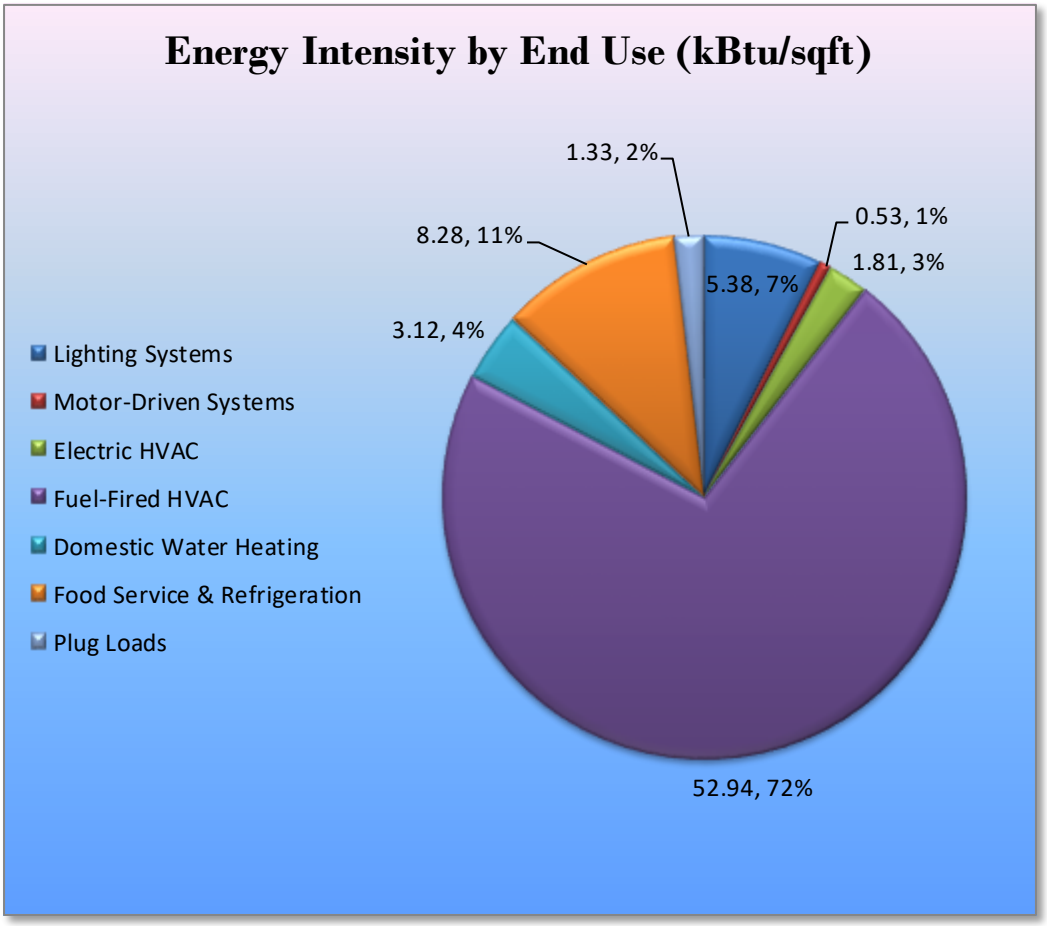
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 70.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

To provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 14 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the Edgemont School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJ prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 15 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**32,804**	**14.6**	**0.0**	**$4,465.58**	**$44,872.25**	**$6,060.00**	**$38,812.25**	**8.69**	**33,033**
ECM 1	Install LED Fixtures	7,516	3.6	0.0	$1,023.13	$15,687.69	$1,000.00	$14,687.69	14.36	7,568
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,558	0.7	0.0	$212.04	$2,123.50	$200.00	$1,923.50	9.07	1,568
ECM 3	Retrofit Fixtures with LED Lamps	23,730	10.2	0.0	$3,230.42	$27,061.06	$4,860.00	$22,201.06	6.87	23,896
Lighting Control Measures		**5,217**	**2.3**	**0.0**	**$710.13**	**$9,744.00**	**$1,360.00**	**$8,384.00**	**11.81**	**5,253**
ECM 4	Install Occupancy Sensor Lighting Controls	4,688	2.0	0.0	$638.22	$8,544.00	$1,360.00	$7,184.00	11.26	4,721
ECM 5	Install High/Low Lighitng Controls	528	0.2	0.0	$71.91	$1,200.00	$0.00	$1,200.00	16.69	532
TOTALS		**38,020**	**16.8**	**0.0**	**$5,175.71**	**$54,616.25**	**$7,420.00**	**$47,196.25**	**9.12**	**38,286**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting measures are summarized in Figure 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**32,804**	**14.6**	**0.0**	**$4,465.58**	**$44,872.25**	**$6,060.00**	**$38,812.25**	**8.69**	**33,033**
ECM 1	Install LED Fixtures	7,516	3.6	0.0	$1,023.13	$15,687.69	$1,000.00	$14,687.69	14.36	7,568
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,558	0.7	0.0	$212.04	$2,123.50	$200.00	$1,923.50	9.07	1,568
ECM 3	Retrofit Fixtures with LED Lamps	23,730	10.2	0.0	$3,230.42	$27,061.06	$4,860.00	$22,201.06	6.87	23,896

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	5,808	2.5	0.0	$790.65	$12,171.60	$100.00	$12,071.60	15.27	5,849
Exterior	1,708	1.1	0.0	$232.48	$3,516.09	$900.00	$2,616.09	11.25	1,720

Measure Description

This measure evaluates replacing existing interior and exterior fixtures containing 250-Watt metal halide lamps with new high-performance LED light fixtures. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,558	0.7	0.0	$212.04	$2,123.50	$200.00	$1,923.50	9.07	1,568
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T12 lamps, ballasts, and reflectors with LED tube lamps, reflectors, and drivers specifically designed for existing linear fluorescent fixtures. The retrofit uses the existing fixture housing but replaces the rest of the components with an efficient source and reflectors designed for LEDs. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output and efficiently projects the light into the space.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	23,730	10.2	0.0	$3,230.42	$27,061.06	$4,860.00	$22,201.06	6.87	23,896
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T8 lamps with LED tube lamps and replacing incandescent, halogen incandescent, and compact fluorescent screw-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in LED lamps can be used as a direct replacement for most other screw-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**5,217**	**2.3**	**0.0**	**$710.13**	**$9,744.00**	**$1,360.00**	**$8,384.00**	**11.81**	**5,253**
ECM 4	Install Occupancy Sensor Lighting Controls	4,688	2.0	0.0	$638.22	$8,544.00	$1,360.00	$7,184.00	11.26	4,721
ECM 5	Install High/Low Lighitng Controls	528	0.2	0.0	$71.91	$1,200.00	$0.00	$1,200.00	16.69	532

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,688	2.0	0.0	$638.22	$8,544.00	$1,360.00	$7,184.00	11.26	4,721

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in restrooms, storage rooms, classrooms and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
528	0.2	0.0	$71.91	$1,200.00	$0.00	$1,200.00	16.69	532

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high-level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period

For this application, the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.2 ECMs Evaluated but Not Recommended

The measures below have been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in each measure description section.

Figure 18 – Summary of Evaluated but Not Recommended ECMs

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades	**177**	**0.3**	**0.0**	**$24.05**	**$1,547.10**	**$0.00**	**$1,547.10**	**64.32**	**178**
Premium Efficiency Motors	177	0.3	0.0	$24.05	$1,547.10	$0.00	$1,547.10	64.32	178
Variable Frequency Drive (VFD) Measures	**1,579**	**1.1**	**0.0**	**$214.94**	**$6,015.30**	**$0.00**	**$6,015.30**	**27.99**	**1,590**
Install VFDs on Boiler Feedwater Pumps	1,579	1.1	0.0	$214.94	$6,015.30	$0.00	$6,015.30	27.99	1,590
Electric Unitary HVAC Measures	**431**	**0.4**	**0.0**	**$58.66**	**$2,536.81**	**$0.00**	**$2,536.81**	**43.24**	**434**
Install High Efficiency Electric AC	431	0.4	0.0	$58.66	$2,536.81	$0.00	$2,536.81	43.24	434
TOTALS	**2,187**	**1.8**	**0.0**	**$297.65**	**$10,099.21**	**$0.00**	**$10,099.21**	**33.93**	**2,202**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
177	0.3	0.0	$24.05	$1,547.10	$0.00	$1,547.10	64.32	178

Measure Description

This measure evaluates replacing the two 3 hp boiler feed water pump standard efficiency motors with EISA 2007 efficiency motors. The evaluation assumes existing motors will be replaced with the same size motors. It is important that the speed of each new motor match the speed of the motor it replaces as closely as possible. The base case motor efficiencies are obtained from nameplate information. Proposed case premium motor efficiencies are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the annual operating hours.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install VFDs on Boiler Feedwater Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,579	1.1	0.0	$214.94	$6,015.30	$0.00	$6,015.30	27.99	1,590

Measure Description

This measure evaluates installing a variable frequency drive (VFD) to control the two 3 hp steam boiler feedwater pumps. The existing level control valve will need to be maintained fully open and its control signal used to modulate the feedwater pump VFD speed. Energy savings result from reducing pump motor speed (and power) at reduced feedwater flow. The magnitude of energy savings is based on the amount of time at reduced loads.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Electric AC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
431	0.4	0.0	$58.66	$2,536.81	$0.00	$2,536.81	43.24	434

Measure Description

This measure evaluates replacing window air conditioners with high efficiency window air conditioners. There have been significant improvements in both compressor and fan motor efficiencies in the past several years. Therefore, electricity savings can be achieved by replacing old units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the old and new unit, the cooling load, and the annual operating hours.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost-effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Perform Routine Motor Maintenance

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Repair/Replace Steam Traps

Properly functioning steam traps ensure that all latent heat in the steam is delivered to the end use by preventing pressurized steam from leaking. Steam traps should be inspected as part of the regular steam system maintenance. Traps that are blocked, venting, or allowing steam to leak through should be repaired or replaced. Repairing or replacing existing steam traps will reduce steam losses.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before deciding to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

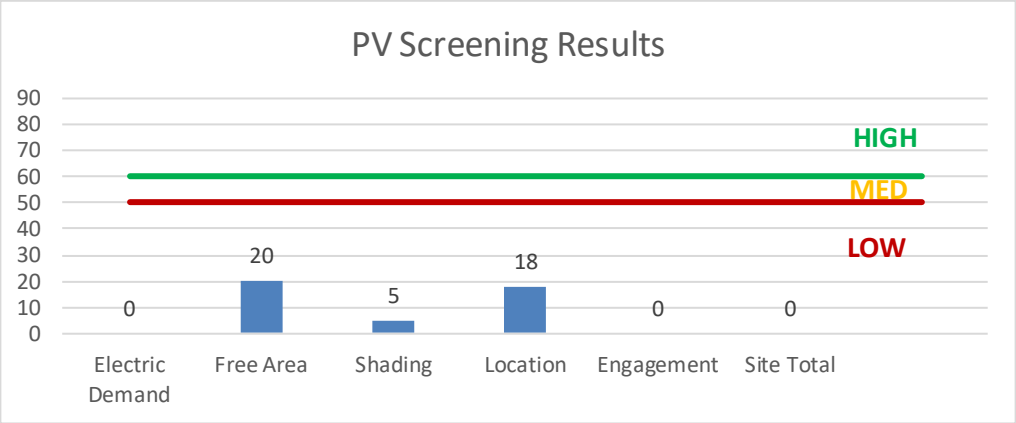
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **Low** potential for installing a PV array.

To be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear not meet these minimum criteria for cost-effective PV installation.

Figure 19 - Photovoltaic Screening



Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

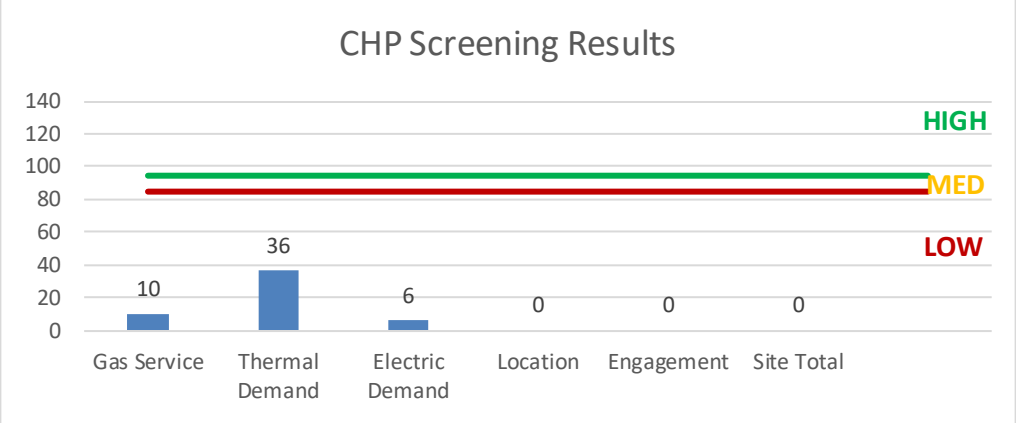
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 20 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically, an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

In our opinion, this facility is not a good candidate for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP can provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you could participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 21 for a list of the eligible programs identified for each recommended ECM.

Figure 21 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install
ECM 1	Install LED Fixtures	x		x
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x		x
ECM 3	Retrofit Fixtures with LED Lamps	x		x
ECM 4	Install Occupancy Sensor Lighting Controls	x		x
ECM 5	Install High/Low Lighitng Controls			x

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to mid-sized facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and install those measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program, you will need to contact the participating contractor assigned to the county where your facility is located; a complete list is provided on the Direct Install website identified below. The contractor will be paid the program incentive directly which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps mentioned above, and the remaining 30% of the cost is your responsibility to the contractor.

Since Direct Install offers a free assessment, LGEA applicants that do not meet the audit program eligibility requirements, but do meet the Direct Install requirements, may be moved directly into this program.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Library	16	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	16	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.77	1,783	0.0	$242.69	$1,638.13	$340.00	5.35
Office	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,320	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.13	308	0.0	$41.97	$467.00	$50.00	9.94
Hallway	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	924	0.55	1,266	0.0	$172.34	$1,770.00	$200.00	9.11
Hallway	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	924	0.14	334	0.0	$45.50	$285.40	$60.00	4.95
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Room 2	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.29	669	0.0	$91.01	$686.80	$140.00	6.01
Room 5	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Custodian	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,320	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,320	0.01	24	0.0	$3.31	$48.20	$10.00	11.55
Nurse Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.10	223	0.0	$30.34	$306.27	$60.00	8.12
Nurse Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Room 7	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.11	$1,285.00	$220.00	6.87
Room 21	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.58	1,337	0.0	$182.01	$1,257.60	$260.00	5.48
Hallway Expo Light	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.23	$71.80	$10.00	8.54
Room 8	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Staff Bathrrom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.82	$58.50	$10.00	7.11
Groupe Study Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.16	380	0.0	$51.70	$467.00	$80.00	7.49
Multipurpose Room	20	Metal Halide: (1) 250W Lamp	Wall Switch	295	1,320	Fixture Replacement	Yes	20	LED - Fixtures: Downlight Pendant	Occupancy Sensor	75	924	3.18	7,362	0.0	$1,002.24	$16,571.60	$800.00	15.74
Custodian Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.82	$58.50	$10.00	7.11
Stage Area	1	Incandescent: 65W A Lamp	Wall Switch	65	1,320	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,320	0.04	82	0.0	$11.16	$53.75	$10.00	3.92
Stage Area	56	Halogen Incandescent: PAR38 90W	Wall Switch	90	1,320	Relamp	No	56	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	15	1,320	2.75	6,376	0.0	$867.92	$3,010.17	$560.00	2.82
Kitchen	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,320	0.15	340	0.0	$46.29	$380.53	$80.00	6.49
Room 13	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.44	1,013	0.0	$137.87	$1,168.00	$200.00	7.02
Room 14	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.55	1,266	0.0	$172.34	$1,402.00	$240.00	6.74

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 22	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Room 22	1	Incandescent: 65W A Lamp	Wall Switch	65	1,320	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,320	0.04	82	0.0	$11.16	$53.75	$10.00	3.92
Stairwell	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	924	0.25	570	0.0	$77.55	$726.50	$90.00	8.21
Stairwell	6	Compact Fluorescent: 23W CFL	Wall Switch	23	1,320	Relamp	No	6	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	1,320	0.03	63	0.0	$8.56	$381.90	$0.00	44.64
2nd Floor Hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	924	0.14	317	0.0	$43.09	$492.50	$50.00	10.27
Room 106	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Room 107	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Room 105	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,320	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	924	0.49	1,139	0.0	$155.11	$1,102.40	$180.00	5.95
Custodian Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,320	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,320	0.01	24	0.0	$3.31	$48.20	$10.00	11.55
Room 104	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.10	223	0.0	$30.34	$306.27	$60.00	8.12
Room 104	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Room 109	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Room 103	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Room 110	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$180.96	$1,460.50	$250.00	6.69
Storage	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,320	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.09	206	0.0	$27.98	$350.00	$40.00	11.08
Storage	4	Incandescent: 65W A Lamp	Wall Switch	65	1,320	Relamp	Yes	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	11	924	0.15	348	0.0	$47.36	$331.01	$40.00	6.14
Room 112	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.64	$117.00	$20.00	7.11
Hallway	3	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	1,320	Relamp & Reballast	Yes	3	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	924	0.27	617	0.0	$83.94	$685.50	$60.00	7.45
Room 115	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.29	669	0.0	$91.01	$686.80	$140.00	6.01
Room 114	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.29	669	0.0	$91.01	$686.80	$140.00	6.01
Boiler Room	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.15	351	0.0	$47.74	$409.50	$70.00	7.11
Boiler Room	9	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,320	Relamp & Reballast	No	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.35	806	0.0	$109.73	$1,053.00	$90.00	8.78
Boiler Room	2	Incandescent: 65W A Lamp	Wall Switch	65	1,320	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,320	0.07	164	0.0	$22.32	$107.51	$20.00	3.92
Exterior Perimeter Light	9	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	863	Fixture Replacement	No	9	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	75	863	1.30	1,964	0.0	$267.35	$3,516.09	$900.00	9.79
Room 12	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	924	0.10	223	0.0	$30.34	$306.27	$60.00	8.12

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
School	19	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	19	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Boiler	2	Combustion Air Fan	3.0	82.0%	No	520	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Compressor	1	Air Compressor	0.8	78.7%	No	520	No	78.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler	1	Other	0.5	71.0%	No	520	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler Room	2	Boiler Feed Water Pump	3.0	78.0%	No	520	Yes	85.5%	Yes	2	1.39	1,756	0.0	$238.99	$7,562.40	$0.00	31.64
Fan Room	School	2	Supply Fan	1.0	82.0%	No	390	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Library	Library	2	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 2	Room 2	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Office	Office	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Office	9	1	Window AC	1.50		Yes	1	Window AC	1.50		12.00		No	0.24	277	0.0	$37.77	$1,633.14	$0.00	43.24
Room 5	Room 5	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse Office	Nurse Office	1	Window AC	0.66		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 7	Room 7	1	Window AC	1.54		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Group Study Room	Group Study Room	1	Window AC	1.16		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 107	Room 107	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teacher Room	Teacher Room	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.13	154	0.0	$20.90	$903.67	$0.00	43.24
Room 3	Room 103	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 112	Room 112	1	Window AC	0.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 115	Room 115	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 114	Room 114	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Forced Draft Steam Boiler	1,189.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Gas Rack Oven (Double)	Yes	No	0.00	0	0.0	$0.00	$9,290.04	$2,000.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	35	Desktop Computer with LCD Monitors	205.0	Yes
School	4	Printer	460.0	Yes
School	3	Copy Machine	850.0	Yes
School	4	Microwave	1,000.0	No
Kitchen	1	Refrigerator	250.0	Yes
Teacher Room	1	Refrigerator	250.0	Yes

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Edgemont Elementary School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 34,638
Built: 1925

For Year Ending: April 30, 2016
Date Generated: December 20, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Edgemont Elementary School 20 Edgemont Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724510

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
73.5 kBtu/ft²

Source EUI
97.1 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	330,511 (13%)
Natural Gas (kBtu)	2,214,138 (87%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	88.3
National Median Source EUI (kBtu/ft²)	116.7
% Diff from National Median Source EUI	-17%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	154

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Furlong Field House and Woodman Field

Montclair Board of Education

28 Essex Avenue

Montclair, New Jersey 07402

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Furlong Field House.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services(TRC), as part of a comprehensive effort to assist New Jersey local governments and public schools in controlling their energy costs and help protect our environment by reducing energy consumption statewide.

1.1 Facility Summary

The Furlong Field House at Woodman Field is a 13,184 square foot facility comprised of a main field house, plus a few smaller buildings adjacent to a large football field with running track and bleachers. The field and bleacher area has no lighting or other energy-using equipment. The Furlong Field House consists primarily of locker rooms, restrooms, and workout areas with gym equipment. There is an adjoining building connected by a covered walkway which contains a large multipurpose room, which is used for awards ceremonies and other special events. Next to the field house is a small building which houses the Building and Grounds Office. This building has a connected garage for storage and a machine shop. There is also small concession stand building with kitchen equipment used to store and prepare food sold at athletic events.

Building occupancy varies widely. The Building and Grounds Office and garage area is usually occupied by facility staff every weekday. The field house and multipurpose room are typically open every weekday (from about 7:00 AM to 5:00 PM) during the school year, with additional hours on some evenings and weekends for sporting events or awards ceremonies. The concession stand is typically occupied only on during sporting events. The field house and multipurpose room is often occupied by just a few students and coaches during most of the day, but may be occupied by hundreds of people when there are sporting events, team practices, or special events.

Interior lighting at Furlong Field House consist mostly of 2 to 4-lamp T8 fluorescent fixtures. There are also some compact fluorescent (CFL) and high intensity discharge (HID) fixtures in some areas. Building exteriors are lit by HID fixtures. The Field House is heated by natural gas. It has a 643-MBh Weil-McLain boiler, plus there are four rooftop units (RTUs) which supply about 790 MBH of supplementary heating and 78 tons of cooling capacity, as needed. The Building and Grounds Office and the garage are heated and cooled by an electric warm air unit heater and a window air conditioning (AC) unit. The concession stand has no heating or cooling. A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated five energy conservation measures (ECMs). We recommend four ECMs for implementation. The four measures together represent an opportunity to reduce the annual energy cost of the facility by about $4,302 and annual greenhouse gas emissions by 29,180 lbs CO_2e. We estimate that if these measures are implemented as recommended, the project would pay for itself in energy savings alone in about 5.0 years. The breakdown of annual utility costs and the potential utility cost savings, following project implementation, are shown in Figure 1 and Figure 2, respectively. We estimate that the four measures together would reduce Furlong Field House's annual energy usage by about 5.3% overall.

A boiler replacement measure was evaluated, but was not recommended for implementation at this time due to the measure's long payback period. If the school district chooses to upgrade the main boiler as well, then that measure could increase overall energy savings by another 5%, but it would likely increase the overall payback period of the project to about 7.5 years.

Figure 1 – Previous 12 Month Utility Costs

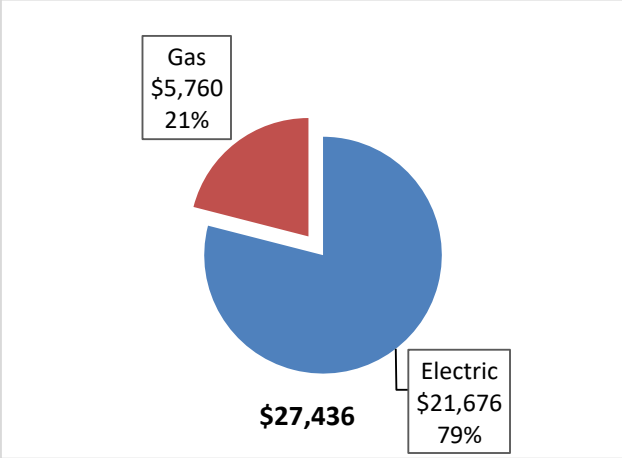
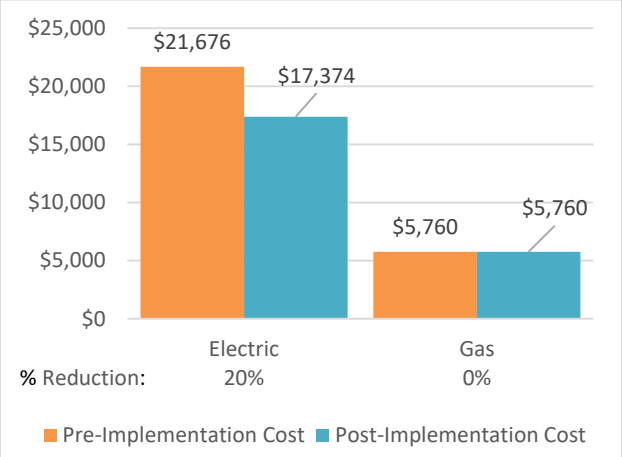


Figure 2 – Potential Post-Implementation Costs



A detailed description of Furlong Field House's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**26,381**	**7.6**	**0.0**	**$3,916.67**	**$17,937.84**	**$1,670.00**	**$16,267.84**	**4.2**	**26,565**
ECM 1	Install LED Fixtures	Yes	6,366	1.2	0.0	$945.08	$3,257.05	$600.00	$2,657.05	2.8	6,410
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	155	0.0	0.0	$22.98	$117.00	$10.00	$107.00	4.7	156
ECM 3	Retrofit Fixtures with LED Lamps	Yes	19,860	6.3	0.0	$2,948.61	$14,563.79	$1,060.00	$13,503.79	4.6	19,999
Lighting Control Measures			**2,597**	**0.9**	**0.0**	**$385.54**	**$5,750.00**	**$695.00**	**$5,055.00**	**13.1**	**2,615**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	2,597	0.9	0.0	$385.54	$5,750.00	$695.00	$5,055.00	13.1	2,615
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**93.9**	**$394.66**	**$15,434.20**	**$1,414.60**	**$14,019.60**	**35.5**	**10,998**
	Install High Efficiency Hot Water Boilers	No	0	0.0	93.9	$394.66	$15,434.20	$1,414.60	$14,019.60	35.5	10,998
TOTAL FOR PROPOSED MEASURES			**28,977**	**8.4**	**0.0**	**$4,302.20**	**$23,687.84**	**$2,365.00**	**$21,322.84**	**5.0**	**29,180**
TOTAL FOR ALL MEASURES			**28,977**	**8.4**	**93.9**	**$4,696.86**	**$39,122.04**	**$3,779.60**	**$35,342.44**	**7.5**	**40,178**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Gas Heating (HVAC/Process) measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

Energy Efficient Practices

TRC also identified four low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at the Furlong Field House include:

- Close Doors and Windows
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for the Furlong Field House. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- Energy Savings Improvement Program (ESIP)
- Demand Response Energy Aggregator

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

This facility may also qualify for the Direct Install program which can provide turnkey installation of multiple measures, through an authorized network of participating contractors. This program can provide substantially higher incentives than SmartStart, up to 70% of the cost of selected measures, although measure eligibility will have to be assessed and be verified by the designated Direct Install contractor and, in most cases, they will perform the installation work.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Steve DiGeronimo	Interim Business Administrator	jdigeronimo@montclair.k12.nj.us	(973) 509-4050
Leonard Saponara	Building & Grounds Supervisor	lsaponara@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Tom Page	Auditor	tpag@TRCsolutions.com	(732) 855-0033

2.2 General Site Information

On November 07, 2016, TRC performed an energy audit at Furlong Field House located in Montclair, New Jersey. TRC's team met with Leonard Saponara to review the facility operations and help focus our investigation on specific energy-using systems.

The Furlong Field House at Woodman Field is a 13,184 square foot facility comprised of a main field house, plus a few smaller buildings adjacent to a large football field with running track and bleachers. The field and bleacher area has no lighting or other energy-using equipment.

The Furlong Field House consists primarily of locker rooms, restrooms, and workout areas with gym equipment. There is an adjoining building connected by a covered walkway which contains a large multipurpose room, which is used for awards ceremonies and other special events. Next to the field house is a small building which houses the Building and Grounds Office. This building has a connected garage for storage and a machine shop. There is also small concession stand building with kitchen equipment used to store and prepare food sold at athletic events.

The original date of construction is unknown for the field house and other buildings at Woodman Field. The building's main boiler was installed in 1994. The field house underwent a $5 million renovation in 2008 and was renamed the Furlong Field House.

2.3 Building Occupancy

Building occupancy varies widely. The Building and Grounds Office and garage area is usually occupied by facility staff every weekday. The field house and multipurpose room are typically open every weekday (from about 7:00 AM to 5:00 PM) during the school year, with additional hours on some evenings and weekends for sporting events or awards ceremonies. The concession stand is typically occupied only on during sporting events. The field house and multipurpose room is often occupied by just a few students and coaches during most of the day but may be occupied by hundreds of people when there are sporting events, team practices, or special events.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Furlong Field House	Weekday	7:00am - 5pm
Furlong Field House	Weekend	CLOSED

2.4 Building Envelope

Furlong Field House is a Tudor-style wood-framed building with stucco exterior. It has a sloped roof with asphalt shingles. The windows are doubled-paned with aluminum frames. It has wooden and steel doors with double-paned glass.

The smaller buildings – the Building and Grounds Office, the garages, and the concession stand - are all of similar design with wooden frames, stucco exterior, and sloped shingled roofs.

Door and window seals all appeared tight. No excessive air infiltration was noted for any of the buildings.

Image 1: Furlong Field House - Front Exterior



2.5 On-Site Generation

The Furlong Field House and adjacent buildings have no on-site power generation.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Interior lighting at Furlong Field House consist mostly of 2 to 4-lamp T8 fluorescent fixtures. There are also some compact fluorescent (CFL) and high intensity discharge (HID) fixtures in some areas. Building exteriors are lit mostly by HID fixtures.

Image2: Furlong Field House / Woodman Field - Typical Lighting Fixtures



Heating Ventilation and Air Conditioning (HVAC)

The Furlong Field House is heated by natural gas. It has a 643-MBh Weil-McLain hydronic boiler, which was installed in 1994. The main boiler appears to be in good condition for its age.

There are also four gas/electric rooftop units (RTUs), three Reznor units and one Carrier unit, which together supply 790 MBh of supplementary heating and 78 tons of cooling capacity, as needed.

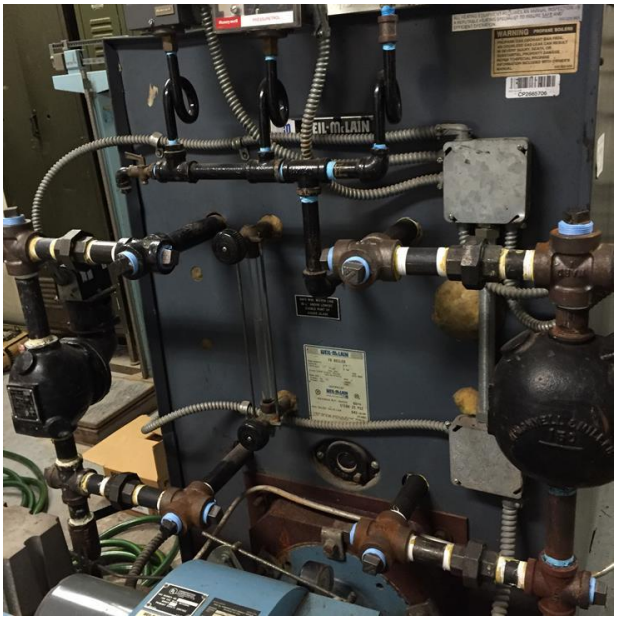
There are also small exhaust fans on the roof of the building with fractional horsepower motors.

The Building and Grounds Office and the machine shop are heated by a single electric warm air unit heater and cooled a through-the-wall air conditioning unit.

The concession stand and an adjacent storage garage have no heating or cooling.

Temperatures at Furlong Field House are setback at night when the building is closed. HVAC systems at all Montclair BOE properties are scheduled remotely through a contract with a company called Energy for America.

Image 3: Furlong Field House / Woodman Field - HVAC Equipment









Domestic Hot Water Heating System

The domestic hot water heating system at the Furlong Field House consist of two A.O. Smith gas-fired storage hot water heaters, each with 98-gallon storage tanks. These supply all restrooms and locker room showers.

Building Plug Load

Building plug load equipment is minimal, just some office equipment for a few small office spaces. There is also some gym equipment and an ice machine.

There are three refrigerators and a freezer chest to store food at the concession stand. The concession stand also has an electric stove with exhaust hood, which is used only during sporting events.

2.7 Water-Using Systems

All faucets, showerheads, toilets, and urinals appeared to be low-flow rated devices which meet or exceed current standards for water conservation in commercial buildings.

For more information on current water conservation standards for commercial buildings, see Section 5.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

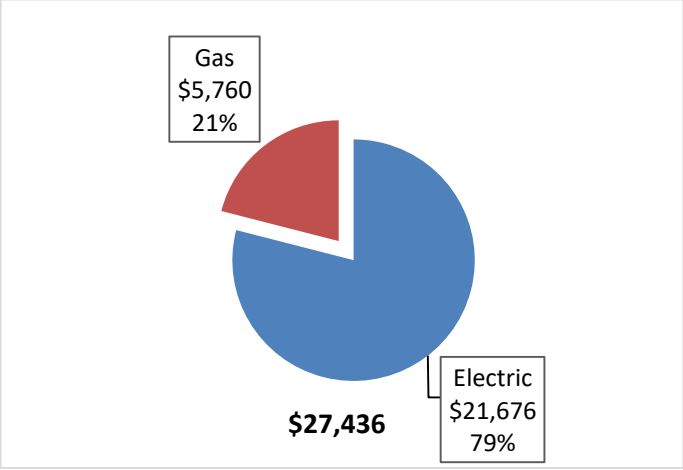
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Furlong Field House		
Fuel	**Usage**	**Cost**
Electricity	146,000 kWh	$21,676
Natural Gas	13,709 Therms	$5,760
Total		**$27,436**

The current annual energy cost for this facility is $27,436 as shown in the chart below.

Figure 7 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over a recent past 12-month period was found to be $0.148/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 8 - Electric Usage & Demand

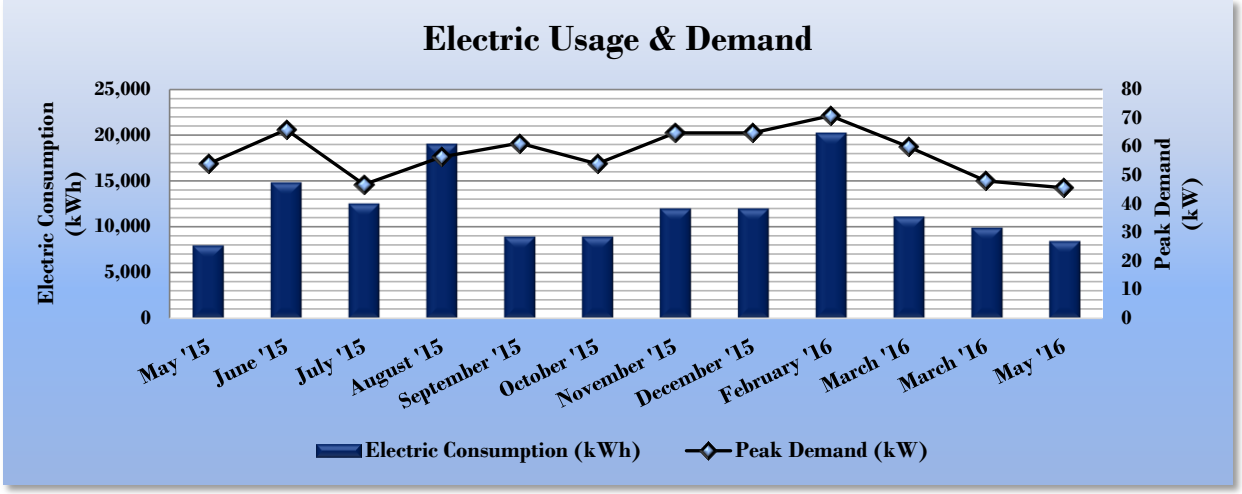


Figure 9 - Electric Usage & Demand

Electric Billing Data for Furlong Field House				
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Total Electric Cost
6/15/15	26	7,920	54	$1,745
7/15/15	30	14,760	66	$2,814
8/13/15	29	12,480	47	$2,238
9/14/15	32	18,960	56	$3,190
10/13/15	29	8,880	61	$1,358
11/12/15	30	8,880	54	$1,358
12/15/15	33	11,940	65	$1,115
1/15/16	31	11,940	65	$1,115
2/18/16	34	20,160	71	$2,596
3/16/16	27	11,040	60	$1,527
4/15/16	30	9,840	48	$1,338
5/17/16	32	8,400	46	$1,163
Totals	**363**	**145,200**	**70.8**	**$21,558**
Annual	**365**	**146,000**	**70.8**	**$21,676**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost over a recent 12-month period was found to be $0.420/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Please Note: The natural gas consumption appears to be adequate for a building of this size, however the billed rate seems to be way below current market averages, less than half of what it should be. We believe there are likely some third-party gas supplier bills that were missing from the utility data provided.

Figure 10 - Natural Gas Usage

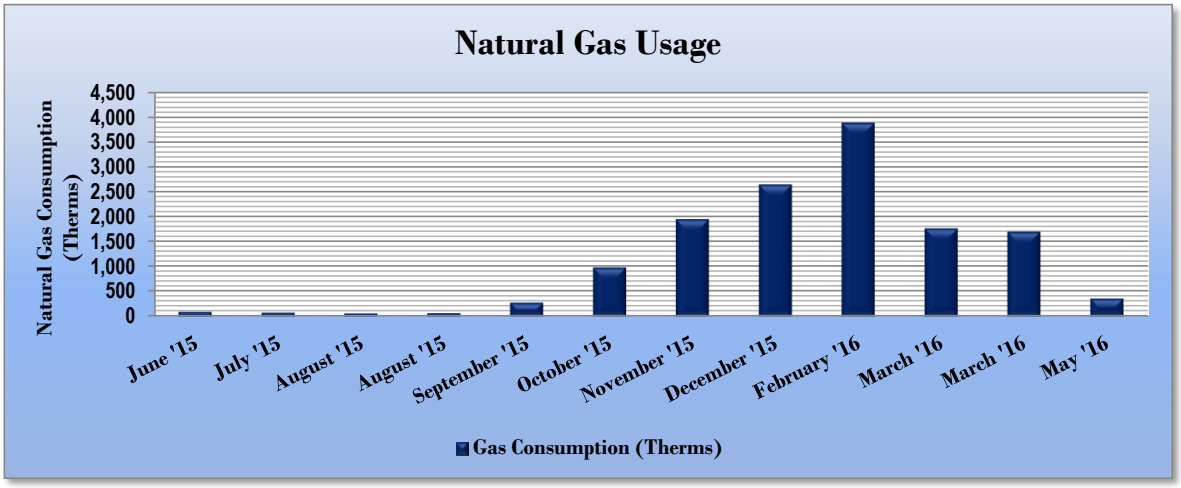


Figure 11 - Natural Gas Usage

Gas Billing Data for Furlong Field House			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
6/16/15	32	92	$112
7/20/15	34	72	$110
8/17/15	28	59	$109
9/15/15	29	62	$111
10/14/15	29	274	$132
11/12/15	29	980	$836
12/15/15	33	1,944	$979
1/15/16	31	2,641	$1,084
2/18/16	34	3,881	$1,146
3/16/16	27	1,764	$803
4/15/16	30	1,696	$247
5/17/16	32	357	$137
Totals	**368**	**13,822**	**$5,807**
Annual	**365**	**13,709**	**$5,760**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Furlong Field House	National Median Building Type: Rec./Entertainment/Parks
Source Energy Use Intensity (kBtu/ft^2)	227.8	96.8
Site Energy Use Intensity (kBtu/ft^2)	141.8	41.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Furlong Field House	National Median Building Type: Rec./Entertainment/Parks
Source Energy Use Intensity (kBtu/ft^2)	204.3	96.8
Site Energy Use Intensity (kBtu/ft^2)	134.3	41.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This building does not belong to one of the building categories that are currently eligible to receive an ENERGY STAR® score.

The EUI scores appear to be higher than the median for this building category, though the discrepancy might be due simply to the broad range of different building types and activities included for that particular building category. However, it might also indicate that there may be additional opportunities to save energy for these buildings through more precise scheduling of HVAC equipment and lighting controls, so that energy usage is kept to a minimum when spaces are unoccupied.

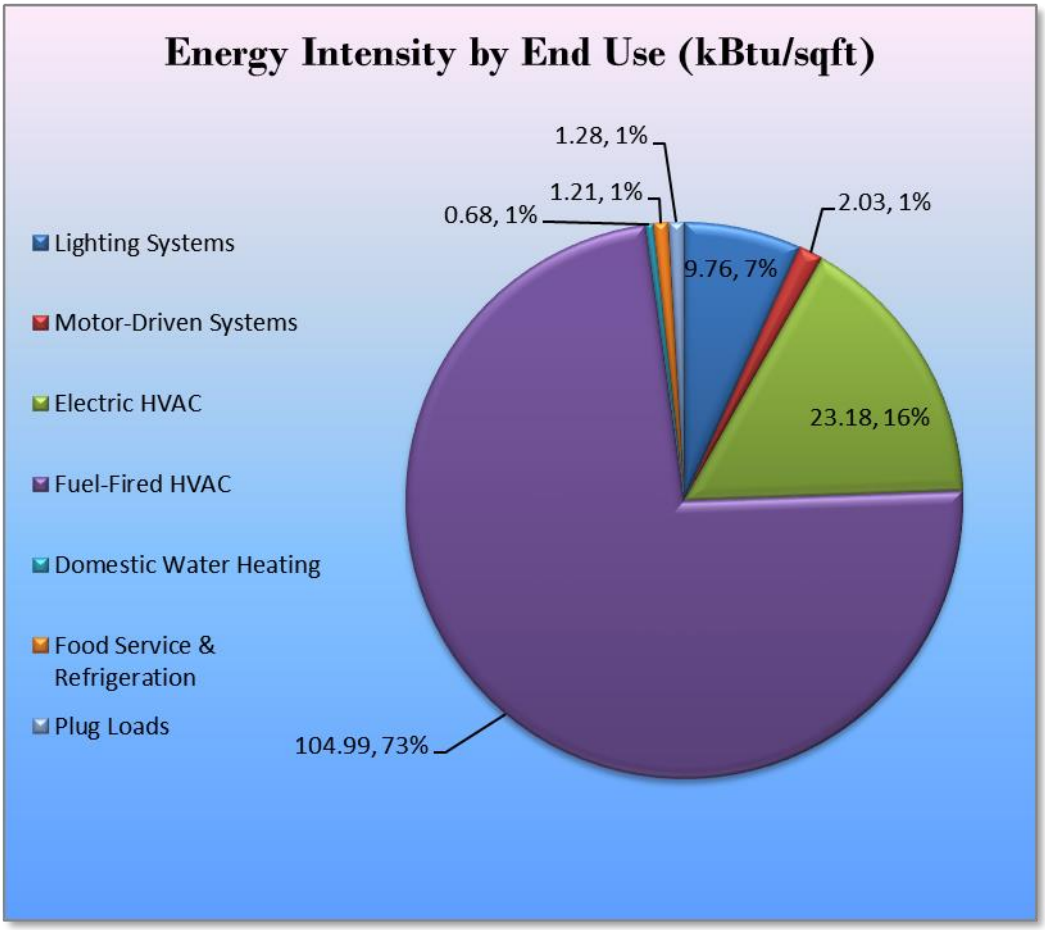
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 14 - Energy Balance (kBtu/ft² and %)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Furlong Field House regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 15 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**26,381**	**7.6**	**0.0**	**$3,916.67**	**$17,937.84**	**$1,670.00**	**$16,267.84**	**4.2**	**26,565**
ECM 1	Install LED Fixtures	6,366	1.2	0.0	$945.08	$3,257.05	$600.00	$2,657.05	2.8	6,410
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	155	0.0	0.0	$22.98	$117.00	$10.00	$107.00	4.7	156
ECM 3	Retrofit Fixtures with LED Lamps	19,860	6.3	0.0	$2,948.61	$14,563.79	$1,060.00	$13,503.79	4.6	19,999
Lighting Control Measures		**2,597**	**0.9**	**0.0**	**$385.54**	**$5,750.00**	**$695.00**	**$5,055.00**	**13.1**	**2,615**
ECM 4	Install Occupancy Sensor Lighting Controls	2,597	0.9	0.0	$385.54	$5,750.00	$695.00	$5,055.00	13.1	2,615
TOTALS		**28,977**	**8.4**	**0.0**	**$4,302.20**	**$23,687.84**	**$2,365.00**	**$21,322.84**	**5.0**	**29,180**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**26,381**	**7.6**	**0.0**	**$3,916.67**	**$17,937.84**	**$1,670.00**	**$16,267.84**	**4.2**	**26,565**
ECM 1	Install LED Fixtures	6,366	1.2	0.0	$945.08	$3,257.05	$600.00	$2,657.05	2.8	6,410
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	155	0.0	0.0	$22.98	$117.00	$10.00	$107.00	4.7	156
ECM 3	Retrofit Fixtures with LED Lamps	19,860	6.3	0.0	$2,948.61	$14,563.79	$1,060.00	$13,503.79	4.6	19,999

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,273	0.4	0.0	$188.94	$1,003.85	$0.00	$1,003.85	5.3	1,281
Exterior	5,093	0.8	0.0	$756.14	$2,253.20	$600.00	$1,653.20	2.2	5,129

Measure Description

We recommend replacing most existing HID fixtures with new high-performance LED light fixtures. Although most HID fixtures can now be simply retrofitted with compatible LED lamps instead, many customers prefer to replace the whole HID fixture with an LED fixture instead.

This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output. Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	155	0.0	0.0	$22.98	$117.00	$10.00	$107.00	4.7	156
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

For older, inefficient T12 linear fluorescent fixtures recommend retrofitting existing fixtures with new LED lamps and replacing ballasts with LED drivers as well. T12 fixtures often contain older, inefficient magnetic ballasts, instead of modern electronic ballasts.

This measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	19,370	6.2	0.0	$2,875.86	$14,388.29	$1,030.00	$13,358.29	4.6	19,506
Exterior	490	0.1	0.0	$72.75	$175.50	$30.00	$145.50	2.0	493

Measure Description

We recommend replacing all existing fixtures containing linear fluorescent and compact florescent lamps with new high-performance LED lamps. Decorative exterior wall sconces with HID lamps near the field house's main entrances were also recommended for retrofit with compatible LED lamps, rather than full fixture replacement.

This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space. Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than ten times longer than many incandescent lamps.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**2,597**	**0.9**	**0.0**	**$385.54**	**$5,750.00**	**$695.00**	**$5,055.00**	**13.1**	**2,615**
ECM 4	Install Occupancy Sensor Lighting Controls	2,597	0.9	0.0	$385.54	$5,750.00	$695.00	$5,055.00	13.1	2,615

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,597	0.9	0.0	$385.54	$5,750.00	$695.00	$5,055.00	13.1	2,615

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in all restrooms, locker rooms, storage rooms, classrooms, offices areas, and other area where occupancy often varies throughout the day, in order prevent unneeded lights from operating after all occupants have left the room.

Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.2 ECM Evaluated, But Not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 18 – Summary of Measure Evaluated, But Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**119.6**	**$502.66**	**$15,434.20**	**$1,414.60**	**$14,019.60**	**27.9**	**14,008**
Install High Efficiency Hot Water Boilers	0	0.0	119.6	$502.66	$15,434.20	$1,414.60	$14,019.60	27.9	14,008
TOTALS	**0**	**0.0**	**119.6**	**$502.66**	**$15,434.20**	**$1,414.60**	**$14,019.60**	**27.9**	**14,008**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Hot Water Boilers

Measure Description

We considered recommending replacement of the field house's main boiler with a new high-efficiency condensing hot water boilers. Significant improvements have been made in combustion technology resulting in increased overall boiler efficiency. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies between 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. The boiler efficiency increases as the return water temperature drops below 130°F. Therefore, condensing hydronic boilers were only evaluated when the return water temperature is less than 130°F during most of the operating hours. As a result, condensing hydronic boilers are recommended for this site, if the hot water heating system can operate at those temperature.

Further study may be necessary to determine feasibility of switching to a high-efficiency condensing boiler. If feasible, a condensing boiler system would provide the most energy savings over the existing unit. If not, then the boiler must be replaced with a less efficient non-condensing model.

Reasons for not Recommending

We chose not to recommend main boiler replacement at this time due the measure's long payback period (~27.9 yrs).

However, the school district may choose to include this upgrade, along with the other recommended ECMs, rather than wait until boiler replacement becomes more necessary. If the school district chooses to include this optional measure, then we estimate that the energy savings for the total payback of measures would increase to 10.3%, though the payback period would increase to 7.5 years (or longer if the existing unit is replaced with a non-condensing boiler).

Note: The payback period for this measure might improve, if the gas rate is revised (see Section 3.3) and/or if the assumed incentive amount is increased, possibly through qualification and participation in the Direct Install program (see Section 8.2).

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced further by increasing the facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

For buildings where occupancy varies widely, making sure that heating or cooling is setback or turned off in unoccupied areas is often the most cost-effective way to achieve energy savings.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

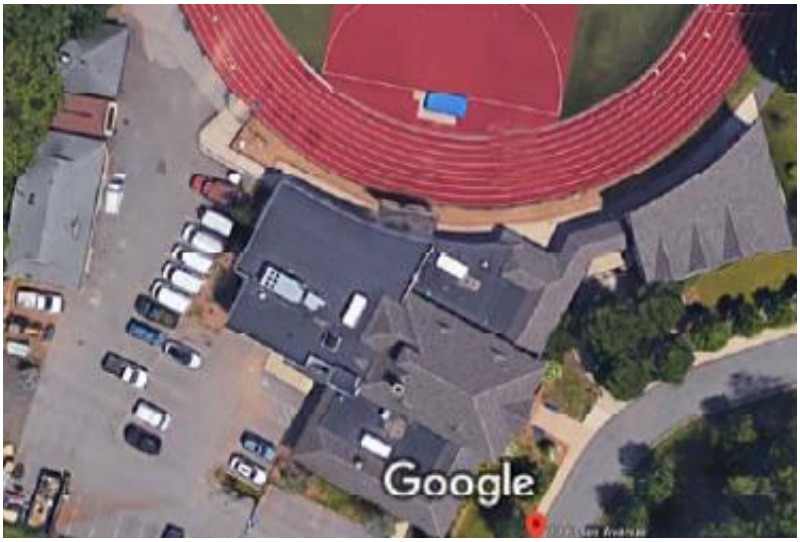
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **low potential** for installing a cost-effective PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the potential for PV at the site.

Image 4: Aerial View of the Facility

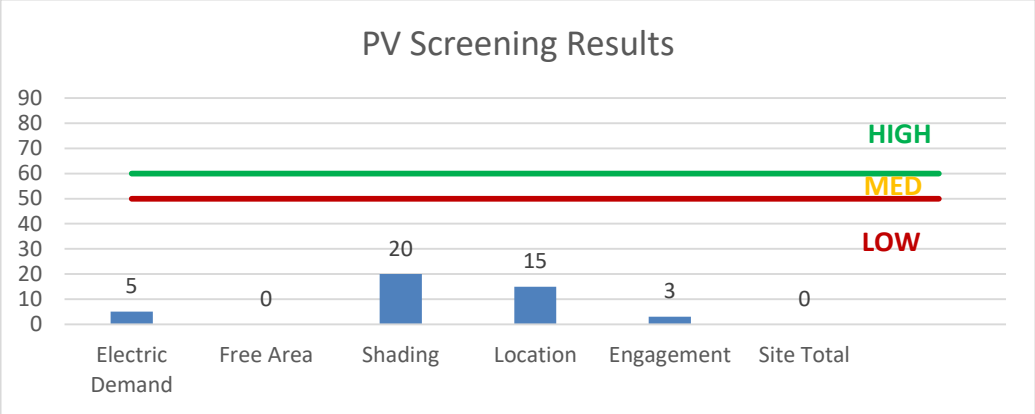


In order to be cost-effective, a solar PV array needs certain minimum criteria, such as flat or south-facing rooftop or other unshaded space on which to place the PV panels.

Most of the building rooftop areas are sloped. Flat roofs are easier for PV installation, but as the image below shows only a relatively small section of roof is flat and unobstructed. In our opinion, the facility does appear not meet these minimum criteria for cost-effective PV installation.

We estimate that the potentially usable area is only about 3,100 ft^2, which might be enough for a small array, but other Montclair BOE properties would probably be more cost-effective to develop for PV solar electric generation.

Figure 19 - Photovoltaic Screening



For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

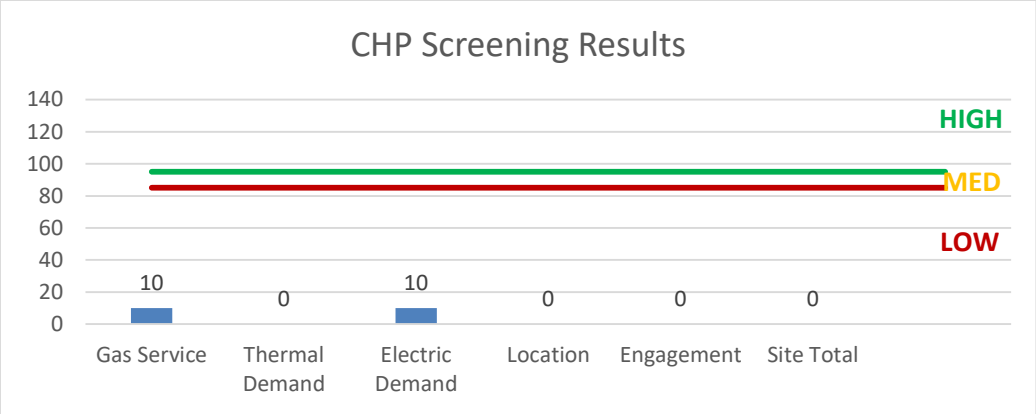
CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **low** potential for installing a cost-effective CHP system.

An infrequent thermal load and lack of space near the existing boilers are among the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in New Jersey specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 20 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 21 for a list of the eligible programs identified for each recommended ECM.

Figure 21 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X		X	
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	X		X	
ECM 3	Retrofit Fixtures with LED Lamps	X		X	
ECM 4	Install Occupancy Sensor Lighting Controls	X		X	

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to medium-sized facilities with a peak electric demand that does not exceed 200 kW for any recent 12-month period. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to **70%** of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor who the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Since Direct Install offers a free assessment of eligible measures, Direct Install is also available to small businesses and other commercial facilities too that may not be eligible for the more detailed facility audits provided by LGEA.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

8.4 Demand Response Energy Aggregator

The first step toward participation in a Demand Response (DR) program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

See Section 7 for additional information.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Front Exterior	2	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	40	4,380	0.28	1,732	0.0	$257.19	$667.58	$200.00	1.82
Rear Door Exterior	1	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	40	4,380	0.14	866	0.0	$128.60	$333.79	$100.00	1.82
Boiler Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.08	260	0.0	$38.57	$175.50	$30.00	3.77
Hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.13	433	0.0	$64.28	$292.50	$50.00	3.77
Office / Elec Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,322	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,625	0.10	328	0.0	$48.73	$266.40	$50.00	4.44
Office / Elec Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	109	0.0	$16.24	$58.50	$30.00	1.75
Weight Rm	15	Metal Halide: (1) 70W Lamp	Wall Switch	95	2,322	Relamp	No	15	LED Screw-In Lamps: 18W Screw-in Corncob Bulbs	Wall Switch	18	2,322	0.94	3,031	0.0	$449.94	$1,405.65	$0.00	3.12
Men's Locker Rm	5	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	5	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.11	352	0.0	$52.20	$717.05	$35.00	13.07
Men's Locker Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	109	0.0	$16.24	$58.50	$45.00	0.83
Women's Locker Rm	5	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	5	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.11	352	0.0	$52.20	$717.05	$35.00	13.07
Women's Locker Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	109	0.0	$16.24	$58.50	$45.00	0.83
2nd Flr Weight Rm	20	Metal Halide: (1) 70W Lamp	Wall Switch	95	2,322	Relamp	No	20	LED Screw-In Lamps: 18W Screw-in Corncob Bulbs	Wall Switch	18	2,322	1.25	4,041	0.0	$599.92	$1,874.20	$0.00	3.12
Coach's Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,322	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,625	0.10	328	0.0	$48.73	$266.40	$50.00	4.44
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,600	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,120	0.03	75	0.0	$11.19	$174.50	$10.00	14.70
2nd Flr Foyer	2	Metal Halide: (1) 70W Lamp	Wall Switch	95	2,322	Relamp	No	2	LED Screw-In Lamps: 18W Screw-in Corncob Bulbs	Wall Switch	18	2,322	0.13	404	0.0	$59.99	$187.42	$0.00	3.12
Stairwell	3	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.08	244	0.0	$36.23	$175.50	$30.00	4.02
Football Locker Rm	6	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	6	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,625	0.19	612	0.0	$90.92	$919.20	$70.00	9.34
Football Locker Rm	2	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.06	208	0.0	$30.93	$117.00	$55.00	2.00
Football Locker Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	109	0.0	$16.24	$58.50	$45.00	0.83
Football Locker Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,322	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,625	0.05	164	0.0	$24.37	$75.20	$50.00	1.03
Front Stairwell	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.08	260	0.0	$38.57	$175.50	$30.00	3.77
Football Locker Rm 2	10	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	10	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,625	0.32	1,021	0.0	$151.54	$1,172.00	$70.00	7.27
Laundry Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.07	219	0.0	$32.49	$233.00	$40.00	5.94
Front Hall	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.03	81	0.0	$12.08	$58.50	$10.00	4.02
Trainer's Rm	8	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	8	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.17	563	0.0	$83.52	$985.28	$35.00	11.38

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Trainer's Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,322	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,625	0.18	578	0.0	$85.78	$285.40	$95.00	2.22
Trainer's Rm	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	104	0.0	$15.47	$58.50	$45.00	0.87
Boys' Locker Rm	8	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	8	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.17	563	0.0	$83.52	$985.28	$35.00	11.38
Back Hall	5	Compact Fluorescent: 2x 26W CFL Recessed Cans	Wall Switch	52	2,322	LED Retrofit	No	5	LED - Fixtures: Downlight Recessed	Wall Switch	21	2,322	0.13	407	0.0	$60.38	$296.90	$0.00	4.92
Boys' Shower	3	Compact Fluorescent: 2x 17W CFL Recessed Cans	Wall Switch	34	2,322	LED Retrofit	No	3	LED - Fixtures: Downlight Recessed	Wall Switch	17	2,322	0.04	134	0.0	$19.87	$172.53	$0.00	8.68
Front Hall	4	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.10	325	0.0	$48.31	$234.00	$40.00	4.02
Men's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,200	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	840	0.05	85	0.0	$12.59	$191.20	$15.00	13.99
Women's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,200	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	840	0.05	85	0.0	$12.59	$191.20	$15.00	13.99
Exit Signs (Field House)	9	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	9	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Outside (Between Bldgs)	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	None	62	4,380	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	None	29	4,380	0.08	490	0.0	$72.75	$175.50	$30.00	2.00
Main Rm (Multi-Purpose Bldg)	9	Compact Fluorescent: 2x 26W CFL Recessed Cans	Wall Switch	52	2,322	LED Retrofit	Yes	9	LED - Fixtures: Downlight Recessed	Occupancy Sensor	21	1,625	0.27	881	0.0	$130.78	$804.42	$35.00	5.88
Server Rm	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	600	0.03	21	0.0	$3.12	$58.50	$10.00	15.54
Men's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,322	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,625	0.05	164	0.0	$24.37	$191.20	$15.00	7.23
Men's Rm	4	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	4	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.09	281	0.0	$41.76	$627.64	$35.00	14.19
Women's Rm	4	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	4	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.09	281	0.0	$41.76	$627.64	$35.00	14.19
Mop Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	800	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	800	0.01	16	0.0	$2.35	$35.90	$5.00	13.16
Girls' Locker Rm	7	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	7	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.15	492	0.0	$73.08	$895.87	$35.00	11.78
Girls' Locker Rm 2	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	11	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.37	1,204	0.0	$178.69	$1,183.50	$180.00	5.62
Girls' Locker Rm 2	4	Compact Fluorescent: 38W 4-pin plug-in CFL	Wall Switch	38	2,322	Relamp	Yes	4	LED - Fixtures: Downlight Surface Mount	Occupancy Sensor	16	1,625	0.09	281	0.0	$41.76	$357.64	$35.00	7.73
Girls' Coach Locker Rm	1	Linear Fluorescent - T5: 4' T5 (28W) - 2L	Wall Switch	60	2,322	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.03	104	0.0	$15.47	$58.50	$30.00	1.84
Girls' Coach Locker Rm	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,322	Relamp & Reballast	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.06	178	0.0	$26.37	$233.00	$30.00	7.70
Front Door (Multi-Purpose Bldg)	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.03	87	0.0	$12.86	$58.50	$10.00	3.77
Exit Signs (Multi-Purpose Bldg)	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Building & Grounds Dept. Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,322	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,625	0.12	385	0.0	$57.19	$306.27	$60.00	4.31
Building & Grounds Dept. Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,322	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,625	0.05	164	0.0	$24.37	$75.20	$35.00	1.65

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Garage	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,625	0.51	1,641	0.0	$243.67	$1,417.50	$220.00	4.91
Garage	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
B&G Dept. Restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	840	0.03	53	0.0	$7.83	$179.20	$0.00	22.88
Machine Shop	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.24	779	0.0	$115.70	$526.50	$90.00	3.77
Machine Shop	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,322	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,322	0.03	92	0.0	$13.63	$71.80	$10.00	4.53
Concession Stand	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	700	0.31	424	0.0	$62.96	$796.50	$125.00	10.66
Concession Stand	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Concession Stand Exterior	6	Compact Fluorescent: 23W Recessed Cans	None	23	4,380	LED Retrofit	No	6	LED - Fixtures: Downlight Recessed	None	17	4,380	0.03	178	0.0	$26.45	$345.06	$0.00	13.04
Garage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,322	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,322	0.05	173	0.0	$25.71	$117.00	$20.00	3.77
Grounds Office Exterior	2	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	40	4,380	0.28	1,732	0.0	$257.19	$667.58	$200.00	1.82
Grounds Office Exterior	1	High-Pressure Sodium: (1) 100W Lamp	None	138	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	20	4,380	0.10	584	0.0	$86.71	$239.19	$100.00	1.61

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Concession Stand	Range Hood	2	Kitchen Hood Exhaust Fan	0.5	78.0%	No	100	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Field House	Ventilation Fans	6	Supply Fan	0.5	78.0%	No	1,800	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Field House	Ventilation Fans	6	Return Fan	0.5	78.0%	No	1,800	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Multi-Purpose Bldg	1	Split-System AC	12.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Field House	2	Packaged AC	20.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Field House	1	Packaged AC	25.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Field House	1	Packaged AC	20.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
B&G Office & Garage	B&G Office & Garage	1	Through-The-Wall AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
B&G Office & Garage	B&G Office & Garage	1	Electric Resistance Heat		17.00	No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Rm	Field House	1	Non-Condensing Hot Water Boiler	643.00	Yes	1	Condensing Hot Water Boiler	643.00	94.00%	Et	0.00	0	119.6	$502.66	$15,434.20	$1,414.60	27.89
Roof	Field House	2	Furnace	250.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Field House	1	Furnace	300.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Field House	1	Furnace	240.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Field House	2	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Cond	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Trainer's Rm	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Concession Stand	1	Stand-Up Refrigerator, Glass Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Concession Stand	1	Freezer Chest	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Cond	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Trainer's Rm	1	Ice Making Head (<450 lbs/day), Batch	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Field House / B&G Office	5	Desktop Computer + Monitor	150.0	Yes
Multi-Purpose	1	TVs (42", LED)	80.0	Yes
Field House / B&G Office	1	Printers (sm.)	80.0	Yes
Field House / B&G Office	1	Copy Machine	240.0	Yes
Server Rm	1	Server Rack	360.0	Yes

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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N/A

ENERGY STAR® Score[1]

Woodman / Furlong Field House

Primary Property Type: Fitness Center/Health Club/Gym
Gross Floor Area (ft²): 13,184
Built: 1925

For Year Ending: April 30, 2016
Date Generated: December 25, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Woodman / Furlong Field House 28 Essex Avenue Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724948

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
152.6 kBtu/ft²

Source EUI
259.2 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	624,375 (31%)
Natural Gas (kBtu)	1,387,841 (69%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	57
National Median Source EUI (kBtu/ft²)	96.8
% Diff from National Median Source EUI	168%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	143

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



George Inness High School

Annex

Montclair Board of Education

141 Park Street

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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Appendix A: Equipment Inventory & Recommendations

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the George Inness High School Annex.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey school districts in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

The George Inness High School Annex is a three-story building totaling 89,261 square foot facility and originally constructed in 1925. The building has both pitched and flat roof sections. Exterior walls are finished with brick masonry. Interior lighting consists mainly of linear fluorescent lamps and fixtures which are mostly controlled with manual wall switches. Heating is provided by two steam boilers and gas-fired furnaces. The cooling system consists of window air conditioners (ACs), split system ACs, two air-cooled scroll chillers and rooftop packaged units.

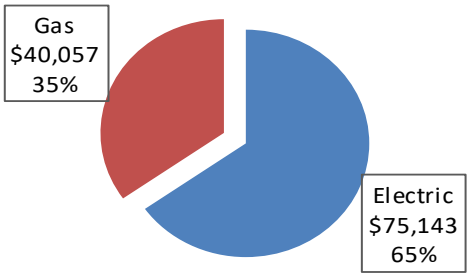
A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

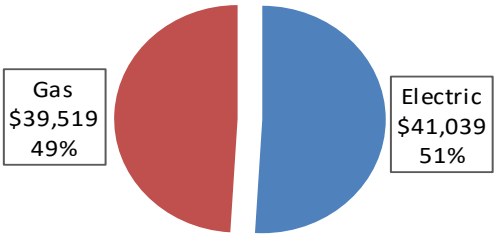
TRC evaluated 13 measures. Five measures were recommended for implementation which together represent an opportunity for George Inness High School Annex to reduce annual energy costs by roughly $27,952 and annual greenhouse gas emissions by 208,065 lbs CO_2e. The measures would pay for themselves in roughly 4.4 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce the George Inness High School Annex's annual energy use by 12.1%.

Figure 1 – Previous 12 Month Utility Costs



$115,200

Figure 2 – Potential Post-Implementation Costs



$80,558

A detailed description of the George Inness High School Annex's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4. Measures without an "ECM #" in the table below have been evaluated, but are not recommended for implementation.

Figure 3 – Summary of Energy Reduction Opportunities

	Energy Conservation Measure	Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**164,362**	**56.3**	**0.0**	**$22,561.48**	**$118,805.52**	**$13,970.00**	**$104,835.52**	**4.65**	**165,512**
ECM 1	Install LED Fixtures	Yes	81,117	30.1	0.0	$11,134.72	$54,426.60	$1,900.00	$52,526.60	4.72	81,685
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	5,345	1.8	0.0	$733.72	$5,499.00	$450.00	$5,049.00	6.88	5,383
ECM 3	Retrofit Fixtures with LED Lamps	Yes	77,900	24.4	0.0	$10,693.04	$58,879.92	$11,620.00	$47,259.92	4.42	78,444
Lighting Control Measures			**21,288**	**6.6**	**0.0**	**$2,922.15**	**$18,068.00**	**$2,305.00**	**$15,763.00**	**5.39**	**21,437**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	19,148	6.0	0.0	$2,628.41	$15,468.00	$2,305.00	$13,163.00	5.01	19,282
ECM 5	Install High/Low Lighitng Controls	Yes	2,140	0.6	0.0	$293.74	$2,600.00	$0.00	$2,600.00	8.85	2,155
Motor Upgrades			**550**	**0.4**	**0.0**	**$75.47**	**$1,596.51**	**$0.00**	**$1,596.51**	**21.15**	**554**
	Premium Efficiency Motors	No	550	0.4	0.0	$75.47	$1,596.51	$0.00	$1,596.51	21.15	554
Electric Unitary HVAC Measures			**4,957**	**4.2**	**0.0**	**$680.44**	**$44,603.20**	**$2,528.00**	**$42,075.20**	**61.84**	**4,992**
	Install High Efficiency Electric AC	No	4,957	4.2	0.0	$680.44	$44,603.20	$2,528.00	$42,075.20	61.84	4,992
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**72.5**	**$656.65**	**$158,612.96**	**$8,744.00**	**$149,868.96**	**228.23**	**8,489**
	Install High Efficiency Steam Boilers	No	0	0.0	59.2	$536.32	$140,215.20	$7,544.00	$132,671.20	247.37	6,933
	Install High Efficiency Furnaces	No	0	0.0	13.3	$120.32	$18,397.75	$1,200.00	$17,197.75	142.93	1,555
HVAC System Improvements			**9,233**	**2.1**	**0.0**	**$1,267.34**	**$1,800.00**	**$500.00**	**$1,300.00**	**1.03**	**9,297**
ECM 6	Install Dual Enthalpy Outside Economizer Control	Yes	9,233	2.1	0.0	$1,267.34	$1,800.00	$500.00	$1,300.00	1.03	9,297
Domestic Water Heating Upgrade			**0**	**0.0**	**69.2**	**$627.16**	**$5,012.53**	**$170.00**	**$4,842.53**	**7.72**	**8,107**
	Install High Efficiency Gas Water Heater	No	0	0.0	9.9	$89.59	$4,912.15	$170.00	$4,742.15	52.93	1,158
ECM 7	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	59.4	$537.57	$100.38	$0.00	$100.38	0.19	6,949
Plug Load Equipment Control - Vending Machine			**4,836**	**0.0**	**0.0**	**$663.76**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.25**	**4,869**
ECM 8	Vending Machine Control	Yes	4,836	0.0	0.0	$663.76	$2,156.40	$0.00	$2,156.40	3.25	4,869
TOTAL FOR ALL RECOMMENDED MEASURES			**199,719**	**65.0**	**59.4**	**$27,952.30**	**$140,930.30**	**$16,775.00**	**$124,155.30**	**4.44**	**208,065**
TOTALS			**205,226**	**69.6**	**141.7**	**$29,454.45**	**$350,655.12**	**$28,217.00**	**$322,438.12**	**10.95**	**223,257**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing old standard efficiency motors with motors of the current efficiency standard (EISA 2007). Motors will be replaced with the same size motors. This measure saves energy by reducing the power used by the motors due to improved electrical efficiency.

Electric Unitary HVAC measures generally involve replacing old inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide cooling equivalent to older air condition systems, but use less energy. These measures save energy by reducing the power used by the air condition system due to improved electrical efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing old inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide heating equivalent to older systems, but use less energy. These measures save energy by reducing the fuel used by the heating due to improved combustion and heat transfer efficiency.

HVAC System Improvements generally involve the installation of automated controls to reduce heating and cooling demand when conditions allow. These measures could encompass changing temperature setpoints, using outside air for free cooling, or limiting excessive outside air during extreme outdoor air temperatures. These measures save energy by reducing the demand on the systems and the amount of time systems operate.

Domestic Water Heating upgrade measures generally involve replacing old inefficient domestic water heating systems with modern energy efficient systems. New domestic water heating systems can provide equivalent or greater capacity as older systems, but use less energy. These measures save energy by reducing the fuel used by the domestic water heating systems due to improved efficiency or the removal of standby losses.

Plug Load Equipment control measures generally involve installing automation that limits the power use or operation of equipment plugged into an electrical receptacle based on occupancy.

Energy Efficient Practices

TRC also identified nine low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at the George Inness High School Annex include:

- Reduce Air Leakage
- Close Doors and Windows
- Ensure Lighting Controls Are Operating Properly
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for the George Inness High School Annex. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- Pay for Performance - Existing Building (P4P EB)
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program, you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	973-509-4050
Designated Representative			
Eric Bonilla	Custodian		973-652-9495
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	732-855-0033

2.2 General Site Information

On November 08, 2016, TRC performed an energy audit at the George Inness High School Annex located in Montclair, New Jersey. TRC's auditor met with Eric Bonilla to review the facility operations and focus the investigation on specific energy-using systems.



Image 1 – Auditorium

The 89,261-square foot facility is a three-story building comprised of classrooms, administrative offices, gymnasium, auditorium, locker rooms, cafeteria, kitchen, storage and mechanical spaces. The original building was constructed in 1925. Three years later in 1928, the auditorium stage and dressing rooms were added. A new section comprised of a kitchen, a cafeteria and additional classrooms was constructed in 2003. The building is used primarily for high school programs.

2.3 Building Occupancy

The school operates on an 11-month schedule and is open Monday through Friday. The gymnasium and auditorium are used after school hours. The school is also used in the summer for various classes and events. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 475 students and staff

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
George Inness High School Annex	Weekday	7:00 AM - 6:30 PM
George Inness High School Annex	Weekend	Closed

2.4 Building Envelope



Image 2 – Building Envelope

The three-story building with basement has a reinforced concrete foundation. The roofing system consists of a pitched asphalt shingled roof on the front facing section and perimeter, and a membrane type flat roof on the back of the building where the HVAC equipment resides. The exterior walls are finished with brick masonry. The windows throughout the facility are operable double-pane with aluminum frames. Windows are in acceptable condition with little sign of outside air infiltration. Exterior doors are constructed of metal and are in good condition. Overall, the building's envelope is in good condition.

2.5 On-site Generation

The George Inness High School Annex does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Lighting at the facility is provided predominately by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as linear 40-Watt fluorescent T12 and incandescent lamps. Most of the building classrooms use 2-lamp or 4-lamp, 2-foot wide by 4-foot long troffers with diffusers. The girl's and the boy's gymnasiums are illuminated with 350-Watt and 400-Watt metal halide respectively. The boiler room, auditorium stage, fitting room are illuminated with a combination of 32-Watt linear fluorescent T8 and 40-Watt fluorescent T12 lamps while the auditorium is lit with 40 and 55-Watt Candelabra and 100-Watt incandescent screw-in lamps. The attic is also illuminated with 100-Watt incandescent lamps. A small number of 60 and 150-Watt incandescent are found in spaces such as closets, storage and boiler rooms. Remaining building spaces are illuminated by 32-Watt linear fluorescent T8 lamps. Lighting control is provided mostly by manual wall switches. The facility exterior lighting system consists of 150-Watt incandescent and 45-Watt LED outdoor wall-mounted area fixture, controlled by photocells.

Steam Heating System



Image 3 – Steam System

The steam system consists of two 3,772 MBh output steam boilers, each with an estimated combustion efficiency of 75%, plus the associated distribution system. Each boiler has a 1 hp combustion air fan, a 3 hp feed water pump and a control valve that maintains the boiler water level. The boilers operate in a lead/lag configuration. The boilers are 29 years old and have passed their useful service life. Steam is supplied to the radiators and heating unit ventilators at 15 psi. Local thermostats are used to control the temperatures in spaces. The school should consider re-evaluating the building heating load and installing modular boilers when existing equipment is replaced.

Air Side Conditioning Systems

Cooling is provided by a combination of window air conditioners (ACs), split system ACs, two air-cooled scroll chillers and rooftop packaged units. There are 12 window ACs ranging from 0.7 to 1.9 ton. They are in relatively good condition and serve spaces such as offices, data room, teacher room, and nurse office. The cafeteria office is served by 1-ton Mitsubishi split AC while the auditorium control center and room 500A are served by a 4-ton Trane split AC. The split system ACs are in good condition. The two 60-ton Trane air-cooled scroll chillers all located on the roof and are used to condition the cafeteria and auditorium. They are eight years old and appear in good condition.

Two 16-ton AAON rooftop packaged units (RTU1-RTU2) equipped with a gas fired furnace section are used to condition rooms 600B and 602. The units are constant air volume, utilize a scroll compressor and a direct-expansion (DX) coil. They appear in good condition. A McQuay rooftop unit equipped with a gas-fired furnace section provides supplemental heating to the auditorium. One Greenheck energy recovery ventilation unit (ERV) is used to condition the kitchen and is in good condition as well. The rooftop packaged units are controlled by Energy of America remote building energy management system. Air is exhausted from the kitchen and cafeteria through the roof exhausters.



Image 4 – Air Conditioning

Building Energy Management System

Most of the rooftop units are controlled by Energy of America remote control system which was not accessible during the survey.

Domestic Hot Water

Domestic hot water is provided by two natural gas fired water heaters. One eight-year-old, Bradford White 75-gallon storage tank non-condensing 76 Mbh water heater is located in the boiler room. It appears in good condition and serves the kitchen and cafeteria. The primary water heater is a 150 Mbh A.O. Smith 15-year-old condensing unit that appears in poor condition. It has a 100-gallon storage tank and is located in the custodial closet. Both heaters are nominally 85% efficient.



Image 5 – Hot Water System

Food Service & Refrigeration

The school houses one small kitchen and a cafeteria. The kitchen includes gas convection ovens and insulated food holding cabinets, two standup refrigerators, one walk-in cooler and one walk-in medium freezer. The kitchen is well maintained. Two other standup refrigerators are in the teacher's and nurse's rooms.

Plug load & Vending Machines



The building has approximately 105 computers with LCD monitors that are used daily, plus servers, three large photocopiers, and seven printers. The computers, monitors, and printers seemed to be all recent models designed with power management software to reduce power when they sit idle for more than a few minutes. The building has two vending machines located in the cafeteria and teacher room.

Image 6 – Typical Plug Load Equipment

2.7 Water-Using Systems

There are several restrooms at this facility. A sampling of restrooms found that the faucets are rated for 2.2 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf)and the urinals are rated at 2 gpf. The kitchen has four faucets that are rated for 3 gpm.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are many factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

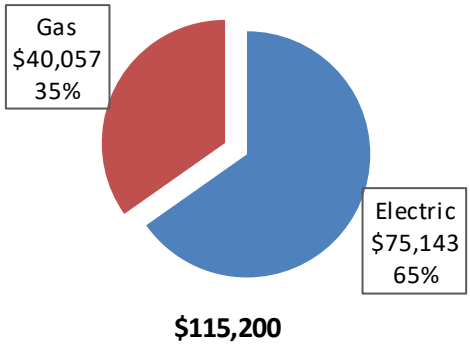
The following energy consumption and cost data is based on the last 12-month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 6 - Utility Summary

Utility Summary for George Inness High School Annex		
Fuel	**Usage**	**Cost**
Electricity	494,368 kWh	$75,143
Natural Gas	44,225 Therms	$40,057
Total		**$115,200**

The current utility cost for this site is $115,200 as shown in the chart below.

Figure 7 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.137/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects high occupancy in the summer months.

Figure 8 - Electric Usage & Demand

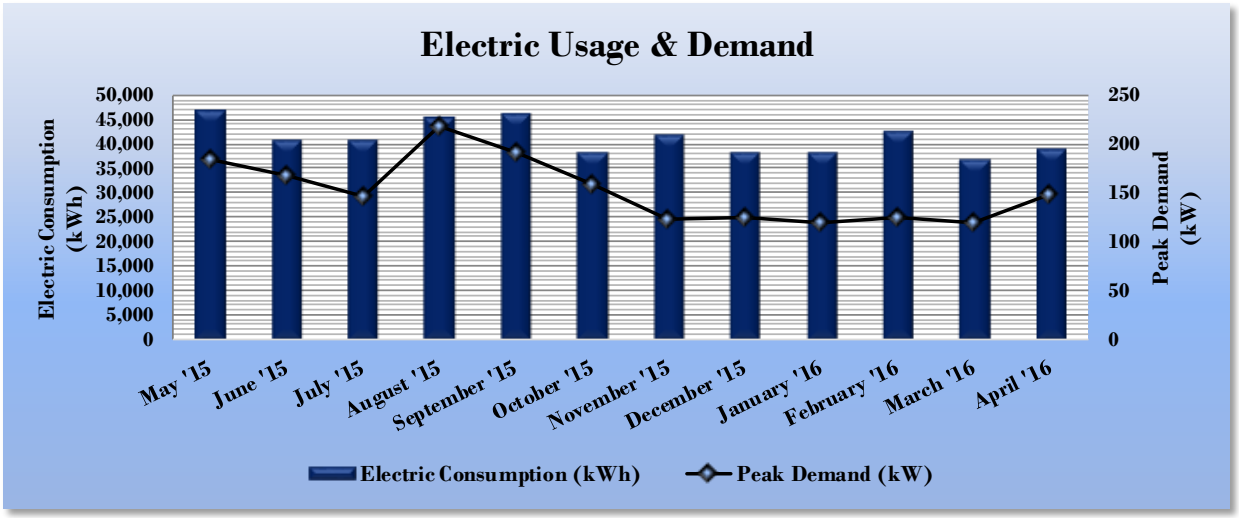


Figure 9 - Electric Usage & Demand

Electric Billing Data for George Inness High School Annex					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
6/15/15	30	46,969	183	$482	$8,486
7/15/15	31	40,814	167	$647	$7,495
8/13/15	30	40,617	146	$661	$7,150
9/14/15	30	45,448	218	$602	$8,524
10/13/15	31	45,968	191	$526	$6,601
11/12/15	30	38,083	159	$1,314	$5,509
12/14/15	30	41,857	123	$693	$5,694
1/14/16	31	38,129	124	$576	$5,082
2/12/16	31	38,163	119	$446	$4,992
3/15/16	31	42,398	125	$451	$5,509
4/14/16	29	36,928	118	$431	$4,884
5/13/16	31	38,994	148	$455	$5,220
Totals	**365**	**494,368**	**218**	**$7,283**	**$75,143**
Annual	**365**	**494,368**	**218**	**$7,283**	**$75,143**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.906/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 10 - Natural Gas Usage

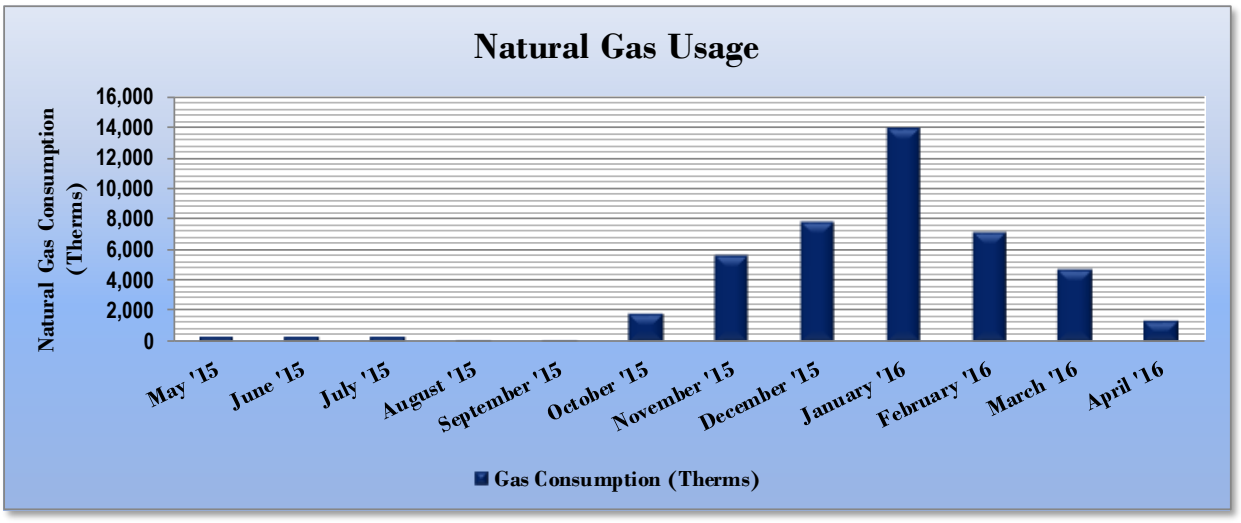


Figure 11 - Natural Gas Usage

Gas Billing Data for George Inness High School Annex				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/16/15	30	388	$404	Yes
7/20/15	31	377	$402	Yes
8/17/15	30	365	$275	No
9/15/15	30	169	$219	No
10/14/15	31	174	$213	No
11/12/15	30	1,830	$4,049	Yes
12/15/15	30	5,667	$6,379	No
1/15/16	31	7,829	$7,709	No
2/16/16	31	14,004	$10,476	No
3/17/16	31	7,164	$6,143	Yes
4/15/16	29	4,790	$2,787	No
5/17/16	31	1,468	$1,001	No
Totals	**365**	**44,225**	**$40,057**	4
Annual	**365**	**44,225**	**$40,057**	

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the Energy Use Intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	George Inness High School Annex	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	111.4	141.4
Site Energy Use Intensity (kBtu/ft^2)	68.4	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	George Inness High School Annex	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	86.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	60.1	58.2

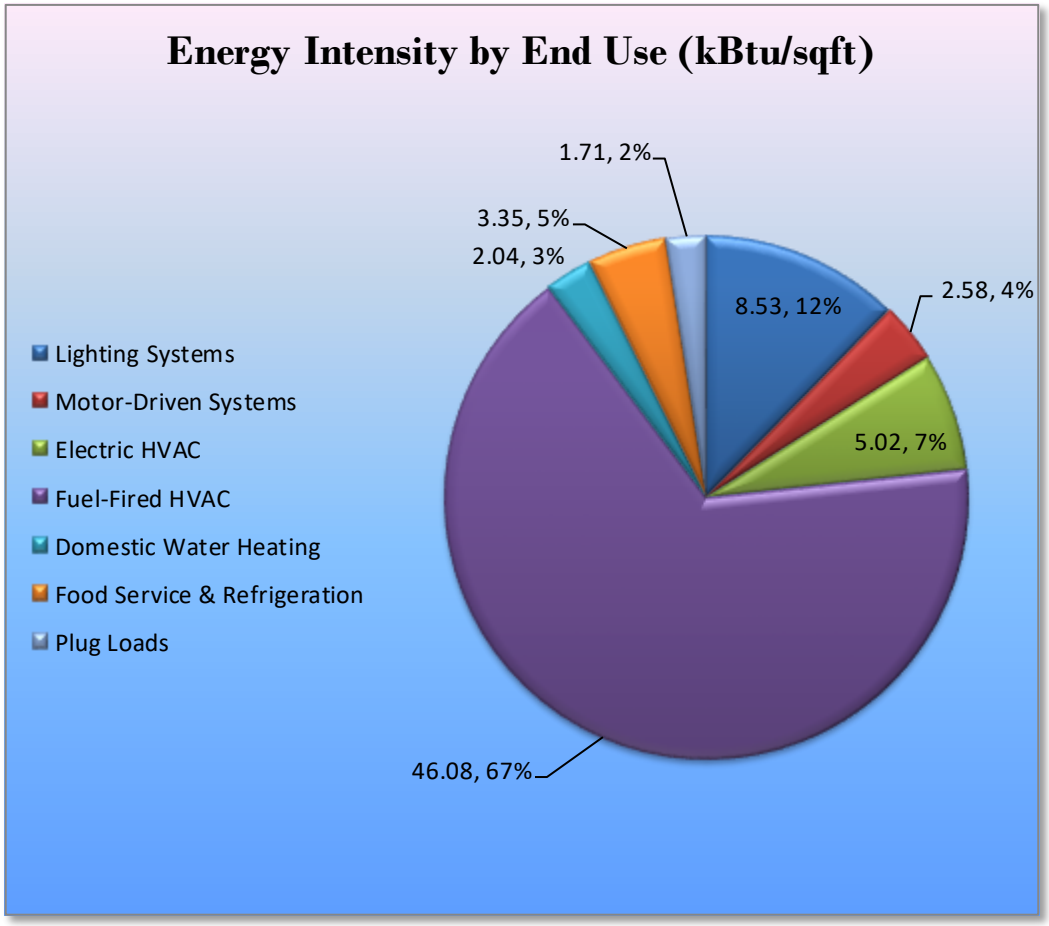
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 67.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 14 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the George Inness High School Annex on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJ prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 15 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**164,362**	**56.3**	**0.0**	**$22,561.48**	**$118,805.52**	**$13,970.00**	**$104,835.52**	**4.65**	**165,512**
ECM 1	Install LED Fixtures	81,117	30.1	0.0	$11,134.72	$54,426.60	$1,900.00	$52,526.60	4.72	81,685
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	5,345	1.8	0.0	$733.72	$5,499.00	$450.00	$5,049.00	6.88	5,383
ECM 3	Retrofit Fixtures with LED Lamps	77,900	24.4	0.0	$10,693.04	$58,879.92	$11,620.00	$47,259.92	4.42	78,444
Lighting Control Measures		**21,288**	**6.6**	**0.0**	**$2,922.15**	**$18,068.00**	**$2,305.00**	**$15,763.00**	**5.39**	**21,437**
ECM 4	Install Occupancy Sensor Lighting Controls	19,148	6.0	0.0	$2,628.41	$15,468.00	$2,305.00	$13,163.00	5.01	19,282
ECM 5	Install High/Low Lighitng Controls	2,140	0.6	0.0	$293.74	$2,600.00	$0.00	$2,600.00	8.85	2,155
HVAC System Improvements		**9,233**	**2.1**	**0.0**	**$1,267.34**	**$1,800.00**	**$500.00**	**$1,300.00**	**1.03**	**9,297**
ECM 6	Install Dual Enthalpy Outside Economizer Control	9,233	2.1	0.0	$1,267.34	$1,800.00	$500.00	$1,300.00	1.03	9,297
Domestic Water Heating Upgrade		**0**	**0.0**	**59.4**	**$537.57**	**$100.38**	**$0.00**	**$100.38**	**0.19**	**6,949**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	59.4	$537.57	$100.38	$0.00	$100.38	0.19	6,949
Plug Load Equipment Control - Vending Machine		**4,836**	**0.0**	**0.0**	**$663.76**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.25**	**4,869**
ECM 8	Vending Machine Control	4,836	0.0	0.0	$663.76	$2,156.40	$0.00	$2,156.40	3.25	4,869
TOTALS		**199,719**	**65.0**	**59.4**	**$27,952.30**	**$140,930.30**	**$16,775.00**	**$124,155.30**	**4.44**	**208,065**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting upgrades are summarized in Figure 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**164,362**	**56.3**	**0.0**	**$22,561.48**	**$118,805.52**	**$13,970.00**	**$104,835.52**	**4.65**	**165,512**
ECM 1	Install LED Fixtures	81,117	30.1	0.0	$11,134.72	$54,426.60	$1,900.00	$52,526.60	4.72	81,685
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	5,345	1.8	0.0	$733.72	$5,499.00	$450.00	$5,049.00	6.88	5,383
ECM 3	Retrofit Fixtures with LED Lamps	77,900	24.4	0.0	$10,693.04	$58,879.92	$11,620.00	$47,259.92	4.42	78,444

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	81,117	30.1	0.0	$11,134.72	$54,426.60	$1,900.00	$52,526.60	4.72	81,685
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing existing metal halide fixtures located in the gymnasiums and halogen incandescent auditorium stage lighting with new high-performance LED light fixtures. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	5,345	1.8	0.0	$733.72	$5,499.00	$450.00	$5,049.00	6.88	5,383
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T12 lamps, ballasts, and reflectors with LED tube lamps, reflectors, and drivers specifically designed for existing linear fluorescent fixtures. The retrofit uses the existing fixture housing but replaces the rest of the components with an efficient source and reflectors designed for LEDs. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output and efficiently projects the light into the space.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	74,701	24.0	0.0	$10,254.00	$58,390.65	$11,570.00	$46,820.65	4.57	75,224
Exterior	3,198	0.4	0.0	$439.05	$489.27	$50.00	$439.27	1.00	3,221

Measure Description

This measure evaluates replacing linear fluorescent T5 and T8 lamps with LED tube lamps and replacing incandescent screw-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in lamps can be used as a direct replacement for most other screw-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**21,288**	**6.6**	**0.0**	**$2,922.15**	**$18,068.00**	**$2,305.00**	**$15,763.00**	**5.39**	**21,437**
ECM 4	Install Occupancy Sensor Lighting Controls	19,148	6.0	0.0	$2,628.41	$15,468.00	$2,305.00	$13,163.00	5.01	19,282
ECM 5	Install High/Low Lighitng Controls	2,140	0.6	0.0	$293.74	$2,600.00	$0.00	$2,600.00	8.85	2,155

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
19,148	6.0	0.0	$2,628.41	$15,468.00	$2,305.00	$13,163.00	5.01	19,282

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in some restrooms, storage rooms, classrooms and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,140	0.6	0.0	$293.74	$2,600.00	$0.00	$2,600.00	8.85	2,155

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are interior corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high-level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period.

For this application, the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.1.3 HVAC System Improvements

Our recommendations for HVAC system improvement measures are summarized in Figure 18 below.

Figure 18 - Summary of HVAC System Improvement ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**9,233**	**2.1**	**0.0**	**$1,267.34**	**$1,800.00**	**$500.00**	**$1,300.00**	**1.03**	**9,297**
ECM 6	Install Dual Enthalpy Outside Economizer Control	9,233	2.1	0.0	$1,267.34	$1,800.00	$500.00	$1,300.00	1.03	9,297

ECM 6: Install Dual Enthalpy Outside Economizer Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
9,233	2.1	0.0	$1,267.34	$1,800.00	$500.00	$1,300.00	1.03	9,297

Measure Description

Dual enthalpy economizers of the packaged units are used to control a ventilation system's outside air intake in order to reduce a facility's total cooling load. A dual enthalpy economizer monitors the air temperature and humidity of both the outside and return air. The control supplies the lowest energy (temperature and humidity) air to the air handling system. When outside air conditions allow, outside air can be used for cooling in place of the air handling system's compressor. This reduces the demand on the cooling system, lowering its usage hours, saving energy.

Savings result from using outside air instead of mechanical cooling whenever possible. The retrofit measure is recommended for RTU 1 and RTU 2.

4.1.4 Domestic Water Heating Upgrade

Our recommendations for domestic water heating measures are summarized in Figure 19 below.

Figure 19 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**59.4**	**$537.57**	**$100.38**	**$0.00**	**$100.38**	**0.19**	**6,949**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	59.4	$537.57	$100.38	$0.00	$100.38	0.19	6,949

ECM 7: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	59.4	$537.57	$100.38	$0.00	$100.38	0.19	6,949

Measure Description

This measure evaluates the savings from installing low flow domestic water devices to reduce overall water flow in general and hot water flow in particular. Low flow faucet aerators reduce the water flow, relative to standard aerators, from the fixture

All of the low flow devices reduce the overall water flow from the fixture which generally reduces the amount of hot water used resulting in energy and water savings.

4.1.5 Plug Load Equipment Control - Vending Machine

Our recommendations for plug load equipment control measures are summarized in Figure 20 below.

Figure 20 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Natural Gas Savings (MMBtu)	Annual N/A Savings (MMBtu)	Annual N/A Savings (MMBtu)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**4,836**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**$663.76**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.25**	**4,869**
ECM 8	Vending Machine Control	4,836	0.0	0.0	0.0	0.0	0.0	$663.76	$2,156.40	$0.00	$2,156.40	3.25	4,869

ECM 8: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,836	0.0	0.0	$663.76	$2,156.40	$0.00	$2,156.40	3.25	4,869

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor based controls to reduce the energy use. These controls power down the machine when the surrounding area is vacant, then monitor the surrounding temperature and power up the cooling system at regular intervals to keep the product cool. Savings are a function of the activity level around the vending machine.

4.2 ECMs Evaluated but Not Recommended

The measures below have been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in each measure description section.

Figure 21 – Summary of Evaluated but Not Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**550**	**0.4**	**0.0**	**$75.47**	**$1,596.51**	**$0.00**	**$1,596.51**	**21.15**	**554**
	Premium Efficiency Motors	550	0.4	0.0	$75.47	$1,596.51	$0.00	$1,596.51	21.15	554
Electric Unitary HVAC Measures		**4,957**	**4.2**	**0.0**	**$680.44**	**$44,603.20**	**$2,528.00**	**$42,075.20**	**61.84**	**4,992**
	Install High Efficiency Electric AC	4,957	4.2	0.0	$680.44	$44,603.20	$2,528.00	$42,075.20	61.84	4,992
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**72.5**	**$656.65**	**$158,612.96**	**$8,744.00**	**$149,868.96**	**228.23**	**8,489**
	Install High Efficiency Steam Boilers	0	0.0	59.2	$536.32	$140,215.20	$7,544.00	$132,671.20	247.37	6,933
	Install High Efficiency Furnaces	0	0.0	13.3	$120.32	$18,397.75	$1,200.00	$17,197.75	142.93	1,555
Domestic Water Heating Upgrade		**0**	**0.0**	**9.9**	**$89.59**	**$4,912.15**	**$170.00**	**$4,742.15**	**52.93**	**1,158**
	Install High Efficiency Gas Water Heater	0	0.0	9.9	$89.59	$4,912.15	$170.00	$4,742.15	52.93	1,158
TOTALS		**5,507**	**4.6**	**82.4**	**$1,502.15**	**$209,724.82**	**$11,442.00**	**$198,282.82**	**132.00**	**15,192**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
550	0.4	0.0	$75.47	$1,596.51	$0.00	$1,596.51	21.15	554

Measure Description

This measure evaluates replacing standard efficiency condenser water pumps motors with EISA 2007 efficiency motors. The evaluation assumes existing motors will be replaced with the same size motors. It is important that the speed of each new motor match the speed of the motor it replaces as closely as possible. The base case motor efficiencies are obtained from nameplate information. Proposed case premium motor efficiencies are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the annual operating hours.

Reasons for not Recommending

The measure was evaluated for the condenser water pump, partially due to its advanced age. The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Electric AC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,957	4.2	0.0	$680.44	$44,603.20	$2,528.00	$42,075.20	61.84	4,992

Measure Description

This measure evaluates replacing package air conditioners with high efficiency package air conditioners. There have been significant improvements in both compressor and fan motor efficiencies in the past several years. Therefore, electricity savings can be achieved by replacing old units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the old and new unit, the cooling load, and the annual operating hours.

Reasons for not Recommending

The measure was evaluated for RTU-1 and RTU-2. The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Steam Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	59.2	$536.32	$140,215.20	$7,544.00	$132,671.20	247.37	6,933

Measure Description

This measure evaluates replacing the two old inefficient steam boilers with high efficiency steam boilers. Significant improvements have been made in combustion technology resulting in increases in overall boiler efficiency. Savings result from improved combustion efficiency and reduced standby losses at low loads. The school should consider re-evaluating the building heating load and installing modular steam boilers when these are replaced.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful live of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Furnaces

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	13.3	$120.32	$18,397.75	$1,200.00	$17,197.75	142.93	1,555

Measure Description

This measure evaluates replacing existing standard furnaces of the packaged units with condensing furnaces. Improved combustion technology and heat exchanger design optimize the heat recovery from the combustion gases which significantly improves the furnace efficiency. Savings result from improved system efficiency. Condensing furnaces do have acidic condensate that needs to be drained.

Reasons for not Recommending

The measure was evaluated for rooftop air handling units. The simple payback of replacing the furnace section exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone. Considering efficient package furnaces when replacing rooftop heating units.

Install High Efficiency Gas Water Heater

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	9.9	$89.59	$4,912.15	$170.00	$4,742.15	52.93	1,158

Measure Description

This measure evaluates the savings from replacing a tank water heater with a high efficiency tank water heater. Improvements in combustion efficiency and reductions in heat loss have improved the overall efficiency of water heaters. Savings result from less gas used during combustion and less time operating during standby to maintain the water tank temperature.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost-effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced further by increasing the facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.4 for any low-flow ECM recommendations.

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before deciding to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

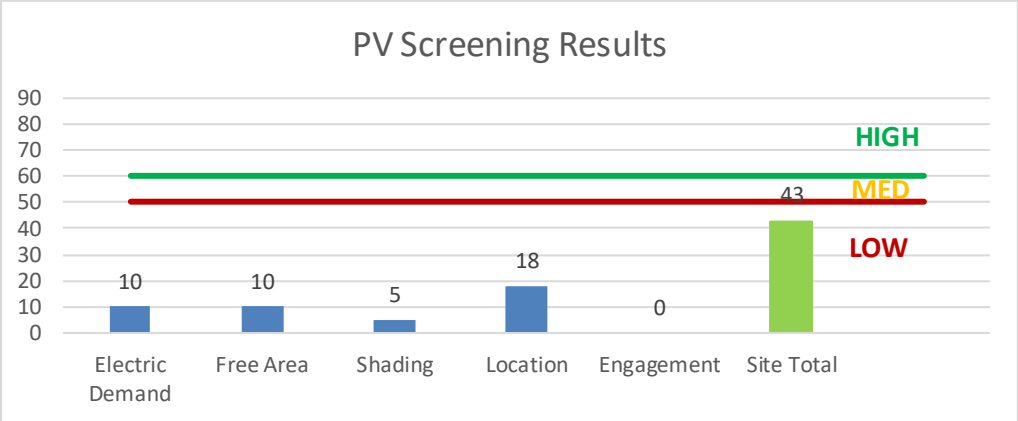
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **Low** potential for installing a PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear not meet these minimum criteria for cost-effective PV installation.

Figure 22 - Photovoltaic Screening



For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

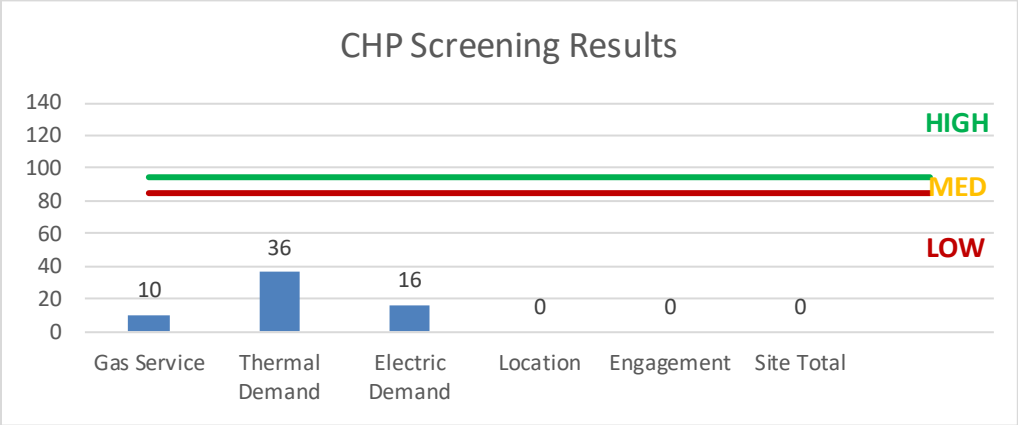
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 23 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

In our opinion, this facility has a moderate potential for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 24 for a list of the eligible programs identified for each recommended ECM.

Figure 24 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x		x	x		
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x		x	x		
ECM 3	Retrofit Fixtures with LED Lamps	x		x	x		
ECM 4	Install Occupancy Sensor Lighting Controls	x		x	x		
ECM 5	Install High/Low Lighitng Controls				x		
ECM 6	Install Dual Enthalpy Outside Economizer Control			x	x		
ECM 7	Install Low-Flow Domestic Hot Water Devices			x	x		
ECM 8	Vending Machine Control	x		x	x		

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

All customer sizes and types may be served by this program. This program provides an effective mechanism for securing incentives for individual projects that may be completed at once or over several years.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Pay for Performance - Existing Buildings

Overview

The Pay for Performance – Existing Buildings (P4P EB) program is designed for larger customers with a peak demand over 200 kW in any of the preceding 12 months. Under this program the minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings. P4P is a generally a good option for medium to large sized facilities looking to implement as many measures as possible under a single project in order to achieve deep energy savings. This program has an added benefit of evaluating a broad spectrum of measures that may not otherwise qualify under other programs. Many facilities pursuing ESIP also utilize the P4P program.

Incentives

Incentives are calculated based on estimated and achieved energy savings ranging from $0.18-$0.22/kWh and $1.80-$2.50/therm, capped at the lesser of 50% total project cost, or $1 million per electric account and $1 million per natural gas account, per fiscal year, not to exceed $2 million per project. An incentive of $0.15/square foot is also available to offset the cost of developing the Energy Reduction Plan (see below) contingent on the project moving forward with measure installation.

How to Participate

To participate in the P4B EB program you will need to contact one of the pre-approved consultants and contractors ("Partners"). Under direct contract to you, the Partner will help further evaluate the measures identified in this report through development of the Energy Reduction Plan (ERP), assist you in implementing selected measures, and verify actual savings one year after the installation. At each of these three milestones your Partner will also facilitate securing program incentives.

Approval of the final scope of work is required by the program prior to installation completion. Although installation can be accomplished by a contractor of your choice (some P4P Partners are also contractors) or by internal personnel, the Partner must remain involved to ensure compliance with the program guidelines and requirements.

Detailed program descriptions, instructions for applying, applications and list of Partners can be found at: www.njcleanenergy.com/P4P.

8.3 Direct Install

Direct Install is a turnkey program available to existing small to medium-sized facilities with an average peak electric demand that does not exceed 200 kW over the recent 12-month period. You work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Each entity is limited to incentives up to $250,000 per fiscal year.

How to Participate

To participate in Direct Install, you will need to contact the participating contractor assigned to the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Basement hallway	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,319	0.49	1,626	0.0	$223.23	$1,653.00	$180.00	6.60
Room 402	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 402	1	Incandescent: 60W A Lamp	Wall Switch	60	1,884	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,884	0.03	110	0.0	$15.17	$53.75	$10.00	2.88
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,200	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,200	0.01	22	0.0	$3.03	$48.20	$10.00	12.60
Closet	1	Incandescent: 60W A Lamp	Wall Switch	60	1,200	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,200	0.03	70	0.0	$9.66	$53.75	$10.00	4.53
Girls Locker Room	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.55	1,807	0.0	$248.03	$1,286.00	$220.00	4.30
Room 403	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.72	2,385	0.0	$327.44	$1,543.00	$320.00	3.74
Room 403	4	Incandescent: 60W A Lamp	Wall Switch	60	1,884	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,884	0.13	442	0.0	$60.67	$215.01	$40.00	2.88
Room 403A	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91
Room 403A	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,884	0.04	143	0.0	$19.63	$117.00	$20.00	4.94
Room 403A	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,884	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,884	0.01	38	0.0	$5.20	$35.90	$5.00	5.94
Closet	8	Incandescent: 60W A Lamp	Wall Switch	60	1,440	Relamp	Yes	8	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	1,008	0.28	711	0.0	$97.65	$546.02	$80.00	4.77
Boiler Room	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.25	813	0.0	$111.61	$642.50	$110.00	4.77
Boiler Room	11	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,884	Relamp & Reballast	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,884	0.43	1,406	0.0	$193.01	$1,287.00	$110.00	6.10
Boiler Room	3	Incandescent: 150W A Lamp	Wall Switch	150	1,884	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	15	1,884	0.27	877	0.0	$120.45	$161.26	$30.00	1.09
Storage	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,440	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.13	336	0.0	$46.17	$467.00	$30.00	9.47
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,440	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,440	0.01	29	0.0	$3.98	$35.90	$5.00	7.77
Storage	1	Incandescent: 60W A Lamp	Wall Switch	60	1,440	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,440	0.03	84	0.0	$11.59	$53.75	$10.00	3.77
Room 413	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Boys Locker Room	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.49	1,243	0.0	$170.62	$1,169.00	$200.00	5.68
Room 415	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 400A	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 400B	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Women Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.14	345	0.0	$47.39	$562.50	$85.00	10.07
Elevator Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.04	109	0.0	$15.00	$117.00	$20.00	6.47

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Custodian Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.02	55	0.0	$7.50	$58.50	$10.00	6.47
Men Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.14	345	0.0	$47.39	$562.50	$85.00	10.07
Kitchen/Cafeteria	42	Linear Fluorescent - T5: 2' T5 (14W) - 1L	Wall Switch	18	1,440	Relamp	No	42	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	1,440	0.26	661	0.0	$90.70	$1,339.80	$210.00	12.46
Kitchen/Cafeteria	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,440	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,440	0.22	556	0.0	$76.38	$570.80	$120.00	5.90
Kitchen/Cafeteria	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.04	109	0.0	$15.00	$117.00	$20.00	6.47
East Entrance	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.06	164	0.0	$22.50	$175.50	$30.00	6.47
Stairwell 10	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	1,884	0.13	429	0.0	$58.89	$300.80	$60.00	4.09
1st Floor Room 500A	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
Room 500B	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
Room 510A	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
East Wing Hallway	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	1,319	0.41	1,355	0.0	$186.02	$1,152.00	$150.00	5.39
Men Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.14	452	0.0	$62.01	$408.50	$85.00	5.22
Custodian Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.02	55	0.0	$7.50	$58.50	$10.00	6.47
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.02	55	0.0	$7.50	$58.50	$10.00	6.47
CST Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,440	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,008	0.14	365	0.0	$50.05	$401.40	$80.00	6.42
Chemical Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.04	109	0.0	$15.00	$117.00	$20.00	6.47
Room 502	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,440	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,008	0.72	1,823	0.0	$250.27	$1,543.00	$320.00	4.89
Custodian Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.04	109	0.0	$15.00	$117.00	$20.00	6.47
Room 504 (Data Room)	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,440	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,008	0.19	486	0.0	$66.74	$496.53	$100.00	5.94
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.05	138	0.0	$18.96	$233.00	$20.00	11.24
Girls Gymnasium	16	Metal Halide: (1) 350W Lamp	Wall Switch	400	1,884	Fixture Replacement	Yes	16	LED - Fixtures: Downlight Pendant	Occupancy Sensor	125	1,319	3.28	10,833	0.0	$1,487.01	$13,257.28	$640.00	8.49
West Wing Hallway	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,319	0.67	2,226	0.0	$305.61	$1,731.87	$280.00	4.75
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	1,200	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	1,200	0.01	19	0.0	$2.56	$31.90	$5.00	10.52
Room 507	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 508	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 509	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 510	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Teacher Room	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.24	795	0.0	$109.15	$591.67	$120.00	4.32
Front Entrance	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	No	8	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,884	0.29	971	0.0	$133.24	$761.07	$160.00	4.51
Front Entrance	4	Incandescent: Candelabra 40W	Wall Switch	40	1,884	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	7	1,884	0.09	286	0.0	$39.26	$175.81	$40.00	3.46
Principal Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91
Closet	2	Incandescent: 60W A Lamp	Wall Switch	60	1,440	Relamp	Yes	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	1,008	0.07	178	0.0	$24.41	$223.51	$20.00	8.34
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,440	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,008	0.05	122	0.0	$16.68	$211.13	$40.00	10.26
Main Office	7	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	7	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.34	1,113	0.0	$152.81	$781.93	$160.00	4.07
Security Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,884	0.04	121	0.0	$16.65	$95.13	$20.00	4.51
Room 525	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Storage	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.16	345	0.0	$47.39	$467.00	$60.00	8.59
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	1,200	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	1,200	0.01	19	0.0	$2.56	$31.90	$5.00	10.52
Room 527	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 531	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91
Men Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.05	181	0.0	$24.80	$233.00	$20.00	8.59
Nurse Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,884	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,884	0.01	38	0.0	$5.20	$35.90	$5.00	5.94
Nurse Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	No	3	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,884	0.11	364	0.0	$49.96	$285.40	$60.00	4.51
Boys Gymnasium	16	Metal Halide: (1) 400W Lamp	Wall Switch	458	1,884	Fixture Replacement	Yes	16	LED - Fixtures: Downlight Pendant	Occupancy Sensor	125	1,319	3.89	12,844	0.0	$1,763.00	$13,257.28	$640.00	7.16
Auditorium	8	Incandescent: Candelabra 40W	Wall Switch	40	1,440	Relamp	No	8	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	7	1,440	0.17	437	0.0	$60.01	$351.62	$80.00	4.53
Auditorium	16	Incandescent: Wall Sconce 100W	Wall Switch	100	1,440	Relamp	No	16	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,440	0.93	2,358	0.0	$323.69	$860.05	$160.00	2.16
Auditorium	16	Incandescent: Candelabra 55W	Wall Switch	55	1,440	Relamp	No	16	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	7	1,440	0.50	1,272	0.0	$174.58	$703.25	$160.00	3.11
Stage	11	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,440	Relamp & Reballast	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.43	1,075	0.0	$147.53	$1,287.00	$110.00	7.98
Stage	58	Halogen Incandescent: 750W Spot Light	Wall Switch	750	1,440	Fixture Replacement	No	58	LED - Fixtures: Track or Mono-Point Directional Lighting Fixtures	Wall Switch	125	1,440	23.76	60,030	0.0	$8,240.12	$34,888.39	$1,740.00	4.02
Storage	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,440	Relamp & Reballast	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.08	195	0.0	$26.82	$234.00	$0.00	8.72

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,440	0.04	109	0.0	$15.00	$117.00	$20.00	6.47
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,440	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,440	0.01	29	0.0	$3.98	$35.90	$5.00	7.77
Fiting Room	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,440	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.18	448	0.0	$61.56	$584.00	$60.00	8.51
Fiting Room	12	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,440	Relamp	No	12	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,440	0.13	318	0.0	$43.64	$578.40	$120.00	10.50
Office	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,884	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.18	587	0.0	$80.54	$584.00	$60.00	6.51
Waiting Room	10	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,884	Relamp & Reballast	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.44	1,467	0.0	$201.34	$1,286.00	$120.00	5.79
Fitting Room	12	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,200	Relamp	Yes	12	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	840	0.17	349	0.0	$47.96	$694.40	$140.00	11.56
Attic Floor	10	Incandescent: 100W A Lamp	Wall Switch	100	1,440	Relamp	No	10	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	1,440	0.58	1,474	0.0	$202.31	$537.53	$100.00	2.16
2nd Floor Hallway	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,040	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	1,428	0.57	2,054	0.0	$282.00	$1,452.80	$210.00	4.41
2nd Floor Hallway	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,040	Relamp	Yes	7	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	1,428	0.24	851	0.0	$116.88	$451.30	$35.00	3.56
Room 600A	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 602A	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,319	0.49	1,626	0.0	$223.23	$1,018.40	$180.00	3.76
Room 602B	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,319	0.49	1,626	0.0	$223.23	$1,018.40	$180.00	3.76
Room 600B	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,319	0.49	1,626	0.0	$223.23	$1,018.40	$180.00	3.76
Women Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.14	345	0.0	$47.39	$408.50	$70.00	7.14
Custodian Closet	1	Compact Fluorescent: 2x13W CFL 4-pin	Wall Switch	26	1,200	Fixture Replacement	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	18	1,200	0.01	11	0.0	$1.48	$63.65	$0.00	43.08
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,884	0.02	71	0.0	$9.81	$58.50	$10.00	4.94
Teacher Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91
Council Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,319	0.08	271	0.0	$37.20	$266.40	$50.00	5.82
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.05	115	0.0	$15.80	$233.00	$20.00	13.48
Room 601	18	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,920	Relamp	Yes	18	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,344	0.87	2,917	0.0	$400.44	$1,828.40	$380.00	3.62
Men Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.05	115	0.0	$15.80	$233.00	$20.00	13.48
Room 603	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
Room 602	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.10	318	0.0	$43.66	$306.27	$60.00	5.64
Room 604	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.72	2,385	0.0	$327.44	$1,543.00	$320.00	3.74

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 605	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
Room 605A	9	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,319	0.37	1,220	0.0	$167.42	$792.80	$155.00	3.81
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,200	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,200	0.01	22	0.0	$3.03	$48.20	$10.00	12.60
Room 608	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.33	1,084	0.0	$148.82	$818.00	$140.00	4.56
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,440	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.05	138	0.0	$18.96	$233.00	$20.00	11.24
Room 607	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,440	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,008	0.25	621	0.0	$85.31	$567.20	$110.00	5.36
Auditorium Control Center	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,440	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,008	0.09	224	0.0	$30.78	$350.00	$40.00	10.07
Auditorium Control Center	1	Incandescent: 60W A Lamp	Wall Switch	60	1,440	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,440	0.03	84	0.0	$11.59	$53.75	$10.00	3.77
Room 601	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	6	LED - Linear Tubes: (4) 3' Lamps	Occupancy Sensor	42	1,319	0.25	827	0.0	$113.49	$631.60	$20.00	5.39
Room 610	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,319	0.27	903	0.0	$124.02	$701.00	$120.00	4.68
Room 613	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.72	2,385	0.0	$327.44	$1,543.00	$320.00	3.74
Room 612	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.58	1,908	0.0	$261.95	$1,257.60	$260.00	3.81
Room 614	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.43	1,431	0.0	$196.46	$972.20	$200.00	3.93
Room 615	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.72	2,385	0.0	$327.44	$1,543.00	$320.00	3.74
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	1,440	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,440	0.01	26	0.0	$3.64	$48.20	$10.00	10.50
Room 616	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.10	318	0.0	$43.66	$306.27	$60.00	5.64
Room 617	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,884	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,319	0.14	477	0.0	$65.49	$401.40	$80.00	4.91
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.05	115	0.0	$15.80	$233.00	$20.00	13.48
Stairwell	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,884	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,319	0.33	1,084	0.0	$148.82	$902.00	$120.00	5.25
Old Stairells	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,884	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	1,319	0.06	189	0.0	$25.99	$343.60	$20.00	12.45
New Stairwells	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,884	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	1,319	0.33	1,084	0.0	$148.82	$801.60	$120.00	4.58
Cafeteria Storage Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,875	Relamp	Yes	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	45	2,013	0.08	403	0.0	$55.37	$331.01	$60.00	4.89
Kitchen Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,200	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.04	91	0.0	$12.50	$117.00	$20.00	7.76
School	37	Exit Signs: LED - 2 W Lamp	None	6	1,200	None	Yes	37	Exit Signs: LED - 2 W Lamp	Occupancy Sensor	6	840	0.04	92	0.0	$12.62	$116.00	$20.00	7.61
Exterior Light Wallpack	5	Incandescent: 150W Screw-in Lamp	Daylight Dimming	150	4,380	Relamp	No	5	LED Screw-In Lamps: Downlight Solid State Retrofit	Daylight Dimming	23	4,380	0.42	3,198	0.0	$439.05	$489.27	$50.00	1.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Exterior Light Wallpack	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	45	4,380	None	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	45	4,380	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Boiler Room	1	Air Compressor	0.5	72.0%	No	650	No	72.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler Room	2	Other	1.0	82.0%	No	650	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler Room	2	Boiler Feed Water Pump	3.0	86.5%	No	650	No	86.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler Room	3	Condenser Water Pump	2.0	78.0%	No	1,300	Yes	86.5%	No		0.42	550	0.0	$75.47	$1,596.51	$0.00	21.15
Boiler Room	DWH	1	Other	0.3	71.0%	No	1,300	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elevator Room	Elevator	1	Other	25.0	75.5%	No	1,300	No	75.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	2	Supply Fan	5.0	88.5%	Yes	1,300	No	88.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Kitchen	2	Exhaust Fan	2.0	86.0%	Yes	1,300	No	86.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Auditorium	2	Supply Fan	7.5	84.0%	No	1,300	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Auditorium	2	Return Fan	3.0	84.0%	No	1,300	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School	School	13	Other	0.3	71.0%	No	1,300	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 504 - Data Room	Data Room	1	Window AC	0.76		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teacher Room	Teacher Room	1	Window AC	1.29		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 508	Room 508	1	Window AC	1.91		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main Office	Main Office	1	Window AC	0.66		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main Office	Main Office	1	Window AC	1.91		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse Office	Nurse Office	1	Window AC	0.66		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 608	Room 608	2	Window AC	1.02		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 612	Room 612	2	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 613	Room 613	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 616	Room 616	1	Window AC	0.91		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Auditorium	1	Split-System AC	4.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Cafeteria Office	1	Split-System AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Room 500A	1	Split-System AC	4.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Room 602 - RTU2	1	Packaged AC	16.00		Yes	1	Packaged AC	16.00		11.50		Yes	3.12	7,095	0.0	$973.89	$23,201.60	$1,514.00	22.27
Roof Top	Room 600B - RTU1	1	Packaged AC	16.00		Yes	1	Packaged AC	16.00		11.50		Yes	3.12	7,095	0.0	$973.89	$23,201.60	$1,514.00	22.27

Electric Chiller Inventory & Recommendations

		Existing Conditions			Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/ Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof Top	Cafeteria/Auditorium	2	Air-Cooled Scroll Chiller	60.00	No							0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler room	School	2	Forced Draft Steam Boiler	3,772.00	Yes	2	Forced Draft Steam Boiler	3,772.00	82.40%	Et	0.00	0	59.2	$536.32	$140,215.20	$7,544.00	247.37
Roof Top	Room 602	1	Furnace	316.00	Yes	1	Furnace	316.00	95.00%	AFUE	0.00	0	3.5	$31.31	$7,159.72	$400.00	215.90
Roof Top	Auditorium	1	Furnace	215.00	Yes	1	Furnace	180.00	95.00%	AFUE	0.00	0	6.4	$57.71	$4,078.32	$400.00	63.74
Roof Top	Room 600B	1	Furnace	316.00	Yes	1	Furnace	316.00	95.00%	AFUE	0.00	0	3.5	$31.31	$7,159.72	$400.00	215.90

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Custodian Closet	School	1	Storage Tank Water Heater (> 50 Gal)	Yes	1	Storage Tank Water Heater (> 50 Gal)	Natural Gas	92.00%	Et	0.00	0	25.2	$228.48	$4,912.15	$170.00	20.75

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
School	10	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	46.9	$424.40	$71.70	$0.00	0.17
Kitchen	4	Faucet Aerator (Kitchen)	3.00	2.20	0.00	0	12.5	$113.17	$28.68	$0.00	0.25

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions		Proposed Conditions			Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Cooler (35F to 55F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Low Temp Freezer (-35F to -5F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teacher Room	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse Office	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Ice Making Head (≥450 lbs/day), Batch	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Gas Rack Oven (Double)	Yes	No	0.00	0	0.0	$0.00	$18,580.09	$4,000.00	0.00
Kitchen	1	Insulated Food Holding Cabinet (3/4 Size)	Yes	No	0.00	0	0.0	$0.00	$2,553.15	$250.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	105	Desktop Computer	191.0	Yes
School	9	Microwave	1,000.0	No
School	3	Copy Machine	800.0	Yes
School	7	Printer	460.0	Yes

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Cafeteria	2	Refrigerated	Yes	0.00	3,224	0.0	$442.50	$1,437.60	$0.00	3.25
Teacher Room	1	Refrigerated	Yes	0.00	1,612	0.0	$221.25	$718.80	$0.00	3.25

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

George Inness High School Annex

Primary Property Type: K-12 School
Gross Floor Area (ft²): 89,261
Built: 1925

For Year Ending: April 30, 2016
Date Generated: December 13, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
George Inness High School Annex 141 Park Street Montclair, New Jersey 07042	_____ , (___)___-_____	___ _____ , (___)___-_____ _____

Property ID: 5724956

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
68 kBtu/ft²

Source EUI
111 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	4,376,478 (72%)
Electric - Grid (kBtu)	1,690,758 (28%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	79.7
National Median Source EUI (kBtu/ft²)	130.1
% Diff from National Median Source EUI	-15%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	420

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Glenfield School

Montclair Board of Education

25 Maple Avenue

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Glenfield School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey school districts in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

Glenfield School is a three-story building with mid-level basement totaling 125,281 square feet. The original school was built in 1896. The roofing systems consist of a mix of flat and pitched roofs sections. Exterior walls are finished with brick masonry and concrete block. The windows throughout the facility are a combination of single and double paned. Interior lighting consists mainly of linear T8 fluorescent lamps and fixtures. Lighting control is provided by both occupancy sensors and manual wall switches. Heating is provided by three condensing gas fired boilers and the cooling system consists of window and split system air conditioners.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated nine measures which represent an opportunity for the Glenfield School to reduce annual energy costs by roughly $35,073 and annual greenhouse gas emissions by 274,524 lbs CO_2e. The measures would pay for themselves in roughly 3.66 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce Glenfield School's annual energy use by 16.0%.

Figure 1 – Previous 12 Month Utility Costs

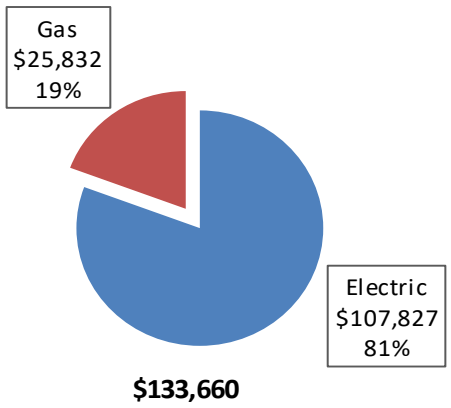
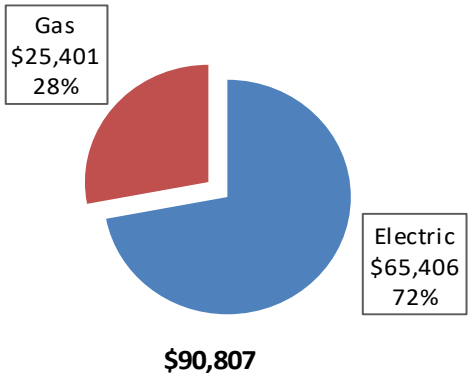


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Glenfield School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**235,829**	**46.0**	**0.0**	**$30,720.41**	**$130,406.63**	**$24,165.00**	**$106,241.63**	**3.46**	**237,478**
ECM 1	Install LED Fixtures	Yes	78,457	10.3	0.0	$10,220.20	$36,662.24	$8,700.00	$27,962.24	2.74	79,005
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	15,901	3.4	0.0	$2,071.41	$15,458.33	$840.00	$14,618.33	7.06	16,013
ECM 3	Retrofit Fixtures with LED Lamps	Yes	141,471	32.3	0.0	$18,428.80	$78,286.05	$14,625.00	$63,661.05	3.45	142,460
Lighting Control Measures			**22,294**	**4.8**	**0.0**	**$2,904.10**	**$18,692.00**	**$1,610.00**	**$17,082.00**	**5.88**	**22,450**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	16,907	3.6	0.0	$2,202.39	$13,092.00	$1,610.00	$11,482.00	5.21	17,025
ECM 5	Install High/Low Lighitng Controls	Yes	5,387	1.2	0.0	$701.71	$5,600.00	$0.00	$5,600.00	7.98	5,424
Motor Upgrades			**1,678**	**0.4**	**0.0**	**$218.57**	**$1,153.79**	**$0.00**	**$1,153.79**	**5.28**	**1,690**
ECM 6	Premium Efficiency Motors	Yes	1,678	0.4	0.0	$218.57	$1,153.79	$0.00	$1,153.79	5.28	1,690
Electric Unitary HVAC Measures			**1,299**	**0.8**	**0.0**	**$169.18**	**$1,633.14**	**$0.00**	**$1,633.14**	**9.65**	**1,308**
ECM 7	Install High Efficiency Electric AC	Yes	1,299	0.8	0.0	$169.18	$1,633.14	$0.00	$1,633.14	9.65	1,308
Domestic Water Heating Upgrade			**0**	**0.0**	**57.5**	**$431.17**	**$100.38**	**$0.00**	**$100.38**	**0.23**	**6,730**
ECM 8	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	57.5	$431.17	$100.38	$0.00	$100.38	0.23	6,730
Plug Load Equipment Control - Vending Machine			**4,836**	**0.0**	**0.0**	**$629.90**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.42**	**4,869**
ECM 9	Vending Machine Control	Yes	4,836	0.0	0.0	$629.90	$2,156.40	$0.00	$2,156.40	3.42	4,869
TOTALS			**265,935**	**52.0**	**57.5**	**$35,073.33**	**$154,142.34**	**$25,775.00**	**$128,367.34**	**3.66**	**274,524**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing old standard efficiency motors with motors of the current efficiency standard (EISA 2007). Motors will be replaced with the same size motors. This measure saves energy by reducing the power used by the motors due to improved electrical efficiency.

Electric Unitary HVAC measures generally involve replacing old inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide cooling equivalent to older air condition systems, but use less energy. These measures save energy by reducing the power used by the air condition system due to improved electrical efficiency.

Domestic Water Heating upgrade measures generally involve replacing old inefficient domestic water heating systems with modern energy efficient systems. New domestic water heating systems can provide equivalent or greater capacity as older systems, but use less energy. These measures save energy by reducing the fuel used by the domestic water heating systems due to improved efficiency or the removal of standby losses.

Plug Load Equipment control measures generally involve installing automation that limits the power use or operation of equipment plugged into an electrical receptacle based on occupancy.

Energy Efficient Practices

TRC also identified four low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at the Glenfield School include:

- Reduce Air Leakage
- Ensure Lighting Controls Are Operating Properly
- Clean and/or Replace HVAC Filters
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for the Glenfield School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	200	kW DC STC
Electric Generation	238,274	kWh/yr
Displaced Cost	$20,730	/yr
Installed Cost	$520,000	

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8. You may also check the following website for further information on available rebates and incentives: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	(973) 509-4050
Designated Representative			
Luis R. Solis Jr	Head Custodian		(973) 509-4183
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 07, 2016, TRC performed an energy audit at Glenfield School located in Montclair, New Jersey. TRC's auditor met with Luis R. Solis Jr to review the facility operations and focus the investigation on specific energy-using systems.

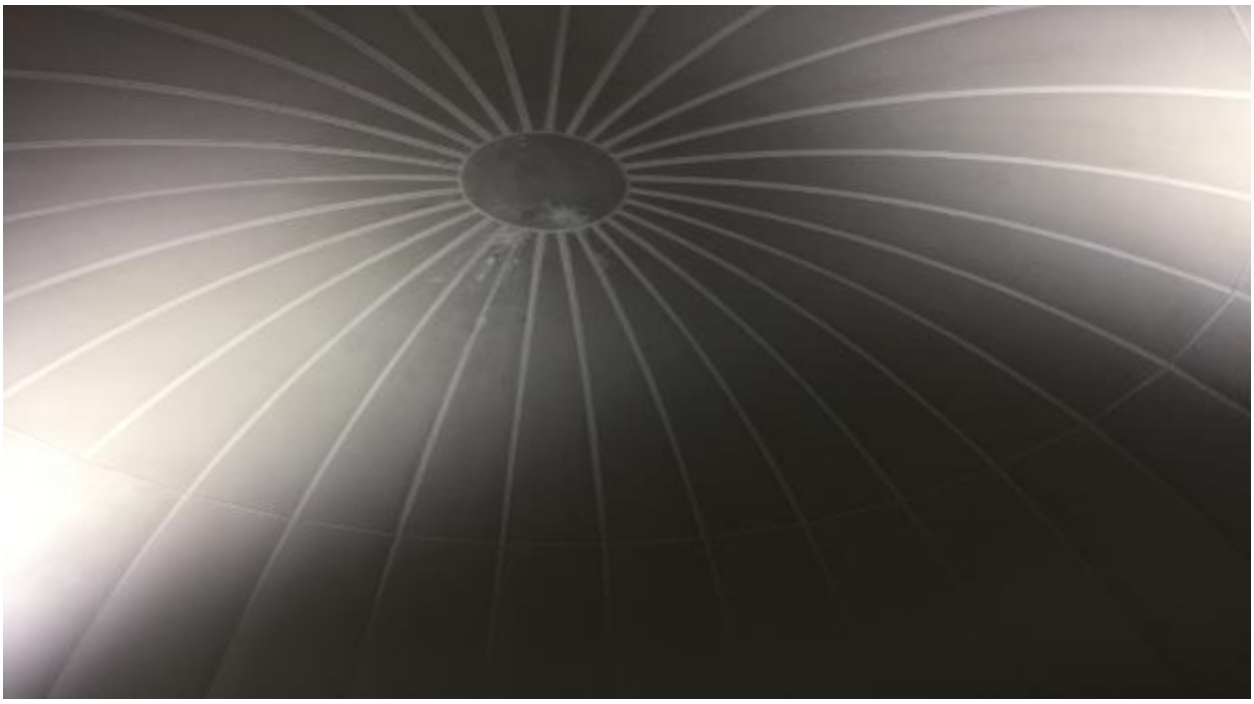


Image 1 – Planetarium Roof

The 125,281-square foot school building has three-stories with a mid-level basement. It is comprised of classrooms, gymnasium, locker rooms, planetarium, dance room, kitchen, cafeteria, administrative offices, library, an indoor garage, storage and mechanical spaces. The original building was constructed in 1896 and expanded to accommodate additional classrooms and other spaces in 1922, 1924, 1928, 1933, and 1980. The roof of the planetarium was under renovation during the survey. The building is primarily used for middle school programs.

2.3 Building Occupancy

The school operates on a 10-month schedule and is open Monday through Friday. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 684 students and 85 staff.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Glenfield School	Weekday	7:00 AM - 6:30:00 PM
Glenfield School	Weekend	Closed

2.4 Building Envelope



Image 2 – Building Envelope

The building has cast-in-place concrete perimeter wall footings with concrete foundation walls. The roofing systems consist of a mix of flat and pitched roof sections which were not accessible during the survey. The gymnasium and the auditorium have a flat roof. Exterior walls are finished with brick masonry and concrete block. The windows throughout the facility are single and double pane glass with aluminum frames and are in acceptable condition with some units showing little signs of outside air infiltration. Exterior doors are constructed of metal. Some door seals were found to be worn out, increasing the level of outside air-infiltration. Although aging, the building envelope appears to be in acceptable condition.

2.5 On-site Generation

Glenfield School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Lighting at the facility is provided predominately by linear 32-Watt fluorescent T8 lamps with electronic ballasts as well as some linear 40-Watt fluorescent T12 lamps. Most of the building spaces use 2-lamp or 4-lamp, 2-foot wide by 4-foot long troffers with diffusers. The gymnasium, auditorium, and planetarium lighting systems have been retrofitted to LED fixtures. The library, fan room, rooms 227, 109, 131 are still using old and inefficient linear 40-Watt fluorescent T12 lamps. The stairwells are primarily illuminated with compact fluorescent lamps while other small spaces such as restrooms, closets and storage rooms use incandescent screw-in lamps. The indoor parking garage is lit with a combination of 175-Watt mercury vapor, linear 32-Watt fluorescent T8 and incandescent lamps. The remaining interior spaces are illuminated with linear 32-Watt fluorescent T8 lamps. Interior lighting control is provided by both occupancy sensors and manual wall switches. Exterior lighting system consists of wall mounted 150 and 400-Watt metal halide, 250-Watt mercury vapor and 34-Watt compact fluorescent lamps. They are controlled with photocells.

Hot Water Heating



Image 3 – Hot Water Heating System

Heating hot water for the building is provided by three AERCO condensing hot water boilers that were installed in 2014 as part of minor mechanical upgrade. Each boiler has an output capacity of 2,790 MBh and a nominal combustion efficiency of 93%. Two 15 HP variable speed hot water pumps configured to operate as "lead/lag" distribute the heating hot water to the heating zones. Distribution devices include the new classroom unit ventilators, cabinet heaters, fan coils and heating coils in air handling units. The heating hot water system is controlled by a district wide building energy management system (BEMS). The hot water system is enable based upon outside air temperature (70°F adjustable). Boilers are automatically rotated based on run time: The boiler with the least amount of run time will become the lead boiler, and the boiler that logs more run time than the others will become the last boiler fired. The unit ventilators are equipped with hot water coils as well as with direct-expansion (DX) coils for cooling and dehumidification in the classrooms. The boilers are in good condition and well maintained.

Air Conditioning (DX)



Cooling is provided by a combination of window and split system air conditioners (ACs). The rooftop units were not accessible during the site survey; therefore, the capacity of the units was estimated.

There are six window units which are sized from 0.67 to 1.9 tons and are in relatively good condition except the unit serving room 116. The computer room is served by one 1-ton split AC.

TRC estimated the library and its offices to be served by four 4-ton split system ACs. We also estimated the planetarium to be served by a 4-ton split system AC.

Image 4 – DX Cooling Equipment

Ventilation – Air-Handling System

There are two AAF central station air-handler units in the facility, located in the mid-level basement. These units provide tempered air via duct distribution systems to the spaces for heating and cooling. Each air handler has one 7.5 hp constant speed supply fan.

Ventilation for the gymnasium is provided by an air-handler equipped with a constant speed 15 hp fan.

The units appear very old and are in fair condition.



Image 5 – Air Handling Equipment

Domestic Hot Water

The domestic hot water system for the facility consists of one Rheem gas fired non-condensing hot water heater with an input rating of 200 MBh and a nominal efficiency of 80%. It has a 100-gallon storage tank and is located in the boiler room. Two small recirculation pumps distribute 120°F water to the entire site. The water heater is three years old and is in good condition.

Food Service & Refrigeration

The school houses a small institutional kitchen and a cafeteria. The kitchen includes gas cooking ovens, four stand up stand up refrigerators and freezers. The kitchen is well maintained. In addition to the kitchen, the school has a cooking classroom with additional electrical cooking and laundry equipment.

Plug load & Vending Machines

There are approximately 81 computer work stations throughout the facility and they are mostly desktop units with LCD monitors. There is no centralized PC power management software installed.

The facility has three refrigerated beverage vending machine located in the cafeteria and room 237.

2.7 Water-Using Systems

There are 14 restrooms at this facility. A sampling of restrooms found that the faucets are rated for 2.2 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf) and the urinals are rated at 2 gpf. The kitchen has two faucets that are rated for 3 gpm. There are no restrooms with showers.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

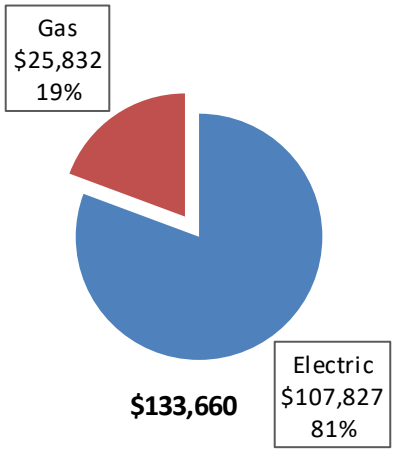
The following energy consumption and cost data is based on the last 12-month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 7 - Utility Summary

Utility Summary for Glenfield School		
Fuel	**Usage**	**Cost**
Electricity	761,052 kWh	$107,827
Natural Gas	34,436 Therms	$25,832
Total		**$133,660**

The current utility cost for this site is $133,660 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.130/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects lower occupancy in the summer months and confirms the school 10 months operation.

Figure 9 - Electric Usage & Demand

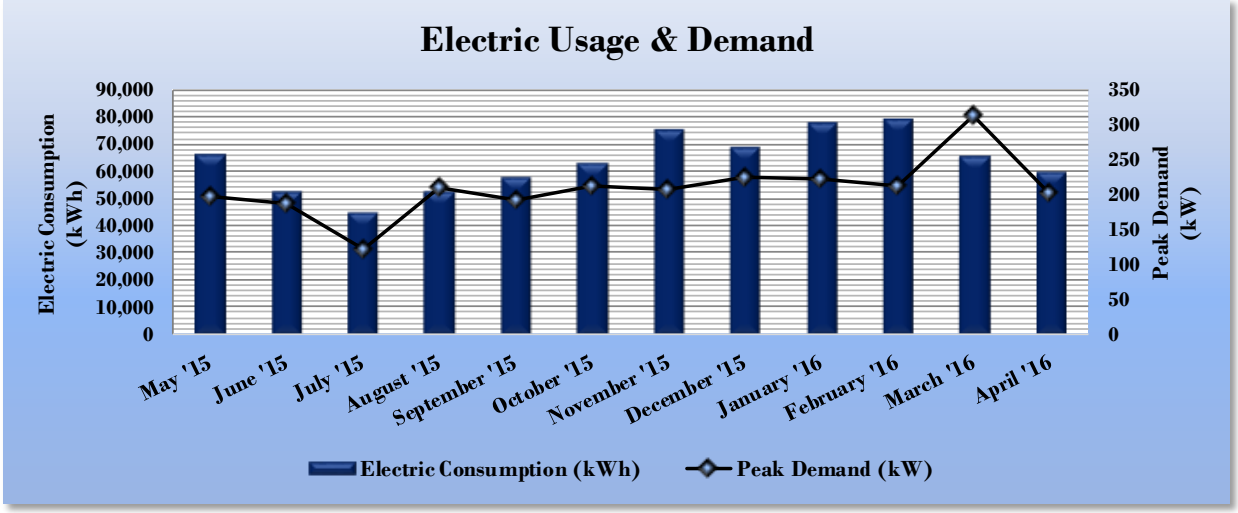


Figure 10 - Electric Usage & Demand

Electric Billing Data for Glenfield School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
6/15/15	30	66,473	197	$711	$11,101
7/14/15	30	52,673	187	$674	$9,219
8/13/15	31	44,945	122	$440	$7,393
9/14/15	30	52,833	209	$754	$9,306
10/13/15	30	57,820	192	$696	$8,030
11/11/15	31	62,833	212	$769	$8,668
12/14/15	31	75,048	207	$752	$9,878
1/14/16	31	68,582	225	$814	$8,843
2/12/16	29	77,540	222	$805	$9,695
3/12/16	31	79,446	211	$770	$9,916
4/13/16	31	65,342	314	$783	$8,373
5/11/16	31	59,602	203	$744	$7,701
Totals	**366**	**763,137**	**313.8**	**$8,712**	**$108,123**
Annual	**365**	**761,052**	**313.8**	**$8,688**	**$107,827**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.750/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 11 - Natural Gas Usage

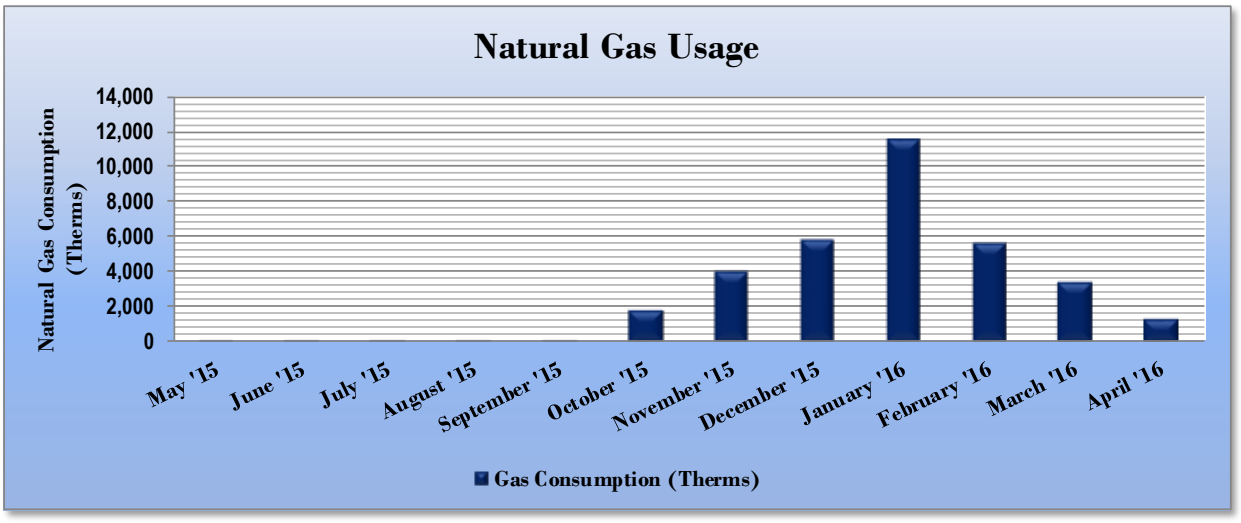


Figure 12 - Natural Gas Usage

Gas Billing Data for Glenfield School			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
6/15/15	30	116	$100
7/14/15	31	95	$84
8/13/15	30	74	$68
9/14/15	31	74	$68
10/13/15	31	116	$99
11/11/15	30	1,854	$1,538
12/14/15	31	4,073	$3,151
1/14/16	30	5,846	$4,385
2/12/16	31	11,652	$8,564
3/12/16	31	5,710	$4,955
4/13/16	29	3,438	$1,963
5/11/16	30	1,388	$858
Totals	**365**	**34,436**	**$25,832**
Annual	**365**	**34,436**	**$25,832**

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the Energy Use Intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Glenfield School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	93.9	141.4
Site Energy Use Intensity (kBtu/ft^2)	48.2	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Glenfield School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	70.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	40.5	58.2

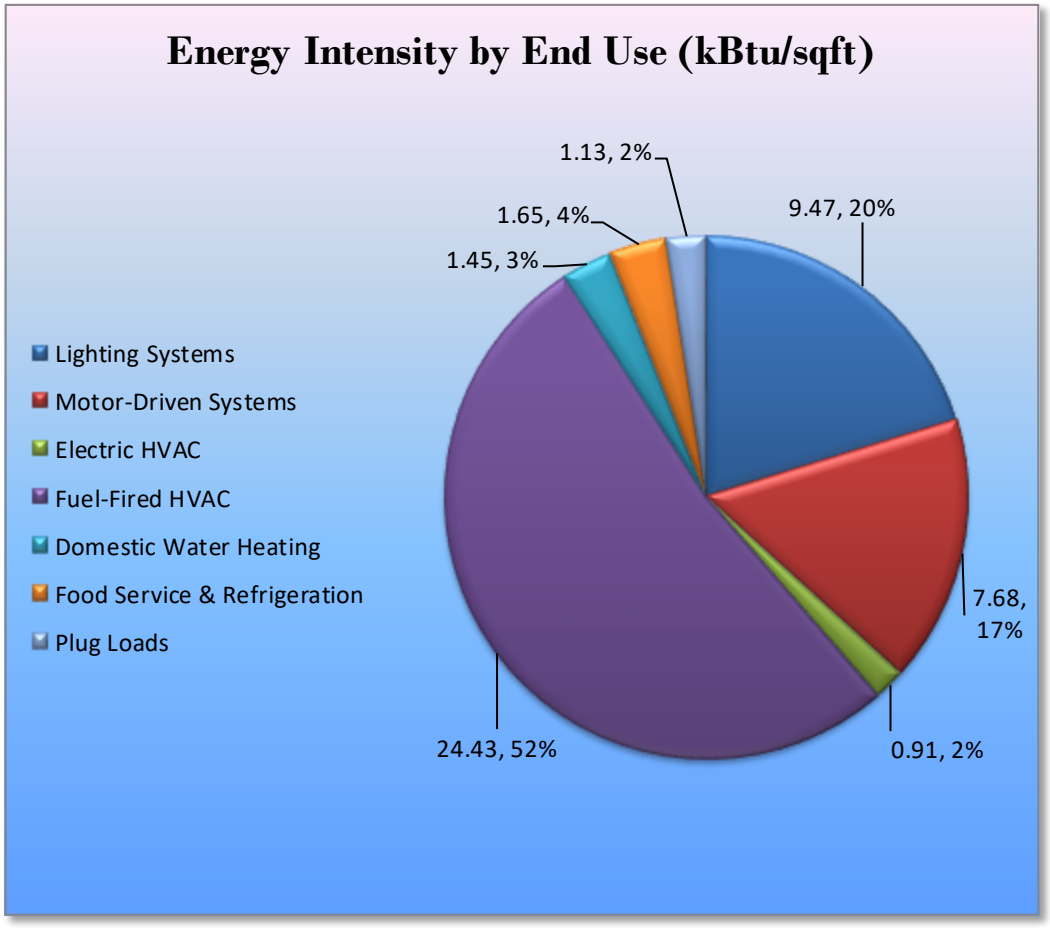
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 35.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 15 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the Glenfield School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJ prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**235,829**	**46.0**	**0.0**	**$30,720.41**	**$130,406.63**	**$24,165.00**	**$106,241.63**	**3.46**	**237,478**
ECM 1	Install LED Fixtures	78,457	10.3	0.0	$10,220.20	$36,662.24	$8,700.00	$27,962.24	2.74	79,005
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	15,901	3.4	0.0	$2,071.41	$15,458.33	$840.00	$14,618.33	7.06	16,013
ECM 3	Retrofit Fixtures with LED Lamps	141,471	32.3	0.0	$18,428.80	$78,286.05	$14,625.00	$63,661.05	3.45	142,460
Lighting Control Measures		**22,294**	**4.8**	**0.0**	**$2,904.10**	**$18,692.00**	**$1,610.00**	**$17,082.00**	**5.88**	**22,450**
ECM 4	Install Occupancy Sensor Lighting Controls	16,907	3.6	0.0	$2,202.39	$13,092.00	$1,610.00	$11,482.00	5.21	17,025
ECM 5	Install High/Low Lighitng Controls	5,387	1.2	0.0	$701.71	$5,600.00	$0.00	$5,600.00	7.98	5,424
Motor Upgrades		**1,678**	**0.4**	**0.0**	**$218.57**	**$1,153.79**	**$0.00**	**$1,153.79**	**5.28**	**1,690**
ECM 6	Premium Efficiency Motors	1,678	0.4	0.0	$218.57	$1,153.79	$0.00	$1,153.79	5.28	1,690
Electric Unitary HVAC Measures		**1,299**	**0.8**	**0.0**	**$169.18**	**$1,633.14**	**$0.00**	**$1,633.14**	**9.65**	**1,308**
ECM 7	Install High Efficiency Electric AC	1,299	0.8	0.0	$169.18	$1,633.14	$0.00	$1,633.14	9.65	1,308
Domestic Water Heating Upgrade		**0**	**0.0**	**57.5**	**$431.17**	**$100.38**	**$0.00**	**$100.38**	**0.23**	**6,730**
ECM 8	Install Low-Flow Domestic Hot Water Devices	0	0.0	57.5	$431.17	$100.38	$0.00	$100.38	0.23	6,730
Plug Load Equipment Control - Vending Machine		**4,836**	**0.0**	**0.0**	**$629.90**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.42**	**4,869**
ECM 9	Vending Machine Control	4,836	0.0	0.0	$629.90	$2,156.40	$0.00	$2,156.40	3.42	4,869
TOTALS		**265,935**	**52.0**	**57.5**	**$35,073.33**	**$154,142.34**	**$25,775.00**	**$128,367.34**	**3.66**	**274,524**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting upgrades are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**235,829**	**46.0**	**0.0**	**$30,720.41**	**$130,406.63**	**$24,165.00**	**$106,241.63**	**3.46**	**237,478**
ECM 1	Install LED Fixtures	78,457	10.3	0.0	$10,220.20	$36,662.24	$8,700.00	$27,962.24	2.74	79,005
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	15,901	3.4	0.0	$2,071.41	$15,458.33	$840.00	$14,618.33	7.06	16,013
ECM 3	Retrofit Fixtures with LED Lamps	141,471	32.3	0.0	$18,428.80	$78,286.05	$14,625.00	$63,661.05	3.45	142,460

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	840	0.2	0.0	$109.36	$2,546.04	$0.00	$2,546.04	23.28	845
Exterior	77,617	10.1	0.0	$10,110.84	$34,116.20	$8,700.00	$25,416.20	2.51	78,160

Measure Description

This measure evaluates replacing existing fixtures containing high intensity discharge (HID) lamps with new high-performance LED light fixtures. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	15,901	3.4	0.0	$2,071.41	$15,458.33	$840.00	$14,618.33	7.06	16,013
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T12 lamps, ballasts, and reflectors with LED tube lamps, reflectors, and drivers specifically designed for existing linear fluorescent fixtures. The retrofit uses the existing fixture housing but replaces the rest of the components with an efficient source and reflectors designed for LEDs. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output and efficiently projects the light into the space.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	139,418	31.8	0.0	$18,161.34	$77,395.13	$14,455.00	$62,940.13	3.47	140,393
Exterior	2,053	0.4	0.0	$267.46	$890.92	$170.00	$720.92	2.70	2,068

Measure Description

This measure evaluates replacing linear fluorescent T8 lamps with LED tube lamps and replacing incandescent and compact fluorescent screw-in/plug-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in/plug-in LED lamps can be used as a direct replacement for most other screw-in/plug-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**22,294**	**4.8**	**0.0**	**$2,904.10**	**$18,692.00**	**$1,610.00**	**$17,082.00**	**5.88**	**22,450**
ECM 4	Install Occupancy Sensor Lighting Controls	16,907	3.6	0.0	$2,202.39	$13,092.00	$1,610.00	$11,482.00	5.21	17,025
ECM 5	Install High/Low Lighitng Controls	5,387	1.2	0.0	$701.71	$5,600.00	$0.00	$5,600.00	7.98	5,424

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
16,907	3.6	0.0	$2,202.39	$13,092.00	$1,610.00	$11,482.00	5.21	17,025

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in restrooms, storage rooms, classrooms and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
5,387	1.2	0.0	$701.71	$5,600.00	$0.00	$5,600.00	7.98	5,424

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high-level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period.

For this application, the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

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4.1.3 Motor Upgrades

Our recommendations for motor upgrades are summarized n Figure 19 below.

Figure 19 - Summary of Motor Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**1,678**	**0.4**	**0.0**	**$218.57**	**$1,153.79**	**$0.00**	**$1,153.79**	**5.28**	**1,690**
ECM 6	Premium Efficiency Motors	1,678	0.4	0.0	$218.57	$1,153.79	$0.00	$1,153.79	5.28	1,690

ECM 6: Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,678	0.4	0.0	$218.57	$1,153.79	$0.00	$1,153.79	5.28	1,690

Measure Description

This measure evaluates replacing the 7.5 hp indoor handler standard efficiency motor with EISA 2007 efficiency motor. The evaluation assumes existing motor will be replaced with the same size motor. It is important that the speed of each new motor match the speed of the motor it replaces as closely as possible. The base case motor efficiencies are obtained from nameplate information. Proposed case premium motor efficiencies are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016*). Savings are based on the difference between baseline and proposed efficiencies and the annual operating hours.

4.1.4 Electric Unitary HVAC Measures

Our recommendations for unitary HVAC measures are summarized in Figure 20 below.

Figure 20 - Summary of Unitary HVAC ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures		**1,299**	**0.8**	**0.0**	**$169.18**	**$1,633.14**	**$0.00**	**$1,633.14**	**9.65**	**1,308**
ECM 7	Install High Efficiency Electric AC	1,299	0.8	0.0	$169.18	$1,633.14	$0.00	$1,633.14	9.65	1,308

ECM 7: Install High Efficiency Electric AC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,299	0.8	0.0	$169.18	$1,633.14	$0.00	$1,633.14	9.65	1,308

Measure Description

This measure evaluates replacing window air conditioner serving room 116 with a high efficiency window air conditioner. There have been significant improvements in both compressor and fan motor efficiencies in the past several years. Therefore, electricity savings can be achieved by replacing old units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the old and new unit, the cooling load, and the annual operating hours.

4.1.5 Domestic Water Heating Upgrade

Our recommendations for domestic water heating measures are summarized in Figure 21 below.

Figure 21 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**57.5**	**$431.17**	**$100.38**	**$0.00**	**$100.38**	**0.23**	**6,730**
ECM 8	Install Low-Flow Domestic Hot Water Devices	0	0.0	57.5	$431.17	$100.38	$0.00	$100.38	0.23	6,730

ECM 8: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	57.5	$431.17	$100.38	$0.00	$100.38	0.23	6,730

Measure Description

This measure evaluates the savings from installing low flow domestic water devices to reduce overall water flow in general and hot water flow in particular. Low flow faucet aerators reduce the water flow, relative to standard aerators, from the fixture.

All of the low flow devices reduce the overall water flow from the fixture which generally reduces the amount of hot water used resulting in energy and water savings.

4.1.6 Plug Load Equipment Control - Vending Machine

Our recommendations for plug load equipment control measures are summarized in Figure 22 below.

Figure 22 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**4,836**	**0.0**	**0.0**	**$629.90**	**$2,156.40**	**$0.00**	**$2,156.40**	**3.42**	**4,869**
ECM 9	Vending Machine Control	4,836	0.0	0.0	$629.90	$2,156.40	$0.00	$2,156.40	3.42	4,869

ECM 9: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,836	0.0	0.0	$629.90	$2,156.40	$0.00	$2,156.40	3.42	4,869

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor based controls to reduce the energy use. These controls power down the machine when the surrounding area is vacant, then monitor the surrounding temperature and power up the cooling system at regular intervals to keep the product cool. Savings are a function of the activity level around the vending machine.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost-effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.5 for any low-flow ECM recommendations.

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

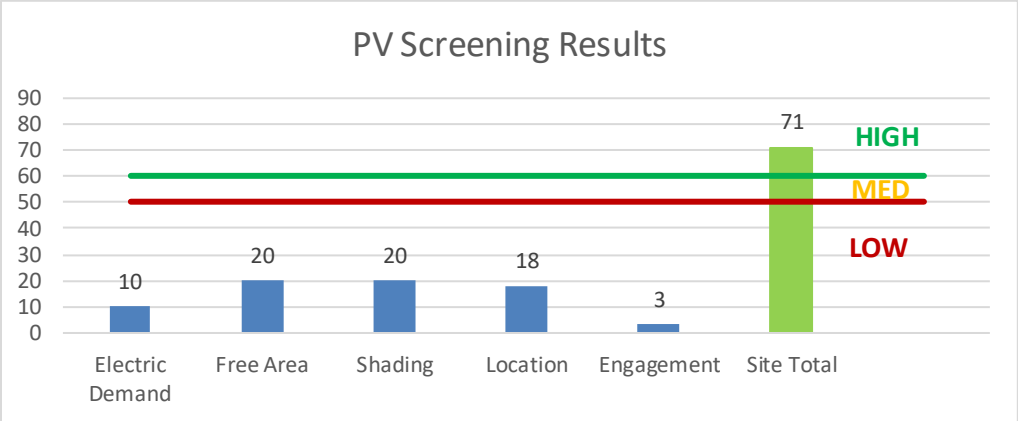
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear meet these minimum criteria for cost-effective PV installation.

Figure 23 - Photovoltaic Screening



Potential	High	
System Potential	200	kW DC STC
Electric Generation	238,274	kWh/yr
Displaced Cost	$20,730	/yr
Installed Cost	$520,000	

Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

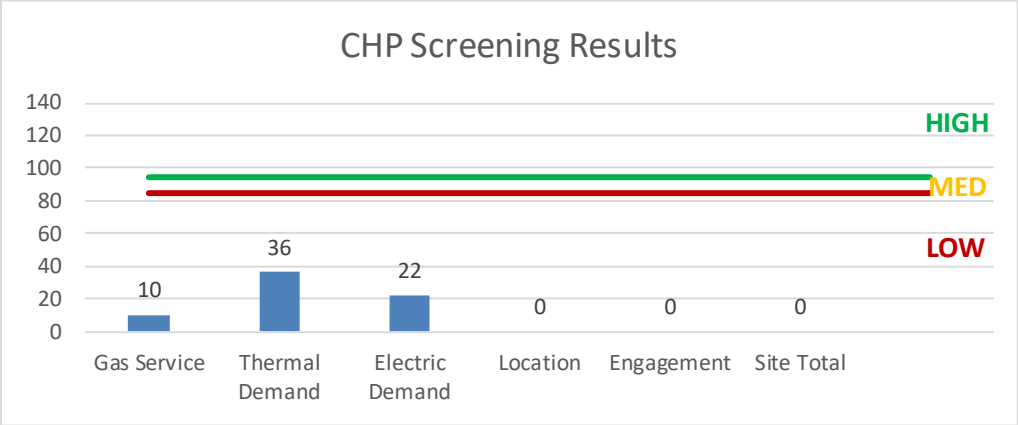
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 24 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facilities because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

In our opinion, the facility is not a good candidate for DR curtailment program.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 25 for a list of the eligible programs identified for each recommended ECM.

Figure 25 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x				
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x				
ECM 3	Retrofit Fixtures with LED Lamps	x				
ECM 4	Install Occupancy Sensor Lighting Controls	x				
ECM 5	Install High/Low Lighitng Controls					
ECM 6	Premium Efficiency Motors					
ECM 7	Install High Efficiency Electric AC					
ECM 8	Install Low-Flow Domestic Hot Water Devices					
ECM 9	Vending Machine Control					

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one-year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.35	1,606	0.0	$209.21	$936.00	$160.00	3.71
Fan Room	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,645	Relamp & Reballast	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.19	897	0.0	$116.89	$585.00	$50.00	4.58
Custodian Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.16	761	0.0	$99.14	$467.00	$80.00	3.90
1st Floor Main Hallway	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.08	381	0.0	$49.57	$375.50	$30.00	6.97
1stFloor Main Hallway	39	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	39	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	1,852	0.99	4,615	0.0	$601.13	$3,664.80	$0.00	6.10
1st Floor Main Hallway	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.52	2,410	0.0	$313.94	$1,711.50	$190.00	4.85
1st Floor Main Hallway	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	5	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,852	0.24	1,116	0.0	$145.42	$675.67	$100.00	3.96
1st Floor Main Hallway	3	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Fixture Replacement	Yes	3	LED - Fixtures: Downlight Solid State Retrofit	High/Low Control	16	1,852	0.02	107	0.0	$13.94	$390.95	$0.00	28.04
Room 112	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.29	1,340	0.0	$174.50	$686.80	$140.00	3.13
Room 111	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.29	1,340	0.0	$174.50	$686.80	$140.00	3.13
Room 109	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,645	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.09	412	0.0	$53.65	$350.00	$40.00	5.78
Room 109	3	Incandescent: 100W A Lamp	Wall Switch	100	2,645	Relamp	No	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,645	0.18	812	0.0	$105.79	$161.26	$30.00	1.24
Room 105-104	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.96	4,465	0.0	$581.67	$2,018.67	$420.00	2.75
Room 103	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	15	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.72	3,349	0.0	$436.25	$1,697.00	$335.00	3.12
Room 134	1	Incandescent: 150W A Lamp	Wall Switch	150	2,645	Relamp	Yes	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	15	1,852	0.09	424	0.0	$55.27	$169.75	$10.00	2.89
Room 110	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,645	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.02	96	0.0	$12.48	$98.00	$5.00	7.45
Room 113	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,645	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,852	0.86	3,995	0.0	$520.47	$1,849.20	$350.00	2.88
Room 131	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,645	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.09	412	0.0	$53.65	$350.00	$40.00	5.78
Room 131	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.02	100	0.0	$13.08	$58.50	$10.00	3.71
Room 132	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.14	634	0.0	$82.62	$408.50	$70.00	4.10
Room 132	1	Incandescent: 100W A Lamp	Wall Switch	100	2,645	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,645	0.06	271	0.0	$35.26	$63.65	$10.00	1.52
Room 114	7	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	7	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.34	1,563	0.0	$203.59	$781.93	$160.00	3.05
Room 115	11	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	11	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.53	2,456	0.0	$319.92	$1,162.47	$240.00	2.88
Room 116	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.38	1,786	0.0	$232.67	$877.07	$180.00	3.00
Room 127 (Computer Room)	38	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	38	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	1.04	4,820	0.0	$627.87	$2,763.00	$450.00	3.68

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 127 (Computer Room)	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.04	201	0.0	$26.15	$117.00	$20.00	3.71
Room 127 (Computer Room)	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,645	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,852	0.16	761	0.0	$99.14	$416.80	$80.00	3.40
Room 127 (Computer Room)	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.01	53	0.0	$6.93	$35.90	$5.00	4.46
Room 121	1	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,645	Relamp & Reballast	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.09	412	0.0	$53.65	$277.83	$40.00	4.43
Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.11	507	0.0	$66.09	$350.00	$40.00	4.69
Storage	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,645	Relamp & Reballast	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.08	359	0.0	$46.76	$234.00	$20.00	4.58
Room 119 Locker Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.16	761	0.0	$99.14	$467.00	$80.00	3.90
Room 119 Locker Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.01	53	0.0	$6.93	$35.90	$5.00	4.46
Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.06	266	0.0	$34.63	$259.60	$20.00	6.92
Bathroom	1	Linear Fluorescent - T12: 2' T12 (20W) - 1L	Wall Switch	25	2,645	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	50	0.0	$6.54	$93.50	$0.00	14.30
Gymnasium	21	LED - Fixtures: Downlight Recessed	Wall Switch	43	2,645	None	Yes	21	LED - Fixtures: Downlight Recessed	Occupancy Sensor	43	1,852	0.18	824	0.0	$107.34	$1,080.00	$140.00	8.76
Room 122 (Planetarium)	4	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	Yes	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	1,852	0.14	653	0.0	$85.11	$331.01	$60.00	3.18
Room 122 (Planetarium)	2	LED - Fixtures: LED Uplight	Wall Switch	43	2,645	None	No	2	LED - Fixtures: LED Uplight	Wall Switch	43	2,645	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 125	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.19	893	0.0	$116.33	$496.53	$100.00	3.41
Boys Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$295.50	$25.00	6.25
Boys Bathroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Boys Bathroom	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.00	21	0.0	$2.73	$63.65	$0.00	23.28
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.04	170	0.0	$22.19	$95.13	$20.00	3.39
Girls Bathrrom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$295.50	$25.00	6.25
Girls Bathrrom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Girls Bathrrom	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Fixture Replacement	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.00	21	0.0	$2.73	$63.65	$0.00	23.28
Room 126 Dance Room	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.58	2,679	0.0	$349.00	$1,257.60	$260.00	2.86
2nd Floor Hallway	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.05	254	0.0	$33.05	$317.00	$20.00	8.99
2nd Floor Hallway	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	Yes	1	LED - Fixtures: Downlight Solid State Retrofit	High/Low Control	16	1,852	0.01	36	0.0	$4.65	$263.65	$0.00	56.73
Cafeteria	74	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	74	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	1.06	4,918	0.0	$640.67	$4,006.60	$545.00	5.40

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hallway	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,852	0.96	4,465	0.0	$581.67	$2,502.67	$400.00	3.61
Hallway	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.49	2,283	0.0	$297.41	$1,653.00	$180.00	4.95
Hallway	6	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.16	761	0.0	$99.14	$551.00	$60.00	4.95
Room 239	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.43	2,009	0.0	$261.75	$972.20	$200.00	2.95
Kitchen	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.22	1,022	0.0	$133.14	$570.80	$120.00	3.39
Kitchen	6	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	6	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.20	931	0.0	$121.25	$381.90	$0.00	3.15
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.10	447	0.0	$58.17	$460.27	$75.00	6.62
Boys Bathroom	8	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	8	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.09	426	0.0	$55.47	$287.20	$40.00	4.46
Girls Bathrrom	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.07	341	0.0	$44.38	$190.27	$40.00	3.39
Girls Bathrrom	8	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	8	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.11	532	0.0	$69.26	$557.20	$75.00	6.96
Closet	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.02	100	0.0	$13.08	$58.50	$10.00	3.71
Closet	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	Yes	1	LED - Fixtures: Downlight Solid State Retrofit	Occupancy Sensor	16	1,852	0.01	36	0.0	$4.65	$179.65	$20.00	34.35
Room 237	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.29	1,340	0.0	$174.50	$686.80	$140.00	3.13
Men Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.01	53	0.0	$6.93	$35.90	$5.00	4.46
Men Bathroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Women Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.01	66	0.0	$8.66	$151.90	$25.00	14.66
Women Bathroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Room 235	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.29	1,185	0.0	$154.36	$761.07	$160.00	3.89
Room 236	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 234	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	2,300	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,300	0.09	349	0.0	$45.48	$234.00	$40.00	4.27
Room 233	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 233	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,300	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.01	46	0.0	$6.03	$35.90	$5.00	5.12
Room 232A	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.15	592	0.0	$77.18	$380.53	$80.00	3.89
Room 232B	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.18	741	0.0	$96.47	$475.67	$100.00	3.89
Room 242	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.15	592	0.0	$77.18	$380.53	$80.00	3.89

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 231	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Room 230	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Room 241	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.19	893	0.0	$116.33	$496.53	$100.00	3.41
Room 229	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.29	1,340	0.0	$174.50	$686.80	$140.00	3.13
Room 229	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.01	53	0.0	$6.93	$35.90	$5.00	4.46
Room 227	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.10	447	0.0	$58.17	$306.27	$60.00	4.23
Room 227	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.13	602	0.0	$78.45	$351.00	$60.00	3.71
Room 227	9	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,645	Relamp & Reballast	No	9	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.19	862	0.0	$112.33	$882.00	$45.00	7.45
Council Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.11	507	0.0	$66.09	$350.00	$60.00	4.39
Room223	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.10	447	0.0	$58.17	$306.27	$60.00	4.23
Room224	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.10	447	0.0	$58.17	$306.27	$60.00	4.23
Room222	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.05	254	0.0	$33.05	$233.00	$20.00	6.45
Library	123	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,645	Relamp & Reballast	Yes	123	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	2.89	13,413	0.0	$1,747.22	$13,330.00	$835.00	7.15
Library	4	Halogen Incandescent: Recessed PAR38 90W	Wall Switch	90	2,645	Relamp	No	4	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,645	0.21	961	0.0	$125.21	$215.01	$40.00	1.40
Library	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.43	2,009	0.0	$261.75	$972.20	$200.00	2.95
Room 246	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.19	893	0.0	$116.33	$496.53	$100.00	3.41
Room 246	7	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	7	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.23	1,086	0.0	$141.46	$376.27	$70.00	2.17
Room 244	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.19	893	0.0	$116.33	$496.53	$100.00	3.41
Hallway Expo Light	2	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,645	Relamp & Reballast	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.04	192	0.0	$24.96	$196.00	$10.00	7.45
Room 218	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.24	1,116	0.0	$145.42	$591.67	$120.00	3.24
Room 214	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.05	223	0.0	$29.08	$211.13	$40.00	5.88
Room 213	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.29	1,340	0.0	$174.50	$686.80	$140.00	3.13
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.05	223	0.0	$29.08	$211.13	$20.00	6.57
Bathroom	1	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.03	155	0.0	$20.21	$53.75	$10.00	2.17
Room 212	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.48	2,233	0.0	$290.84	$1,067.33	$220.00	2.91

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.05	223	0.0	$29.08	$211.13	$20.00	6.57
Room 216	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.19	893	0.0	$116.33	$496.53	$100.00	3.41
Room 216	1	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.03	155	0.0	$20.21	$63.65	$10.00	2.65
Room 220	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	0.38	1,786	0.0	$232.67	$877.07	$180.00	3.00
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.02	106	0.0	$13.87	$71.80	$10.00	4.46
Storage	1	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.03	155	0.0	$20.21	$63.65	$10.00	2.65
Men Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$449.50	$25.00	9.81
Women Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$449.50	$25.00	9.81
Auditorium	22	LED - Fixtures: Wall Pack 43W	Wall Switch	43	2,645	None	No	22	LED - Fixtures: Wall Pack 43W	Wall Switch	43	2,645	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stage	75	Halogen Incandescent: PAR38 90W	Wall Switch	90	2,645	Relamp	No	75	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	3.98	18,479	0.0	$2,407.13	$4,773.75	$750.00	1.67
Room 210	3	Halogen Incandescent: Recessed PAR38 90W	Wall Switch	90	2,645	Relamp	Yes	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	1,852	0.16	764	0.0	$99.49	$306.95	$50.00	2.58
Stairwells	36	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Fixture Replacement	No	36	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.16	756	0.0	$98.42	$2,291.44	$0.00	23.28
3rd Floor House Gill	60	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,852	Relamp	No	60	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,852	2.20	7,154	0.0	$931.95	$5,708.00	$1,200.00	4.84
Room 304	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.01	66	0.0	$8.66	$151.90	$25.00	14.66
Girls Bathrrom	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.06	266	0.0	$34.63	$413.60	$20.00	11.37
Girls Bathrrom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Girls Bathrrom	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.00	21	0.0	$2.73	$63.65	$0.00	23.28
Men Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.06	266	0.0	$34.63	$413.60	$20.00	11.37
Men Bathroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,645	0.00	23	0.0	$2.97	$35.90	$5.00	10.40
Men Bathroom	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.00	21	0.0	$2.73	$63.65	$0.00	23.28
Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.04	170	0.0	$22.19	$95.13	$20.00	3.39
Room 310	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	14	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.51	2,074	0.0	$270.13	$1,331.87	$280.00	3.89
Room 313	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Hallway	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,610	0.19	777	0.0	$101.16	$580.53	$80.00	4.95
Room 312	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.37	1,481	0.0	$192.95	$951.33	$200.00	3.89

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 311	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	14	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.51	2,074	0.0	$270.13	$1,331.87	$280.00	3.89
Room 306	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,300	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.01	46	0.0	$6.03	$35.90	$5.00	5.12
Room 321	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Room 319	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.18	741	0.0	$96.47	$475.67	$100.00	3.89
Room 320	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	14	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.51	2,074	0.0	$270.13	$1,331.87	$280.00	3.89
Room 322	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.44	1,777	0.0	$231.54	$1,141.60	$240.00	3.89
Room 323	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	14	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.51	2,074	0.0	$270.13	$1,331.87	$280.00	3.89
Hallway	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	2	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	1,852	0.03	133	0.0	$17.32	$271.80	$10.00	15.12
Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,852	0.29	1,340	0.0	$174.50	$770.80	$120.00	3.73
Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,852	0.41	1,903	0.0	$247.85	$1,277.50	$150.00	4.55
Bathroom	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.10	465	0.0	$60.60	$521.30	$70.00	7.45
Boys Bathroom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$449.50	$25.00	9.81
Boys Bathroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.02	100	0.0	$13.08	$58.50	$10.00	3.71
Closet	1	Compact Fluorescent: 23W Circular CFL	Wall Switch	23	2,645	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	2,645	0.00	21	0.0	$2.73	$63.65	$0.00	23.28
Closet	1	Incandescent: 60W A Lamp	Wall Switch	60	2,645	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.03	155	0.0	$20.21	$63.65	$10.00	2.65
Girls Bathrrom	5	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,645	Relamp	Yes	5	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,852	0.07	332	0.0	$43.29	$449.50	$25.00	9.81
Girls Bathrrom	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	2,645	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	2,645	0.01	41	0.0	$5.35	$31.90	$5.00	5.03
Room 335	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.29	1,185	0.0	$154.36	$761.07	$160.00	3.89
Room 335	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 331	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Room 329	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 334	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 333	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.11	444	0.0	$57.88	$285.40	$60.00	3.89
Room 334	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,300	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.01	46	0.0	$6.03	$35.90	$5.00	5.12

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 335	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 335	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,300	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.01	46	0.0	$6.03	$35.90	$5.00	5.12
Room 330	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.29	1,185	0.0	$154.36	$761.07	$160.00	3.89
Room 330	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Occupancy Sensor	32	2,300	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.01	46	0.0	$6.03	$35.90	$5.00	5.12
Room 332	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.33	1,333	0.0	$173.65	$856.20	$180.00	3.89
Room 336	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 336	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 326	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 326	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 327	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 327	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 337	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 337	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Room 338	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	2,300	Relamp	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,300	0.22	889	0.0	$115.77	$570.80	$120.00	3.89
Room 338	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Occupancy Sensor	46	2,300	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,300	0.02	83	0.0	$10.85	$98.00	$5.00	8.57
Hallway	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,852	0.58	2,679	0.0	$349.00	$1,541.60	$240.00	3.73
Speech Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.03	127	0.0	$16.52	$174.50	$30.00	8.75
Girls Locker Room	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,852	0.46	2,156	0.0	$280.89	$1,534.50	$240.00	4.61
Girls Locker Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.04	170	0.0	$22.19	$95.13	$20.00	3.39
Exterior Perimeter Light	1	Metal Halide: (1) 150W Lamp	Daylight Dimming	190	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	45	4,380	0.10	730	0.0	$95.14	$390.68	$100.00	3.06
Exterior Perimeter Light	8	Metal Halide: (1) 400W Lamp	Daylight Dimming	458	4,380	Fixture Replacement	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	125	4,380	1.75	13,419	0.0	$1,747.98	$3,125.42	$800.00	1.33
Exterior Perimeter Light	6	Mercury Vapor: (1) 250W Lamp	Daylight Dimming	290	4,380	Fixture Replacement	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	75	4,380	0.85	6,498	0.0	$846.43	$2,344.06	$600.00	2.06
Exterior Perimeter Light	2	Compact Fluorescent: 34W CFL	Daylight Dimming	34	4,380	Fixture Replacement	No	2	LED - Fixtures: Downlight Solid State Retrofit	Daylight Dimming	24	4,380	0.01	103	0.0	$13.39	$127.30	$0.00	9.51
Garage	65	Mercury Vapor: (1) 175W Lamp	Daylight Dimming	205	4,380	Fixture Replacement	No	65	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	55	4,380	6.39	49,111	0.0	$6,397.44	$25,394.01	$6,500.00	2.95
Garage	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,645	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,645	0.06	301	0.0	$39.23	$175.50	$30.00	3.71

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Garage	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,645	Relamp	No	3	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,645	0.11	511	0.0	$66.57	$285.40	$60.00	3.39
Garage	8	Incandescent: Recessed 60W	Wall Switch	60	2,645	Relamp	No	8	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,645	0.27	1,241	0.0	$161.66	$430.02	$80.00	2.17
Exterior Perimeter Light	7	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,380	Fixture Replacement	No	7	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	75	4,380	1.01	7,757	0.0	$1,010.47	$2,734.74	$700.00	2.01
Speech	38	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	38	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Other	0.1	69.0%	No	4,380	No	69.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	School	2	Heating Hot Water Pump	15.0	93.0%	Yes	4,000	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	School	1	Supply Fan	7.5	84.0%	No	4,000	Yes	91.7%	No		0.41	1,678	0.0	$218.57	$1,153.79	$0.00	5.28
Boiler Room	School	1	Supply Fan	7.5	88.5%	No	4,000	No	88.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Gymnasium	1	Supply Fan	15.0	92.0%	No	4,000	No	92.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
School	School	53	Other	0.8	71.0%	No	4,000	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 112	Room 112	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 111	Room 111	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 114	Room 114	1	Window AC	1.92		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 115	Room 115	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 116	Room 116	1	Window AC	1.92		Yes	1	Window AC	1.50		12.00		No	0.77	1,299	0.0	$169.18	$1,633.14	$0.00	9.65
Room 127-Comp Room	Room 127-Comp Room	1	Split-System AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 237	Room 237	1	Window AC	1.92		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Planetarium	Planetarium	1	Split-System AC	4.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Library	Library	4	Split-System AC	4.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	3	Condensing Hot Water Boiler	2,790.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
School Bathrooms	12	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	51.7	$388.06	$86.04	$0.00	0.22
Kitchen	2	Faucet Aerator (Kitchen)	3.00	2.20	0.00	0	5.7	$43.12	$14.34	$0.00	0.33

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 113 Cooking & Sewing Class	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Freezer, Solid Door (>50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (>50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 237	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Gas Rack Oven (Double)	Yes	No	0.00	0	0.0	$0.00	$9,290.04	$2,000.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	81	Desktop Computer	204.0	Yes
School	4	Copy Machine	850.0	Yes
School	10	Printer	460.0	Yes
School	8	Microwave	850.0	No
Room 113	4	Electric Range	1,000.0	Yes
Room 113	1	Electric Washing Machine	500.0	Yes
Room 113	1	Electric Dryer Machine	1,000.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Cafeteria	2	Refrigerated	Yes	0.00	3,224	0.0	$419.93	$1,437.60	$0.00	3.42
Room 237	1	Refrigerated	Yes	0.00	1,612	0.0	$209.97	$718.80	$0.00	3.42

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

35

ENERGY STAR® Score[1]

Glenfield Middle School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 125,281
Built: 1922

For Year Ending: April 30, 2016
Date Generated: December 20, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Glenfield Middle School 25 Maple Avenue Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5727438

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
47.9 kBtu/ft²

Source EUI
93.9 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	2,610,836 (44%)
Natural Gas (kBtu)	3,396,283 (56%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	42.4
National Median Source EUI (kBtu/ft²)	83.1
% Diff from National Median Source EUI	13%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	470

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Hillside School

54 Orange Road

Montclair, New Jersey 07042

Montclair Board of Education

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Hillside School.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local governments in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

Hillside School is a 125,799 square foot facility constructed in 1931. The building is a three-story educational facility including but not limited to classrooms, library areas, offices, hallways and an auditorium.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 17-Watt T8 and 59-Watt T8 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several incandescent, and compact fluorescent lamps. Exterior lighting is provided by a combination of 100-Watt metal halide fixtures, 100-Watt incandescent, and 250-Watt mercury vapor fixtures. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation is provided by window air conditioning (AC) units. Heating is provided by convectors that that are served by the Central Heating Plant.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated seven measures and recommends six measures which together represent an opportunity for the Hillside School to reduce annual energy costs by roughly $36,471 and annual greenhouse gas emissions by 240,907 lbs CO_2e. We estimate that if all measures were implemented as recommended, the project would pay for itself in 4.1 years. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce the Hillside School's annual energy use by 14%.

Figure 1 – Previous 12 Month Utility Costs

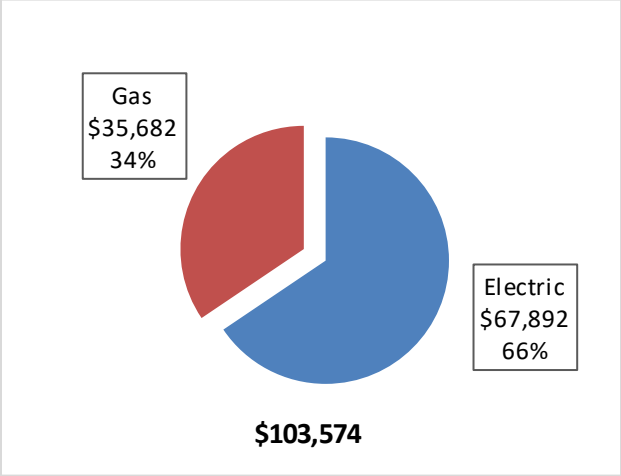
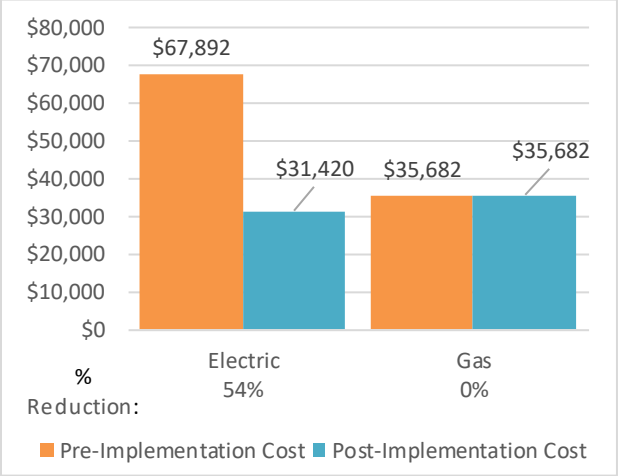


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Hillside School's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**209,371**	**46.9**	**0.0**	**$31,918.71**	**$146,006.71**	**$21,745.00**	**$124,261.71**	**3.9**	**210,835**
ECM 1	Install LED Fixtures	Yes	18,278	3.8	0.0	$2,786.45	$43,765.28	$4,800.00	$38,965.28	14.0	18,406
ECM 2	Retrofit Fixtures with LED Lamps	Yes	187,817	42.8	0.0	$28,632.80	$101,058.32	$16,945.00	$84,113.32	2.9	189,130
ECM 3	Install LED Exit Signs	Yes	3,276	0.2	0.0	$499.47	$1,183.11	$0.00	$1,183.11	2.4	3,299
Lighting Control Measures			**28,655**	**6.3**	**0.0**	**$4,368.42**	**$29,720.00**	**$3,150.00**	**$26,570.00**	**6.1**	**28,855**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	24,564	5.4	0.0	$3,744.85	$25,920.00	$3,150.00	$22,770.00	6.1	24,736
ECM 5	Install High/Low Lighitng Controls	Yes	4,090	0.9	0.0	$623.57	$3,800.00	$0.00	$3,800.00	6.1	4,119
Electric Unitary HVAC Measures			**1,796**	**1.0**	**0.0**	**$273.85**	**$16,149.94**	**$0.00**	**$16,149.94**	**59.0**	**1,809**
	Install High Efficiency Electric AC	No	1,796	1.0	0.0	$273.85	$16,149.94	$0.00	$16,149.94	59.0	1,809
Plug Load Equipment Control - Vending Machine			**1,209**	**0.0**	**0.0**	**$184.29**	**$230.00**	**$0.00**	**$230.00**	**1.2**	**1,217**
ECM 6	Vending Machine Control	Yes	1,209	0.0	0.0	$184.29	$230.00	$0.00	$230.00	1.2	1,217
TOTALS (RECOMMENDED MEASURES ONLY)			**239,234**	**53.2**	**0.0**	**$36,471.42**	**$175,956.71**	**$24,895.00**	**$151,061.71**	**4.1**	**240,907**
TOTALS (ALL EVALUATED MEASURES)			**241,031**	**54.2**	**0.0**	**$36,745.28**	**$192,106.65**	**$24,895.00**	**$167,211.65**	**4.6**	**242,716**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Electric Unitary HVAC measures generally involve replacing older inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide equivalent cooling to older air condition systems at a reduced energy cost. These measures save energy by reducing the power used by the air conditioning systems, due to improved electrical efficiency.

Plug Load Equipment control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.

Energy Efficient Practices

TRC also identified seven low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at the Hillside School include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Clean Evaporator/Condenser Coils on AC Systems
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for the Hillside School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	135	kW DC STC
Electric Generation	160,835	kWh/yr
Displaced Cost	$13,990	/yr
Installed Cost	$351,000	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Thomas Page	Auditor	MTraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 03, 2016, TRC performed an energy audit at Hillside School located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Hillside School is a 125,799 square foot facility constructed in 1931. The building is a three-story educational facility including but not limited to classrooms, library areas, offices, hallways and an auditorium.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Hillside School	Weekday	5:30 AM - 3:30 PM
Hillside School	Weekend	unoccupied

2.4 Building Envelope

The Hillside School is a three-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with operable frames. The flat roof is constructed of built-up roofing material.

Figure 7 – Building Façade



2.5 On-Site Generation

Hillside School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the Hillside School consists mainly of 32-Watt T8 fluorescent fixtures with a few 17-Watt T8 and 59-Watt T8 fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. The linear fluorescent fixtures are 2-foot, 4-foot, or 8-foot long, mainly troffers with diffusers having 1, 2, 3, or 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 27-Watt compact fluorescent lamps, 100-Watt incandescent lamps, and 250-Watt metal halide lamps. The exit signs are mostly LED fixtures, though some are incandescent fixtures.

Interior lighting control in the building is provided by a combination of manual switches and occupancy sensors.

Figure 8 - Building Lighting Systems

Linear Fluorescent Fixture	*Exterior Fixture*
	

Exterior lighting is provided by a combination of 100-Watt metal halide fixtures, 100-Watt incandescent, and 250-Watt mercury vapor fixtures.

Heating System

The Central Heating Plant has two natural gas fired Weil McLain steam boilers with an input rating of 7,938 MBh each and a nominal efficiency of 80%. These boilers provide space heating for the Hillside School, the Montclair Community Pre-K, and the district Administration Building.

Figure 9 – Heating System

Steam Boiler	*Baseboard Heater*
	

Direct Expansion Air Conditioning System (DX)

Air conditioning (AC) at the facility is primarily provided by window air conditioning units with capacities ranging between 0.42 ton and 1.5 tons and efficiency of around 10.9 EER.

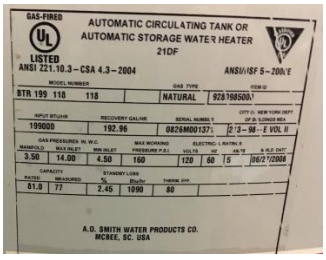
Figure 10 – DX Air Conditioning System

Window AC	*Window AC Arrangement*
	

Domestic Hot Water Heating System

The domestic hot water is supplied by one A.O. Smith 199 kBtu/hr input domestic hot water boiler. The boiler has an 81-gallon tank capacity and an efficiency of 80%.

Figure 11 – Domestic Hot Water Heating System

Domestic Hot Water Heater	*DHW Heater Nameplate*
	

Food Service Equipment

The facility has one full sized electric convection oven, insulated food holding cabinet, and an electric oven/steam cooker.

Refrigeration

The facility has two 19 cu. ft. stand up refrigerators with solid door and one ice making head producing around 400 pounds of ice per day.

Figure 12 – Refrigeration System

Solid Door Refrigerator



Building Plug Load

The facility contains several plug-load systems which contribute to plug load electric use including but not limited to printers, microwaves, and televisions. In addition to the typical plug load equipment, the facility also has a refrigerated vending machine.

Figure 13 – Vending Machines



3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

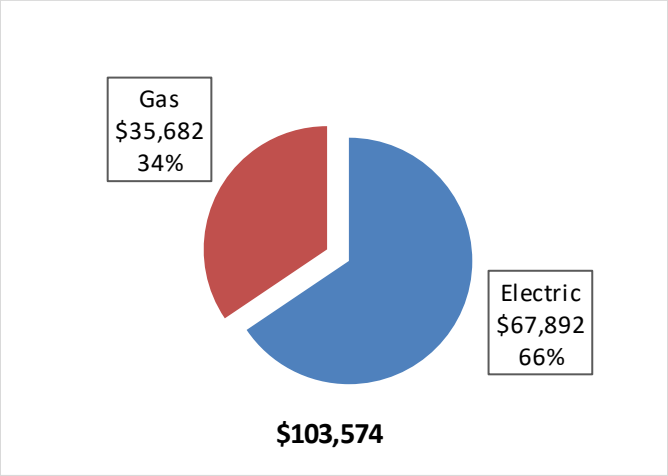
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 14 - Utility Summary

Utility Summary for Hillside School		
Fuel	**Usage**	**Cost**
Electricity	445,334 kWh	$67,892
Natural Gas	44,496 Therms	$35,682
Total		**$103,574**

The current annual energy cost for this facility is $103,574 as shown in the chart below.

Figure 15 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.152/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Electric usage estimation and calibration methodology:

1. The Montclair BOE buildings Hillside, the Administration Building, Pre-K, and Central Heating Plant are served by three electric meters 65 795 083 02, 67 125 896 06, and 42 007 763 08. There is not a clear delineation of loads (or equipment kW) served by the meters, therefore, kW was not prorated.
2. Total energy use from all the meters combined is around 638,475 kWh for a 12-month period.
3. Monthly "calculated" energy use from the LGEA analysis tools were used to calculate the percentage contribution of each building. The percentages are:
    a. Hillside – 70%
    b. Administration Building – 11%
    c. Pre-K – 18%
    d. Central Heating Plant – 1%
4. The above percentages were applied to the "actual" total monthly energy use from bills to estimate monthly utility energy use to which all the tools were then calibrated.

Figure 16 - Electric Usage & Demand

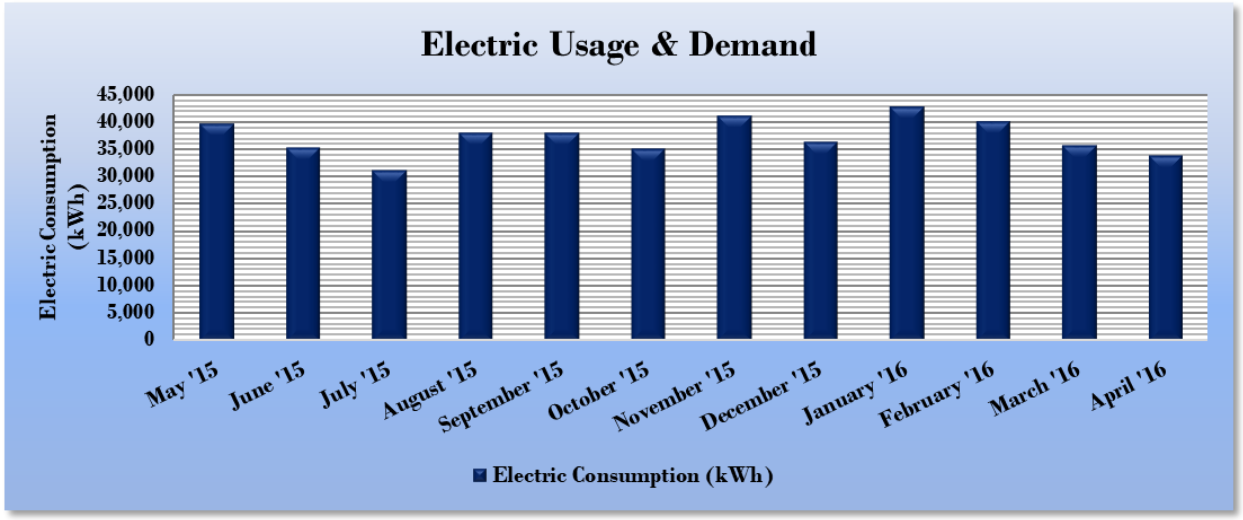


Figure 17 - Electric Usage & Demand

Electric Billing Data for Hillside School				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
6/15/15	33	39,547	$7,688	Yes
7/14/15	29	35,272	$6,781	Yes
8/17/15	34	31,193	$5,957	Yes
9/14/15	28	37,916	$6,959	Yes
10/13/15	29	37,851	$5,588	Yes
11/10/15	28	35,133	$4,939	Yes
12/11/15	31	40,989	$5,618	Yes
1/13/16	33	36,331	$4,744	Yes
2/11/16	29	42,800	$5,495	Yes
3/14/16	32	40,015	$5,139	Yes
4/13/16	30	35,638	$4,793	Yes
5/13/16	30	33,869	$4,375	Yes
Totals	**366**	**446,554**	**$68,078**	12
Annual	**365**	**445,334**	**$67,892**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.802/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Natural gas use was allocated to the sites served by the Central Heating Plant using the following method:

1. The Administration Building, Hillside School, Montclair Community Pre-K, and Central Heating Plant are served by two gas meters: 65 795 083 02 and 67 125 896 06. There is not a clear delineation of which buildings and equipment are served by each meter.
2. Total annual gas use for both of the meters combined is 59,235 therms.
3. The calculated gas use from the LGEA analysis for each building was used to determine the percentage of the total historical gas use to be assigned to each building. Total gas use was allocated to the three buildings served by the Central Heating Plant as follows:
    a. Hillside School - 75%
    b. Administration Building - 9%
    c. Montclair Community Pre-K - 16%
4. The above percentages were applied to the total monthly gas use from the utility bills to estimate the monthly gas use for the individual buildings. This estimated monthly gas use is what is provided in each of the reports.

Figure 18 - Natural Gas Usage

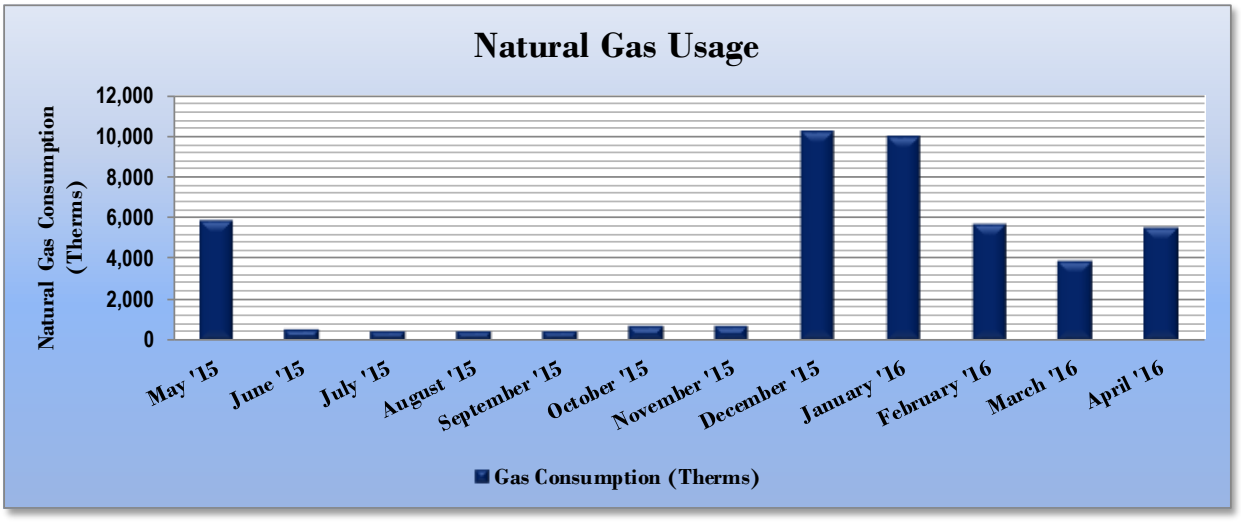


Figure 19 - Natural Gas Usage

Gas Billing Data for Hillside School				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/15/15	33	5,934	$3,201	Yes
7/14/15	29	500	$1,004	Yes
8/17/15	34	420	$417	Yes
9/14/15	28	419	$1,042	Yes
10/13/15	29	460	$642	Yes
11/10/15	28	677	$720	Yes
12/11/15	31	727	$938	Yes
1/13/16	33	10,293	$9,641	Yes
2/11/16	29	10,006	$9,178	Yes
3/14/16	32	5,693	$3,879	Yes
4/13/16	30	3,897	$2,119	Yes
5/13/16	30	5,591	$3,000	Yes
Totals	**366**	**44,618**	**$35,780**	12
Annual	**365**	**44,496**	**$35,682**	

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 20 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Hillside School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	75.1	141.4
Site Energy Use Intensity (kBtu/ft^2)	47.4	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 21 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Hillside School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	54.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	41.0	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. The Central Heating Plant and the three buildings served by it have a combined score of 74.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

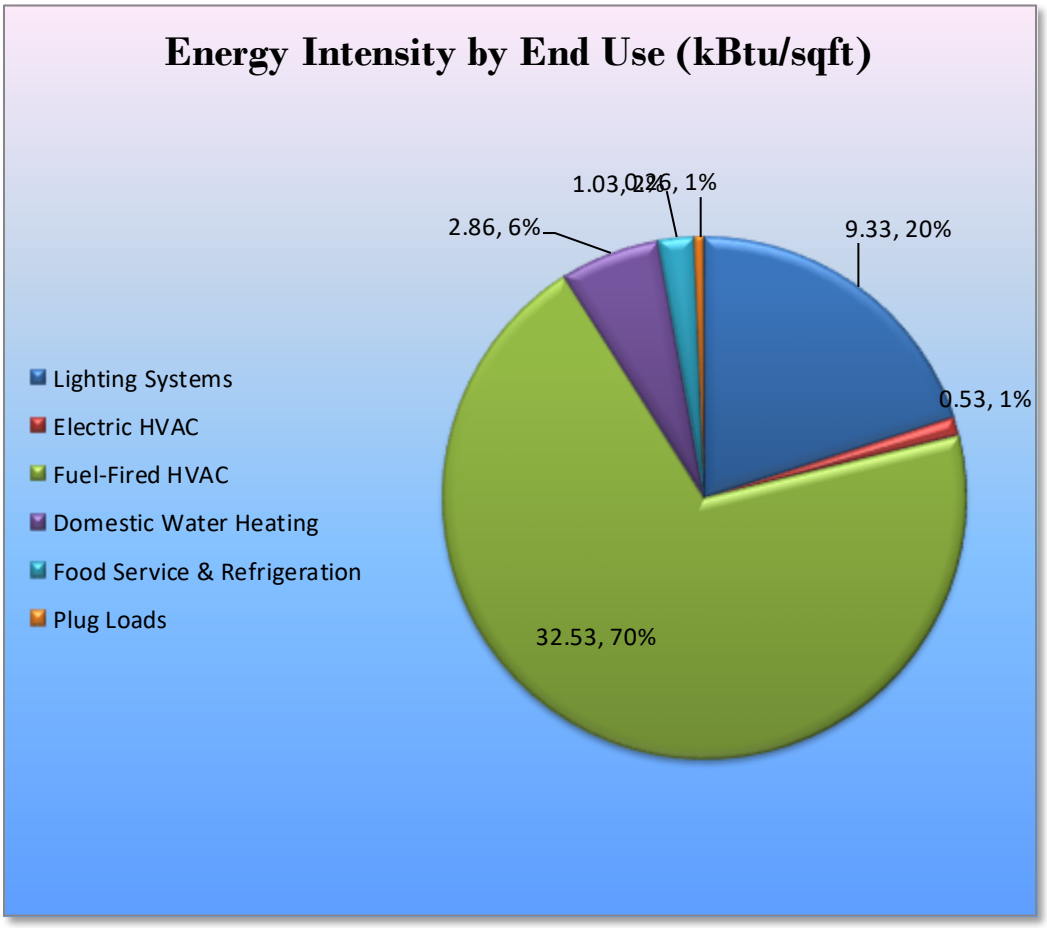
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 22 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Hillside School regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 23 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**209,371**	**46.9**	**0.0**	**$31,918.71**	**$146,006.71**	**$21,745.00**	**$124,261.71**	**3.9**	**210,835**
ECM 1	Install LED Fixtures	18,278	3.8	0.0	$2,786.45	$43,765.28	$4,800.00	$38,965.28	14.0	18,406
ECM 2	Retrofit Fixtures with LED Lamps	187,817	42.8	0.0	$28,632.80	$101,058.32	$16,945.00	$84,113.32	2.9	189,130
ECM 3	Install LED Exit Signs	3,276	0.2	0.0	$499.47	$1,183.11	$0.00	$1,183.11	2.4	3,299
Lighting Control Measures		**28,655**	**6.3**	**0.0**	**$4,368.42**	**$29,720.00**	**$3,150.00**	**$26,570.00**	**6.1**	**28,855**
ECM 4	Install Occupancy Sensor Lighting Controls	24,564	5.4	0.0	$3,744.85	$25,920.00	$3,150.00	$22,770.00	6.1	24,736
ECM 5	Install High/Low Lighitng Controls	4,090	0.9	0.0	$623.57	$3,800.00	$0.00	$3,800.00	6.1	4,119
Plug Load Equipment Control - Vending Machine		**1,209**	**0.0**	**0.0**	**$184.29**	**$230.00**	**$0.00**	**$230.00**	**1.2**	**1,217**
ECM 6	Vending Machine Control	1,209	0.0	0.0	$184.29	$230.00	$0.00	$230.00	1.2	1,217
TOTALS		**239,234**	**53.2**	**0.0**	**$36,471.42**	**$175,956.71**	**$24,895.00**	**$151,061.71**	**4.1**	**240,907**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 24 below.

Figure 24 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**209,371**	**46.9**	**0.0**	**$31,918.71**	**$146,006.71**	**$21,745.00**	**$124,261.71**	**3.9**	**210,835**
ECM 1	Install LED Fixtures	18,278	3.8	0.0	$2,786.45	$43,765.28	$4,800.00	$38,965.28	14.0	18,406
ECM 2	Retrofit Fixtures with LED Lamps	187,817	42.8	0.0	$28,632.80	$101,058.32	$16,945.00	$84,113.32	2.9	189,130
ECM 3	Install LED Exit Signs	3,276	0.2	0.0	$499.47	$1,183.11	$0.00	$1,183.11	2.4	3,299

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	16,107	3.5	0.0	$2,455.52	$42,593.25	$4,500.00	$38,093.25	15.5	16,220
Exterior	2,171	0.3	0.0	$330.93	$1,172.03	$300.00	$872.03	2.6	2,186

Measure Description

We recommend replacing existing fixtures containing mercury vapor and metal halide lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a HID lamp.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	184,094	42.4	0.0	$28,065.22	$100,618.79	$16,895.00	$83,723.79	3.0	185,381
Exterior	3,723	0.5	0.0	$567.57	$439.53	$50.00	$389.53	0.7	3,749

Measure Description

We recommend retrofitting existing incandescent, linear fluorescent, and compact fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tube and more than 10 times longer than many incandescent lamps.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	3,276	0.2	0.0	$499.47	$1,183.11	$0.00	$1,183.11	2.4	3,299

Measure Description

We recommend replacing all incandescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 25 below.

Figure 25 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**28,655**	**6.3**	**0.0**	**$4,368.42**	**$29,720.00**	**$3,150.00**	**$26,570.00**	**6.1**	**28,855**
ECM 4	Install Occupancy Sensor Lighting Controls	24,564	5.4	0.0	$3,744.85	$25,920.00	$3,150.00	$22,770.00	6.1	24,736
ECM 5	Install High/Low Lighitng Controls	4,090	0.9	0.0	$623.57	$3,800.00	$0.00	$3,800.00	6.1	4,119

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
24,564	5.4	0.0	$3,744.85	$25,920.00	$3,150.00	$22,770.00	6.1	24,736

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in all offices, storage rooms, classrooms, kitchen areas, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,090	0.9	0.0	$623.57	$3,800.00	$0.00	$3,800.00	6.1	4,119

Measure Description

We recommend installing occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors, parking lots, and parking garages.

Lighting fixtures with these controls operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared sensors. The lighting systems are switched to full lighting levels whenever an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period of time. Energy savings results from only providing full lighting levels when it is required.

For this type of measure the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage needs to be provided to ensure that lights turn on in each area as an occupant approaches.

Additional savings from reduced lighting maintenance may also result from this measure, due to reduced lamp operation.

4.1.3 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment control measures can be summarized in Figure 26 below.

Figure 26 - Summary of Plug Load Equipment ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,209**	**0.0**	**0.0**	**$184.29**	**$230.00**	**$0.00**	**$230.00**	**1.2**	**1,217**
ECM 6	Vending Machine Control	1,209	0.0	0.0	$184.29	$230.00	$0.00	$230.00	1.2	1,217

ECM 6: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,209	0.0	0.0	$184.29	$230.00	$0.00	$230.00	1.2	1,217

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy use. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

4.2 ECM Evaluated But Not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 27 – Summary of Measure Evaluated, But Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures	**1,796**	**1.0**	**0.0**	**$273.85**	**$16,149.94**	**$0.00**	**$16,149.94**	**59.0**	**1,809**
Install High Efficiency Electric AC	1,796	1.0	0.0	$273.85	$16,149.94	$0.00	$16,149.94	59.0	1,809
TOTALS	**1,796**	**1.0**	**0.0**	**$273.85**	**$16,149.94**	**$0.00**	**$16,149.94**	**59.0**	**1,809**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Air Conditioning Units

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,796	1.0	0.0	$273.85	$16,149.94	$0.00	$16,149.94	59.0	1,809

Measure Description

We evaluated replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units. There have been significant improvements in both compressor and fan motor efficiencies over the past several years. Therefore, electricity savings can be achieved by replacing older units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling load, and the estimated annual operating hours.

Reasons for not Recommending

This measure has a long payback, more than the rated useful life of the replacement equipment. The measure is not recommended for implementation on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

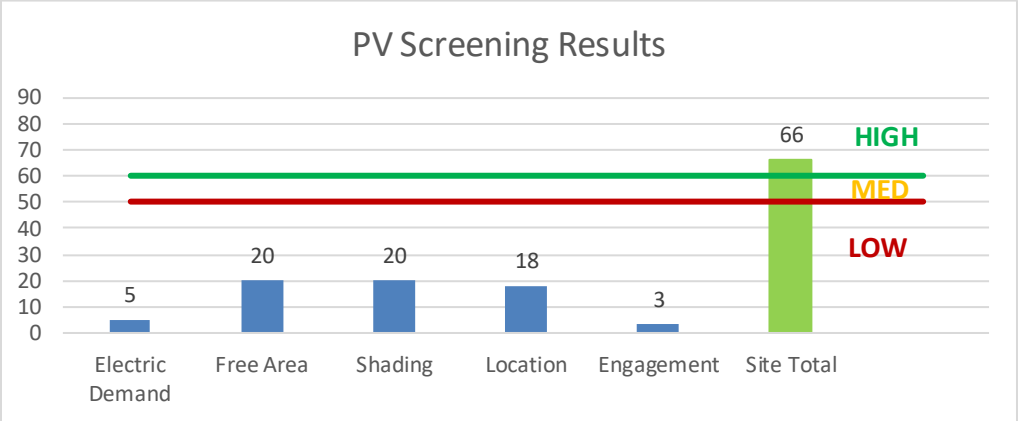
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the building may be feasible. If Hillside School is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 28 - Photovoltaic Screening



Potential	High	
System Potential	135	kW DC STC
Electric Generation	160,835	kWh/yr
Displaced Cost	$13,990	/yr
Installed Cost	$351,000	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.2 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a no potential for installing a cost-effective CHP system.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 29 for a list of the eligible programs identified for each recommended ECM.

Figure 29 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	X					
ECM 2	Retrofit Fixtures with LED Lamps	X					
ECM 3	Install LED Exit Signs						
ECM 4	Install Occupancy Sensor Lighting Controls	X					
ECM 5	Install High/Low Lighitng Controls						
ECM 6	Vending Machine Control						

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 29	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,820	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.06	204	0.0	$31.08	$190.27	$40.00	4.84
Dir Of BC Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.08	374	0.0	$57.02	$445.50	$65.00	6.67
Rm 1	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Corridor 4	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.22	997	0.0	$152.06	$668.00	$80.00	3.87
Corridor 4	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridor 5	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.27	1,247	0.0	$190.08	$785.00	$100.00	3.60
Corridor 5	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridor 5	2	Linear Fluorescent - T8: 8' T8 (59W) - 2L	Wall Switch	110	2,600	Relamp	Yes	2	LED - Linear Tubes: (2) 8' Lamps	High/Low Control	72	1,820	0.08	356	0.0	$54.33	$420.00	$0.00	7.73
Corridor 3	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.08	374	0.0	$57.02	$375.50	$30.00	6.06
Corridor 3	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridor 3	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,820	0.67	3,073	0.0	$468.41	$1,531.87	$280.00	2.67
Rm 2	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 3	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Boys Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Rm 4	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.57	2,618	0.0	$399.17	$1,322.80	$245.00	2.70
Rm 4	1	Linear Fluorescent - T8: 8' T8 (59W) - 2L	Wall Switch	110	2,600	Relamp	No	1	LED - Linear Tubes: (2) 8' Lamps	Wall Switch	72	2,600	0.02	114	0.0	$17.32	$110.00	$0.00	6.35
Rm 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.02	105	0.0	$15.95	$71.80	$10.00	3.87
Women's Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.08	374	0.0	$57.02	$445.50	$65.00	6.67
Woodshop	20	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	No	20	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.65	2,960	0.0	$451.27	$1,504.00	$300.00	2.67
Woodshop	12	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	12	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.14	628	0.0	$95.72	$430.80	$60.00	3.87
Music Rm (Rm 7)	33	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	33	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.90	4,115	0.0	$627.26	$2,470.50	$400.00	3.30
Music Office 1	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Music Office 2	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Music Office 3	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Music Storage	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Dishwash Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Kitchen Service	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.41	1,870	0.0	$285.12	$1,022.00	$185.00	2.94
Kitchen	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.60	2,743	0.0	$418.18	$1,827.00	$290.00	3.68
Mop Closet	1	Incandescent: INC-125W	Wall Switch	125	2,600	Relamp	No	1	LED Screw-In Lamps: LED-19W	Wall Switch	19	2,600	0.07	318	0.0	$48.43	$43.95	$5.00	0.80
Entrance to Kitchen	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.02	99	0.0	$15.04	$58.50	$10.00	3.22
Storage Area	4	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	Yes	4	LED Screw-In Lamps: LED-9W	Occupancy Sensor	9	1,820	0.14	642	0.0	$97.91	$445.81	$20.00	4.35
Cafeteria	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Cafeteria	24	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	24	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.98	4,489	0.0	$684.29	$2,344.80	$430.00	2.80
Staff Cafeteria	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.16	748	0.0	$114.05	$570.80	$95.00	4.17
Boys Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.01	52	0.0	$7.98	$35.90	$5.00	3.87
Main Office	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.41	1,870	0.0	$285.12	$1,147.50	$185.00	3.38
Gym 1	15	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,600	Fixture Replacement	Yes	15	LED - Fixtures: Low-Bay	Occupancy Sensor	89	1,820	2.29	10,452	0.0	$1,593.46	$21,566.63	$2,285.00	12.10
Gym 1	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Gym 2	15	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,600	Fixture Replacement	Yes	15	LED - Fixtures: Low-Bay	Occupancy Sensor	89	1,820	2.29	10,452	0.0	$1,593.46	$21,566.63	$2,285.00	12.10
Gym 2	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Storage Closet	5	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	Yes	5	LED Screw-In Lamps: LED-9W	Occupancy Sensor	9	1,820	0.18	803	0.0	$122.39	$489.77	$25.00	3.80
Costume	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.02	99	0.0	$15.04	$58.50	$10.00	3.22
Costume	5	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	Yes	5	LED Screw-In Lamps: LED-9W	Occupancy Sensor	9	1,820	0.18	803	0.0	$122.39	$489.77	$60.00	3.51
Storage	9	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	Yes	9	LED Screw-In Lamps: LED-9W	Occupancy Sensor	9	1,820	0.32	1,445	0.0	$220.30	$665.58	$45.00	2.82
Drama Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Restroom	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68
Closet	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Auditorium	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Auditorium	6	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	6	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Auditorium	150	Incandescent: INC-150W	Wall Switch	150	2,600	Relamp	No	150	LED Screw-In Lamps: LED-23W	Wall Switch	23	2,600	12.54	57,184	0.0	$8,717.70	$6,592.95	$750.00	0.67

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Storage	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68
DHW Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.05	209	0.0	$31.91	$143.60	$20.00	3.87
Storage	2	Incandescent: INC-150W	Wall Switch	150	2,600	Relamp	Yes	2	LED Screw-In Lamps: LED-23W	Occupancy Sensor	23	1,820	0.18	803	0.0	$122.39	$357.91	$10.00	2.84
Custodial Area	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Custodial Area	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
OT Rm	1	Incandescent: INC-150W	Wall Switch	150	2,600	Relamp	No	1	LED Screw-In Lamps: LED-23W	Wall Switch	23	2,600	0.08	381	0.0	$58.12	$43.95	$5.00	0.67
Pre-School Child Study	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.33	1,496	0.0	$228.10	$972.00	$155.00	3.58
Corridor 1	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.22	997	0.0	$152.06	$668.00	$80.00	3.87
Corridor 1	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridor 1	2	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	2,600	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	2,600	0.04	173	0.0	$26.44	$153.07	$40.00	4.28
Foyer	2	Linear Fluorescent - T8: 2' T8 (17W) - 4L	Wall Switch	63	2,600	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	2,600	0.04	173	0.0	$26.44	$153.07	$40.00	4.28
Foyer	8	Compact Fluorescent: CFL-1L-27W	Wall Switch	27	2,600	Relamp	Yes	8	LED Screw-In Lamps: LED - 19W Lamp	Occupancy Sensor	19	1,820	0.07	329	0.0	$50.21	$621.62	$0.00	12.38
Rm 22 (Tech)	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 22 (Tech)	19	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	19	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.78	3,553	0.0	$541.73	$1,968.80	$355.00	2.98
Rm 24	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Rm 24A	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,600	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.16	748	0.0	$114.05	$570.80	$95.00	4.17
Rm 24B (Drama)	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 26 (Dance)	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	26	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.71	3,242	0.0	$494.21	$2,061.00	$330.00	3.50
Duplicating Center	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.33	1,496	0.0	$228.10	$972.00	$155.00	3.58
Paper Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$40.00	6.10
Entrance/Stairwell	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.13	592	0.0	$90.25	$351.00	$60.00	3.22
Rm 101	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 102	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 102	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.19	878	0.0	$133.83	$650.53	$115.00	4.00
Rm 102	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Corridor 10	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.22	997	0.0	$152.06	$668.00	$80.00	3.87
Rm 103	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Corridor 9	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Corridor 11	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.27	1,247	0.0	$190.08	$985.00	$100.00	4.66
Corridor 11	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.02	105	0.0	$15.95	$71.80	$10.00	3.87
Rm 104	30	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.82	3,740	0.0	$570.24	$2,295.00	$370.00	3.38
Sewing Rm	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	997	0.0	$152.06	$738.00	$115.00	4.10
Boys Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	3	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.03	157	0.0	$23.93	$107.70	$15.00	3.87
Rm 106 Tech Lab	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.38	1,746	0.0	$266.11	$1,089.00	$175.00	3.43
Rm 107 Music	30	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.82	3,740	0.0	$570.24	$2,295.00	$370.00	3.38
Rm 107	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.38	1,756	0.0	$267.66	$1,031.07	$195.00	3.12
Closet Storage	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68
Closet Storage	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68
Closet Storage	2	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.07	305	0.0	$46.49	$87.91	$10.00	1.68
Parent Teacher Rm	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	691	0.0	$105.30	$585.00	$100.00	4.61
Main Office	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.41	1,870	0.0	$285.12	$1,147.50	$185.00	3.38
Office	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	997	0.0	$152.06	$738.00	$115.00	4.10
Princ Office	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	997	0.0	$152.06	$738.00	$115.00	4.10
Nurse	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	997	0.0	$152.06	$738.00	$115.00	4.10
Rm 120	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Rm 121	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61
Rm 122	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.45	1,450	0.0	$221.12	$1,228.50	$210.00	4.61
Corridor 7	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.08	374	0.0	$57.02	$375.50	$30.00	6.06
Rm 123	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 124	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Restroom	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Rm 125	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.17	553	0.0	$84.24	$468.00	$80.00	4.61
Girls Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Girls Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.01	52	0.0	$7.98	$35.90	$5.00	3.87
Mop Closet	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Corridor 8	14	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	14	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,820	0.67	3,073	0.0	$468.41	$1,531.87	$280.00	2.67
Corridor 8	2	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.04	685	0.0	$104.43	$215.11	$0.00	2.06
Storage Closet	2	Incandescent: INC-100W	Wall Switch	100	2,600	Relamp	No	2	LED Screw-In Lamps: LED-15W	Wall Switch	15	2,600	0.11	508	0.0	$77.49	$87.91	$10.00	1.01
Boys Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Boys Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.01	52	0.0	$7.98	$35.90	$5.00	3.87
Rm 126	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61
Rm 127	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61
Rm 128	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61
Rm 129	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.09	276	0.0	$42.12	$234.00	$40.00	4.61
Staff Restroom	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Rm 130	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.27	1,247	0.0	$190.08	$855.00	$135.00	3.79
Stairwell 3	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.13	592	0.0	$90.25	$351.00	$60.00	3.22
Corridor 13	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.44	1,995	0.0	$304.13	$1,336.00	$160.00	3.87
Corridor 13	1	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	343	0.0	$52.22	$107.56	$0.00	2.06
Rm 227	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.45	1,450	0.0	$221.12	$1,228.50	$210.00	4.61
Rm 228	27	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	27	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.58	1,865	0.0	$284.30	$1,579.50	$270.00	4.61
Rm 228	2	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.04	685	0.0	$104.43	$215.11	$0.00	2.06
Studio 229	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.02	99	0.0	$15.04	$58.50	$10.00	3.22
Studio 229	3	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	3	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.10	457	0.0	$69.74	$131.86	$15.00	1.68
Rm 201	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.45	1,450	0.0	$221.12	$1,228.50	$210.00	4.61

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Corridor 15	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.25	1,122	0.0	$171.07	$726.50	$90.00	3.72
Corridor 15	3	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	3	LED Exit Signs: 2 W Lamp	None	6	8,760	0.07	1,028	0.0	$156.65	$322.67	$0.00	2.06
Rm 202	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.49	2,244	0.0	$342.14	$1,323.00	$215.00	3.24
Offices	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.19	878	0.0	$133.83	$650.53	$115.00	4.00
Rm 203	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Girls Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Mop Closet	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Corridor 14	2	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.04	685	0.0	$104.43	$215.11	$0.00	2.06
Corridor 14	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.41	1,870	0.0	$285.12	$1,277.50	$150.00	3.95
Corridor 16	1	Exit Signs: Incandescent	None	40	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	343	0.0	$52.22	$107.56	$0.00	2.06
Corridor 16	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,820	0.27	1,247	0.0	$190.08	$985.00	$100.00	4.66
Rm 204	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.25	1,122	0.0	$171.07	$796.50	$125.00	3.93
Rm 207	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Boys Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Library (205)	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.60	2,743	0.0	$418.18	$1,827.00	$290.00	3.68
Library (205)	28	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,600	Relamp	Yes	28	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	1.35	6,145	0.0	$936.82	$3,203.73	$630.00	2.75
Rm 206	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Rm 206A	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Stairwell	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.09	395	0.0	$60.17	$234.00	$40.00	3.22
Rm 208A	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 208A	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 209	30	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.65	2,072	0.0	$315.89	$1,755.00	$300.00	4.61
Stairwell	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.13	592	0.0	$90.25	$351.00	$60.00	3.22
Rm 220	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Rm 221	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	26	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.56	1,796	0.0	$273.77	$1,521.00	$260.00	4.61

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 222	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.45	1,450	0.0	$221.12	$1,228.50	$210.00	4.61
Corridor 12	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.02	99	0.0	$15.04	$58.50	$10.00	3.22
Corridor 12	8	Linear Fluorescent - T8: 8' T8 (59W) - 2L	Wall Switch	110	2,600	Relamp	Yes	8	LED - Linear Tubes: (2) 8' Lamps	High/Low Control	72	1,820	0.31	1,426	0.0	$217.34	$1,080.00	$0.00	4.97
Rm 223	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.39	1,243	0.0	$189.53	$1,053.00	$180.00	4.61
Rm 223A	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Rm 223A	1	Incandescent: INC-60W	Wall Switch	60	2,600	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,600	0.03	152	0.0	$23.25	$43.95	$5.00	1.68
Rm 225	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.57	2,618	0.0	$399.17	$1,768.50	$280.00	3.73
Boys/Girls Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.04	197	0.0	$30.08	$117.00	$20.00	3.22
Boys/Girls Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,600	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.01	52	0.0	$7.98	$35.90	$5.00	3.87
Mop Closet	1	Incandescent: INC-75W	Wall Switch	75	2,600	Relamp	No	1	LED Screw-In Lamps: LED-11W	Wall Switch	11	2,600	0.04	191	0.0	$29.06	$43.95	$5.00	1.34
Storage	1	Incandescent: INC-75W	Wall Switch	75	2,600	Relamp	No	1	LED Screw-In Lamps: LED-11W	Wall Switch	11	2,600	0.04	191	0.0	$29.06	$43.95	$5.00	1.34
Rm 226	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.52	1,658	0.0	$252.71	$1,404.00	$240.00	4.61
Rm 227	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Rm 228	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Rm 229	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.66	2,992	0.0	$456.19	$1,944.00	$310.00	3.58
Faculty Lounge	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	499	0.0	$76.03	$504.00	$75.00	5.64
Bathroom	1	Incandescent: INC-75W	Wall Switch	75	2,600	Relamp	No	1	LED Screw-In Lamps: LED-11W	Wall Switch	11	2,600	0.04	191	0.0	$29.06	$43.95	$5.00	1.34
Parking Lot	2	Mercury Vapor: (1) 250W Lamp	Daylight Dimming	290	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	87	4,380	0.27	2,045	0.0	$311.76	$781.35	$200.00	1.86
Perimeter	10	Incandescent: INC-100W	Daylight Dimming	100	4,380	Relamp	No	10	LED Screw-In Lamps: LED-15W	Daylight Dimming	15	4,380	0.56	4,281	0.0	$652.71	$439.53	$50.00	0.60
Perimeter	1	Metal Halide: (1) 100W Lamp	Daylight Dimming	128	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	38	4,380	0.06	451	0.0	$68.80	$390.68	$100.00	4.22

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 21	Room 21	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.04	71	0.0	$10.77	$635.11	$0.00	58.97
24	24	2	Window AC	1.25		Yes	2	Window AC	1.25		12.00		No	0.17	303	0.0	$46.15	$2,721.90	$0.00	58.97
29 Bldg and Grounds	29 Bldg and Grounds	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	121	0.0	$18.46	$1,088.76	$0.00	58.97
29 Bldg and Grounds	29 Bldg and Grounds	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	121	0.0	$18.46	$1,088.76	$0.00	58.97
Asst. Principal Office	Asst. Principal Office	1	Window AC	1.50		Yes	1	Window AC	1.50		12.00		No	0.10	182	0.0	$27.69	$1,633.14	$0.00	58.97
Library	Library	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.08	151	0.0	$23.08	$1,360.95	$0.00	58.97
Main Office	Main Office	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.08	151	0.0	$23.08	$1,360.95	$0.00	58.97
Main Office	Main Office	1	Window AC	1.50		Yes	1	Window AC	1.50		12.00		No	0.10	182	0.0	$27.69	$1,633.14	$0.00	58.97
Nurse	Nurse	1	Window AC	0.42		Yes	1	Window AC	0.42		12.00		No	0.03	50	0.0	$7.69	$453.65	$0.00	58.97
Principal's Office	Principal's Office	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	101	0.0	$15.38	$907.30	$0.00	58.97
Print Shop	Print Shop	1	Window AC	1.50		Yes	1	Window AC	1.50		12.00		No	0.10	182	0.0	$27.69	$1,633.14	$0.00	58.97
Print Shop	Print Shop	1	Window AC	1.50		Yes	1	Window AC	1.50		12.00		No	0.10	182	0.0	$27.69	$1,633.14	$0.00	58.97

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Hillside	1	Forced Draft Steam Boiler	2,500.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Hillside	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hillside	2	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hillside	1	Ice Making Head (<450 lbs/day), Batch	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hillside	1	Insulated Food Holding Cabinet (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Hillside	1	Electric Combination Oven/Steam Cooker (<15 Pans)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Hillside	1	Electric Convection Oven (Full Size)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Hillside	4	Large Copier	515.0	
Hillside	1	Projector TV	120.0	
Hillside	7	Video Projector	200.0	
Hillside	1	Washer	900.0	
Hillside	1	Dryer	1,600.0	
Hillside	4	Small Refrigerator	27.6	
Hillside	1	Large Refrigerator	600.0	
Hillside	2	3D Printer	515.0	
Hillside	4	Microwave	1,000.0	
Hillside	1	Printer	20.0	
Hillside	1	Medium Refrigerator	50.0	

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hillside	1	Glass Fronted Refrigerated	Yes	0.00	1,209	0.0	$184.29	$230.00	$0.00	1.25

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Montclair Valley Road Campus (4 Buildings)

Primary Property Type: K-12 School
Gross Floor Area (ft²): 172,102
Built: 1879

For Year Ending: April 30, 2016
Date Generated: June 20, 2018

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Montclair Valley Road Campus (4 Buildings) 22 Valley Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 6364554

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
47.1 kBtu/ft²

Source EUI
76 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	5,917,390 (73%)
Electric - Grid (kBtu)	2,187,666 (27%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	60.1
National Median Source EUI (kBtu/ft²)	97
% Diff from National Median Source EUI	-22%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	557

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Montclair Community Pre-K

22 Valley Road

Montclair, New Jersey 07042

Montclair Board of Education

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Montclair Community Pre-K.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey educational facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

Montclair Community Pre-K is a 28,511 square foot facility constructed in 1900. The building is a three-story educational facility including but not limited to classrooms, offices, hallways and restrooms.

Lighting at the facility consists mainly of 32-Watt T8 linear fluorescent fixtures with 32-Watt T8 U-bend fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several 60-Watt incandescent lamps. Exterior lighting is provided by a combination of 70-Watt and 100-Watt metal halide fixtures and 150-Watt high pressure sodium fixtures. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation is provided by a combination of package units and window AC units. Heating is provided by the Central Heating Plant.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated five measures and recommended four measures which together represent an opportunity for Montclair Community Pre-K to reduce annual energy costs by roughly $7,443 and annual greenhouse gas emissions by 49,167 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 5.4 years. TRC has defined high priority measures as the evaluated measures that have a simple payback less than the typical equipment life of the proposed equipment. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Montclair Community Pre-K's annual energy use by 12%.

Figure 1 – Previous 12 Month Utility Costs

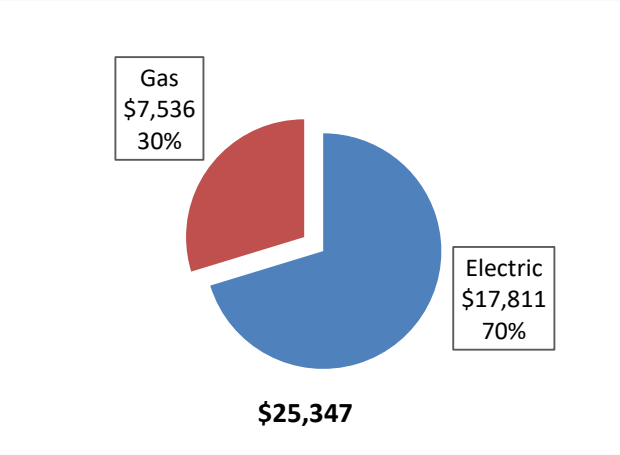
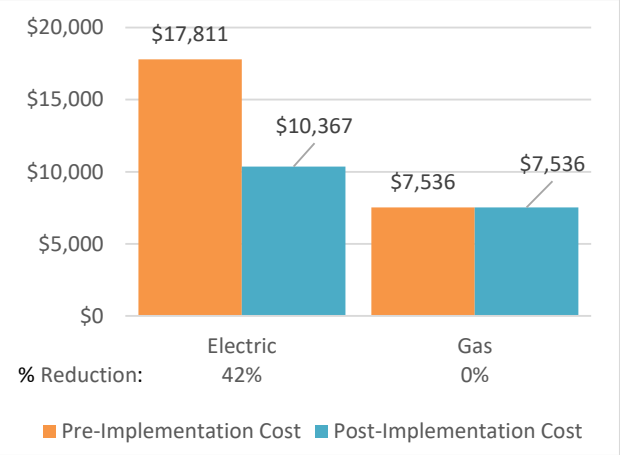


Figure 2 – Potential Post-Implementation Costs



A detailed description of Montclair Community Pre-K's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the evaluated energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		High Priority?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**41,993**	**11.1**	**0.0**	**$6,401.83**	**$33,919.29**	**$6,125.00**	**$27,794.29**	**4.3**	**42,286**
ECM 1	Install LED Fixtures	Yes	3,857	0.5	0.0	$588.01	$3,125.42	$800.00	$2,325.42	4.0	3,884
ECM 2	Retrofit Fixtures with LED Lamps	Yes	38,136	10.6	0.0	$5,813.83	$30,793.88	$5,325.00	$25,468.88	4.4	38,402
Lighting Control Measures			**6,833**	**1.9**	**0.0**	**$1,041.64**	**$13,830.00**	**$1,715.00**	**$12,115.00**	**11.6**	**6,880**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	6,525	1.8	0.0	$994.77	$13,230.00	$1,715.00	$11,515.00	11.6	6,571
ECM 4	Install High/Low Lighitng Controls	Yes	307	0.1	0.0	$46.87	$600.00	$0.00	$600.00	12.8	310
Electric Unitary HVAC Measures			**4,208**	**3.1**	**0.0**	**$641.58**	**$46,537.06**	**$996.67**	**$45,540.39**	**71.0**	**4,238**
	Install High Efficiency Electric AC	No	4,208	3.1	0.0	$641.58	$46,537.06	$996.67	$45,540.39	71.0	4,238
TOTALS FOR HIGH PRIORITY MEASURES			**48,825**	**12.9**	**0.0**	**$7,443.48**	**$47,749.29**	**$7,840.00**	**$39,909.29**	**5.4**	**49,167**
TOTALS FOR ALL EVALUATED MEASURES			**53,034**	**16.1**	**0.0**	**$8,085.06**	**$94,286.35**	**$8,836.67**	**$85,449.69**	**10.6**	**53,405**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Electric Unitary HVAC measures generally involve replacing older inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide equivalent cooling to older air condition systems at a reduced energy cost. These measures save energy by reducing the power used by the air conditioning systems, due to improved electrical efficiency.

Energy Efficient Practices

TRC also identified seven low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Montclair Community Pre-K include:

- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Montclair Community Pre-K. Based on the configuration of the site and its loads there is a moderate potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	Medium	
System Potential	50	kW DC STC
Electric Generation	59,569	kWh/yr
Displaced Cost	$5,180	/yr
Installed Cost	$130,000	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Thomas Page	Auditor	MTraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 09, 2016, TRC performed an energy audit at Montclair Community Pre-K located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Montclair Community Pre-K is a 28,511 square foot facility constructed in 1900. The building is a three-story educational facility including but not limited to classrooms, offices, hallways and restrooms.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Montclair Community Pre-K	Weekday	8:00 AM - 6:00 PM
Montclair Community Pre-K	Weekend	unoccupied

2.4 Building Envelope

The Pre-K facility is a three-story building. The construction is of concrete masonry block with painted exterior and double pane clear windows with operable frames. The slanted roof in the main building is constructed of tile roofing material.

Figure 7 – Building Façade



2.5 On-Site Generation

Montclair Community Pre-K does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at Montclair Community Pre-K consists mainly of 32-Watt T8 linear fluorescent fixtures with a few 32-Watt T8 U-bend fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. The linear fluorescent fixtures are 4-foot long or U-bend, mainly troffers with diffusers having 2, 3, or 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 60-Watt incandescent lamps. All the exit signs are LED fixtures.

Interior lighting control in the building is provided by a combination of manual switches and occupancy sensors.

Figure 8 - Building Lighting Systems

Linear Fluorescent Fixture	*Exterior Fixture*
	

Exterior lighting is provided by a combination of 70-Watt and 100-Watt metal halide fixtures and 150-Watt high pressure sodium fixtures.

Heating System

The Central Heating Plant has two natural gas fired Weil McLain steam boilers with an input rating of 7,938 MBh each and a nominal efficiency of 80%. These boilers provide space heating for Hillside School, the Montclair Community Pre-K, and the district Administration Building.

Figure 9 – Heating System



Direct Expansion Air Conditioning System (DX)

Air conditioning (AC) at the facility is primarily provided by a combination of package units and window AC units. Package/portable units have capacities between 1 ton and 2.67 tons and window AC units have capacities between 0.58 ton and 1.25 tons with efficiency ratings of around 10.9 EER.

Figure 10 – DX Air Conditioning System

Window AC



Portable Units



Domestic Hot Water Heating System

The domestic hot water heating system for the facility consists of one A.O. Smith gas fired hot water heater with an input rating of 199 kBtu/hr and a nominal efficiency of 80%. The water heater has a 100 gallon storage tank.

Figure 11 – Domestic Water Heater



Building Plug Load

The facility contains several plug-load systems which contribute to plug load electric use including but not limited to copier, printers, microwaves, and refrigerators.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

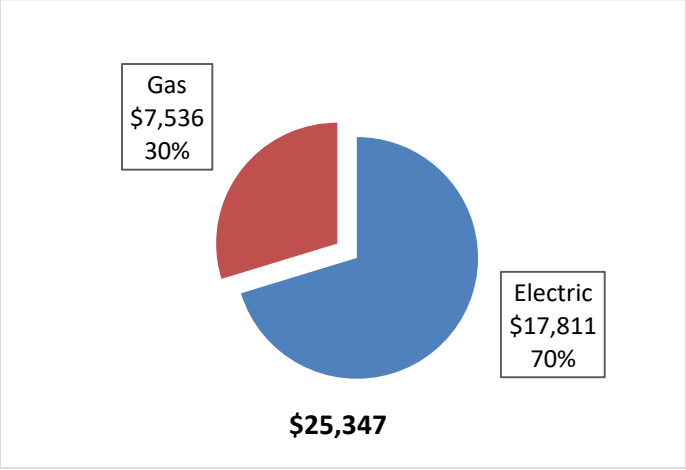
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 12 - Utility Summary

Utility Summary for Montclair Community Pre-K		
Fuel	**Usage**	**Cost**
Electricity	116,830 kWh	$17,811
Natural Gas	9,397 Therms	$7,536
Total		**$25,347**

The current annual energy cost for this facility is $25,347 as shown in the chart below.

Figure 13 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.152/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Electric usage estimation and calibration methodology:

1. The Montclair BOE buildings Hillside School, Administration, Montclair Community Pre-K, and Central Heating Plant are served by three electric meters 65 795 083 02, 67 125 896 06, and 42 007 763 08. There is not a clear delineation of loads served by the meters. Based on this, demand (kW) data was not prorated.
2. Total energy use from all the meters combined is around 638,475 kWh for a 12-month period.
3. Monthly "calculated" energy use from the LGEA analysis tools were used to calculate the percentage contribution of each building. The percentages are:
    a. Hillside School – 70%
    b. Administration Building – 11%
    c. Montclair Community Pre-K – 18%
    d. Central Heating Plant – 1%
4. The above percentages were applied to the "actual" total monthly energy use from bills to estimate monthly utility energy use to which all the tools were then calibrated.

Figure 14 - Electric Usage & Demand

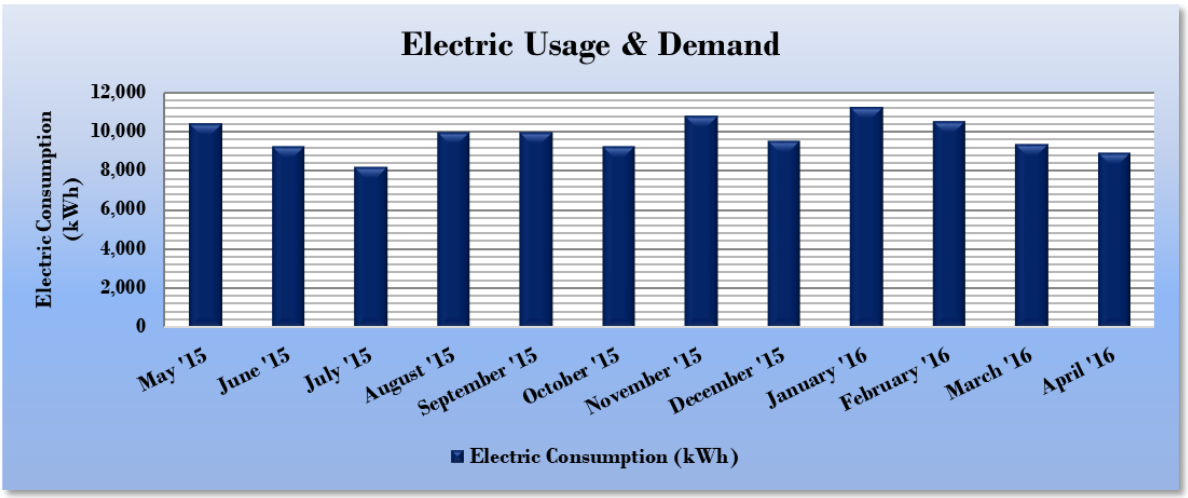


Figure 15 - Electric Usage & Demand

Electric Billing Data for Montclair Community Pre-K				
Period Ending	Days in Period	Electric Usage (kWh)	Total Electric Cost	TRC Estimated Usage?
6/15/15	33	10,375	$2,017	Yes
7/14/15	29	9,253	$1,779	Yes
8/12/15	29	8,183	$1,563	Yes
9/14/15	33	9,947	$1,826	Yes
10/13/15	29	9,930	$1,466	Yes
11/10/15	28	9,217	$1,296	Yes
12/11/15	31	10,753	$1,474	Yes
1/13/16	33	9,531	$1,245	Yes
2/11/16	29	11,228	$1,442	Yes
3/14/16	32	10,498	$1,348	Yes
4/13/16	30	9,349	$1,257	Yes
5/13/16	30	8,885	$1,148	Yes
Totals	**366**	**117,150**	**$17,860**	12
Annual	**365**	**116,830**	**$17,811**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.802/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Natural gas use was allocated to the sites served by the Central Heating Plant using the following method:

1. The Administration Building, Hillside School, Montclair Community Pre-K, and Central Heating Plant are served by two gas meters: 65 795 083 02 and 67 125 896 06. There is not a clear delineation of which buildings and equipment are served by each meter.
2. Total annual gas use for both of the meters combined is 59,235 therms.
3. The calculated gas use from the LGEA analysis for each building was used to determine the percentage of the total historical gas use to be assigned to each building. Total gas use was allocated to the three buildings served by the Central Heating Plant as follows:
    a. Hillside School - 75%
    b. Administration Building - 9%
    c. Montclair Community Pre-K - 16%
4. The above percentages were applied to the total monthly gas use from the utility bills to estimate the monthly gas use for the individual buildings. This estimated monthly gas use is what is provided in each of the reports.

Figure 16 - Natural Gas Usage

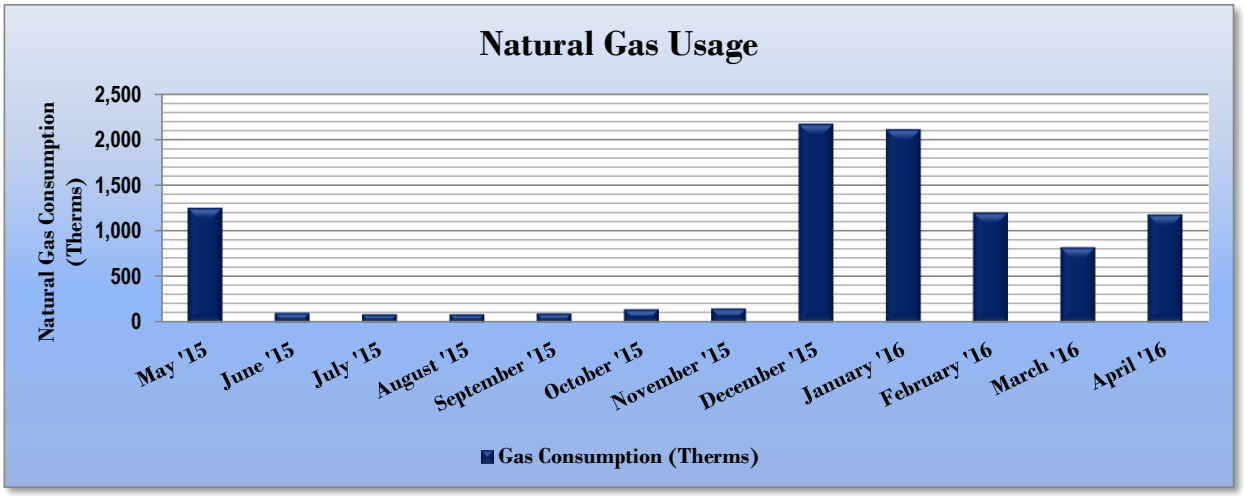


Figure 17 - Natural Gas Usage

Gas Billing Data for Montclair Community Pre-K				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/15/15	33	1,253	$676	Yes
7/14/15	29	106	$212	Yes
8/12/15	29	89	$88	Yes
9/14/15	33	89	$220	Yes
10/13/15	29	97	$136	Yes
11/10/15	28	143	$152	Yes
12/11/15	31	153	$198	Yes
1/13/16	33	2,174	$2,036	Yes
2/11/16	29	2,113	$1,938	Yes
3/14/16	32	1,202	$819	Yes
4/13/16	30	823	$447	Yes
5/13/16	30	1,181	$634	Yes
Totals	**366**	**9,423**	**$7,556**	12
Annual	**365**	**9,397**	**$7,536**	

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 18 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Montclair Community Pre-K	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	78.5	141.4
Site Energy Use Intensity (kBtu/ft^2)	46.9	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 19 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Montclair Community Pre-K	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	60.2	141.4
Site Energy Use Intensity (kBtu/ft^2)	41.1	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. The Central Heating Plant and the three buildings served by it have a combined score of 74.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

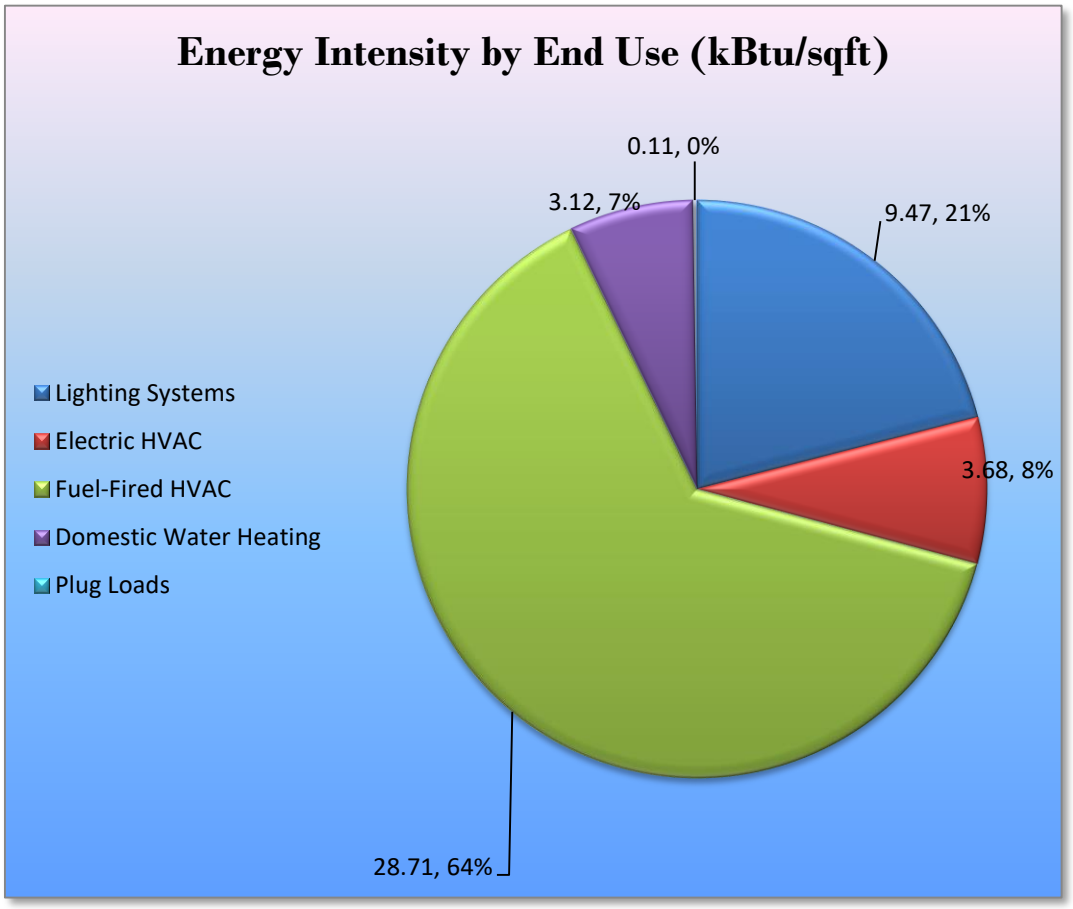
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 20 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Montclair Community Pre-K regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 High Priority ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 21 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**41,993**	**11.1**	**0.0**	**$6,401.83**	**$33,919.29**	**$6,125.00**	**$27,794.29**	**4.3**	**42,286**
ECM 1	Install LED Fixtures	3,857	0.5	0.0	$588.01	$3,125.42	$800.00	$2,325.42	4.0	3,884
ECM 2	Retrofit Fixtures with LED Lamps	38,136	10.6	0.0	$5,813.83	$30,793.88	$5,325.00	$25,468.88	4.4	38,402
Lighting Control Measures		**6,833**	**1.9**	**0.0**	**$1,041.64**	**$13,830.00**	**$1,715.00**	**$12,115.00**	**11.6**	**6,880**
ECM 3	Install Occupancy Sensor Lighting Controls	6,525	1.8	0.0	$994.77	$13,230.00	$1,715.00	$11,515.00	11.6	6,571
ECM 4	Install High/Low Lighitng Controls	307	0.1	0.0	$46.87	$600.00	$0.00	$600.00	12.8	310
TOTALS		**48,825**	**12.9**	**0.0**	**$7,443.48**	**$47,749.29**	**$7,840.00**	**$39,909.29**	**5.4**	**49,167**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 22 below.

Figure 22 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**41,993**	**11.1**	**0.0**	**$6,401.83**	**$33,919.29**	**$6,125.00**	**$27,794.29**	**4.3**	**42,286**
ECM 1	Install LED Fixtures	3,857	0.5	0.0	$588.01	$3,125.42	$800.00	$2,325.42	4.0	3,884
ECM 2	Retrofit Fixtures with LED Lamps	38,136	10.6	0.0	$5,813.83	$30,793.88	$5,325.00	$25,468.88	4.4	38,402

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Exterior	3,857	3,857	0	0.5	0.0	$588.01	$3,125.42	$800.00	$2,325.42	4.0	3,884

Measure Description

We recommend replacing exterior fixtures containing metal halide and high-pressure sodium lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a metal halide or high-pressure sodium lamp.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Annual Electric Savings (kWh)	Chilled Water Savings (Ton-Hr)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	38,136	38,136	0	10.6	0.0	$5,813.83	$30,793.88	$5,325.00	$25,468.88	4.4	38,402

Measure Description

We recommend retrofitting existing T8 linear fluorescent, T8 U-bend fluorescent, and incandescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 23 below.

Figure 23 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**6,833**	**1.9**	**0.0**	**$1,041.64**	**$13,830.00**	**$1,715.00**	**$12,115.00**	**11.6**	**6,880**
ECM 3	Install Occupancy Sensor Lighting Controls	6,525	1.8	0.0	$994.77	$13,230.00	$1,715.00	$11,515.00	11.6	6,571
ECM 4	Install High/Low Lighitng Controls	307	0.1	0.0	$46.87	$600.00	$0.00	$600.00	12.8	310

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 3: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
6,525	1.8	0.0	$994.77	$13,230.00	$1,715.00	$11,515.00	11.6	6,571

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in classrooms, restrooms, offices areas, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

ECM 4: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
307	0.1	0.0	$46.87	$600.00	$0.00	$600.00	12.8	310

Measure Description

We recommend installing occupancy sensors to provide dual level lighting control for lighting fixtures in spaces that are infrequently occupied but may require some level of continuous lighting for safety or security reasons. Typical areas for such lighting control are stairwells, interior corridors, parking lots, and parking garages.

Lighting fixtures with these controls operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared sensors. The lighting systems are switched to full lighting levels whenever an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period of time. Energy savings results from only providing full lighting levels when it is required.

For this type of measure the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage needs to be provided to ensure that lights turn on in each area as an occupant approaches.

Additional savings from reduced lighting maintenance may also result from this measure, due to reduced lamp operation.

4.2 Other Evaluated ECM

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 24 – Summary of Other Evaluated ECM

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures	**4,208**	**3.1**	**0.0**	**$641.58**	**$46,537.06**	**$996.67**	**$45,540.39**	**71.0**	**4,238**
Install High Efficiency Electric AC	4,208	3.1	0.0	$641.58	$46,537.06	$996.67	$45,540.39	71.0	4,238
TOTALS	**4,208**	**3.1**	**0.0**	**$641.58**	**$46,537.06**	**$996.67**	**$45,540.39**	**71.0**	**4,238**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Air Conditioning Units

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
4,208	3.1	0.0	$641.58	$46,537.06	$996.67	$45,540.39	71.0	4,238

Measure Description

We recommend replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units when cost effective. There have been significant improvements in both compressor and fan motor efficiencies over the past several years. Therefore, electricity savings can be achieved by replacing older units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling load, and the estimated annual operating hours.

Reasons for not Recommending

This measure has a long payback, more than the rated useful life of the replacement equipment. The measure is not recommended for implementation on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

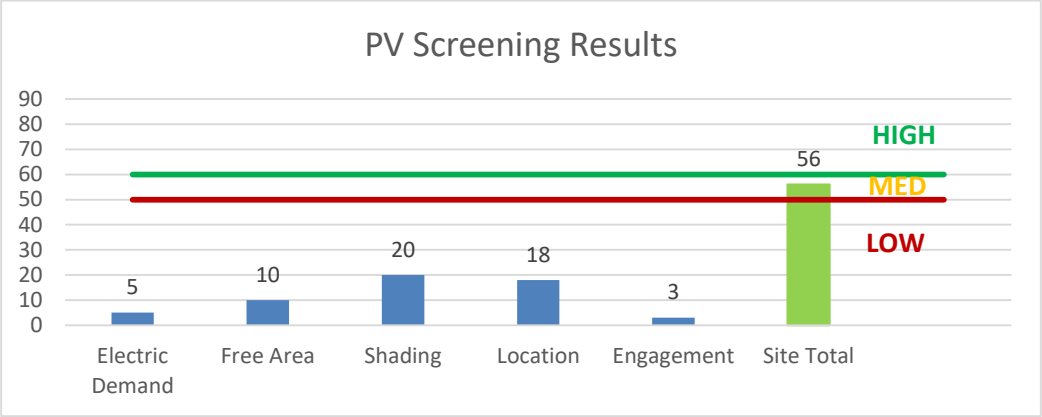
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **Medium** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the potential for PV at the site. A PV array located on the roof of the building may be feasible. If Montclair Community Pre-K is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 25 - Photovoltaic Screening



Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.2 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility does not have the potential for installing a cost-effective CHP system.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion this building is not is a good candidate for DR.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 26 for a list of the eligible programs identified for each recommended ECM.

Figure 26 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x					
ECM 2	Retrofit Fixtures with LED Lamps	x					
ECM 3	Install Occupancy Sensor Lighting Controls	x					
ECM 4	Install High/Low Lighitng Controls						

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Class 18	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.50	1,839	0.0	$280.35	$1,862.80	$315.00	5.52
Restroom 1	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Restroom 2	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Exec Dir Office	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.17	553	0.0	$84.24	$468.00	$80.00	4.61
Class 7	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.66	2,417	0.0	$368.46	$2,013.20	$345.00	4.53
Class 7	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Restroom 1	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.04	140	0.0	$21.35	$126.40	$0.00	5.92
Restroom 2	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.04	140	0.0	$21.35	$126.40	$0.00	5.92
Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Stairwell 1	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.09	319	0.0	$48.60	$234.00	$40.00	3.99
Stairwell 2	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.09	319	0.0	$48.60	$234.00	$40.00	3.99
DLC Office	24	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	24	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.98	3,625	0.0	$552.69	$2,884.80	$500.00	4.31
DLC Office	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
DLC	21	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	21	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.86	3,172	0.0	$483.61	$2,659.20	$455.00	4.56
DLC	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Restroom 1	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Restroom 2	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Stairwell 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.06	239	0.0	$36.45	$175.50	$30.00	3.99
Stairwell 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.06	239	0.0	$36.45	$175.50	$30.00	3.99
LV1 1S Stairwell	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.06	239	0.0	$36.45	$175.50	$30.00	3.99
LV1 1S Stairwell	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.06	239	0.0	$36.45	$175.50	$30.00	3.99
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,820	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.06	207	0.0	$31.59	$150.40	$30.00	3.81
Hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,470	0.16	604	0.0	$92.12	$551.00	$60.00	5.33
Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Class 6	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,820	Relamp	No	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.49	1,554	0.0	$236.92	$1,128.00	$225.00	3.81

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Class 5	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,820	Relamp	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.39	1,243	0.0	$189.53	$902.40	$180.00	3.81
Restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 4	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,820	Relamp	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.39	1,243	0.0	$189.53	$902.40	$180.00	3.81
Stairwell 25	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Stairwell 25	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Front Desk Area	12	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	12	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,470	0.31	1,127	0.0	$171.86	$1,298.40	$70.00	7.15
Front Desk Area	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Front Desk Area	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.13	414	0.0	$63.18	$351.00	$60.00	4.61
Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Class 8	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.45	1,662	0.0	$253.32	$1,367.20	$235.00	4.47
Stairwell 3 Floor	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.13	478	0.0	$72.90	$351.00	$60.00	3.99
3rd Floor Hall	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,470	0.11	403	0.0	$61.41	$434.00	$40.00	6.42
3rd Floor Hall	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Class 16	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.19	705	0.0	$107.47	$679.50	$105.00	5.35
Class 16	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 16	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,100	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,470	0.14	532	0.0	$81.07	$555.40	$95.00	5.68
Office 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,820	Relamp	No	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.11	352	0.0	$53.61	$285.40	$60.00	4.20
Office 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,820	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.07	234	0.0	$35.74	$190.27	$40.00	4.20
3rd Flr Stairwell Back	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.17	638	0.0	$97.20	$468.00	$80.00	3.99
Class 15	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 15	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,100	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,470	0.58	2,127	0.0	$324.28	$1,681.60	$310.00	4.23
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 14	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 14	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,100	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,470	0.58	2,127	0.0	$324.28	$1,681.60	$310.00	4.23

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Restroom 1	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Restroom 2	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Janitor Closet	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
2nd Flr Class 25	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.49	1,813	0.0	$276.35	$1,442.40	$250.00	4.31
Stairwell 2nd Flr	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Hall 2nd Flr	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Speech Therapy	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.04	138	0.0	$21.06	$117.00	$20.00	4.61
Speech Therapy	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,820	Relamp	No	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.10	311	0.0	$47.38	$225.60	$45.00	3.81
Class 12/6	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.11	403	0.0	$61.41	$504.00	$75.00	6.99
Class 12/6	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Class 12	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.11	403	0.0	$61.41	$504.00	$75.00	6.99
Class 12	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Restroom 1	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.33	1,208	0.0	$184.23	$1,242.00	$190.00	5.71
Restroom 1	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Class 13	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.45	1,662	0.0	$253.32	$1,367.20	$235.00	4.47
Restroom 2	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
2nd Flr Stairwell	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.06	239	0.0	$36.45	$175.50	$30.00	3.99
1st Flr Stairwell	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.09	319	0.0	$48.60	$234.00	$40.00	3.99
2nd Flr N Hallway	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.35	1,275	0.0	$194.39	$936.00	$160.00	3.99
2nd Flr N Hallway	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Mop Closet	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Stairwell/Back Door	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Stairwell/Back Door	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,100	0.06	239	0.0	$36.45	$150.40	$30.00	3.30
Hallway (1st Flr)	6	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	6	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	1,470	0.15	564	0.0	$85.93	$579.20	$0.00	6.74

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hallway (1st Flr)	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Janitor Closet	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Break Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.09	276	0.0	$42.12	$234.00	$40.00	4.61
Break Rm	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Occupancy Sensor	62	1,820	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,820	0.02	61	0.0	$9.25	$63.20	$0.00	6.83
Restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Outer Class 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.08	302	0.0	$46.06	$715.50	$100.00	13.36
Class 2	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.66	2,417	0.0	$368.46	$2,013.20	$345.00	4.53
Class 1	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,100	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,470	0.66	2,417	0.0	$368.46	$2,013.20	$345.00	4.53
Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Restroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,100	0.02	70	0.0	$10.68	$63.20	$0.00	5.92
Pre-K Annex Rm 9	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.22	806	0.0	$122.82	$1,008.00	$150.00	6.99
Pre-K Annex Rm 9	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Restroom 1	1	Incandescent: INC-60W	Wall Switch	60	2,100	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,100	0.03	123	0.0	$18.78	$53.75	$5.00	2.60
Restroom 2	1	Incandescent: INC-60W	Wall Switch	60	2,100	Relamp	No	1	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,100	0.03	123	0.0	$18.78	$53.75	$5.00	2.60
Annex Rm 8	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.41	1,511	0.0	$230.29	$1,687.50	$255.00	6.22
Annex Rm 8	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Annex Rm 8	2	Incandescent: INC-60W	Wall Switch	60	2,100	Relamp	No	2	LED Screw-In Lamps: LED-9W	Wall Switch	9	2,100	0.07	246	0.0	$37.55	$107.51	$10.00	2.60
Exterior Annex	2	Metal Halide: (1) 70W Lamp	Daylight Dimming	95	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	29	4,380	0.09	670	0.0	$102.13	$781.35	$200.00	5.69
Ext. Back of Pre-K Bldg	1	Metal Halide: (1) 100W Lamp	Daylight Dimming	128	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	38	4,380	0.06	451	0.0	$68.80	$390.68	$100.00	4.22
Elevator	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.02	80	0.0	$12.15	$58.50	$10.00	3.99
Basement	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,470	0.68	2,518	0.0	$383.82	$2,542.50	$390.00	5.61
Back stair	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,100	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,100	0.04	159	0.0	$24.30	$117.00	$20.00	3.99
Ext Side Bldg	4	High-Pressure Sodium: (1) 150W Lamp	Daylight Dimming	188	4,380	Fixture Replacement	No	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	56	4,380	0.35	2,651	0.0	$404.22	$1,562.71	$400.00	2.88
Ext Front Entrance	1	High-Pressure Sodium: (1) 150W Lamp	Daylight Dimming	188	4,380	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	56	4,380	0.09	663	0.0	$101.05	$390.68	$100.00	2.88

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 1	Room 1	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.08	114	0.0	$17.31	$1,360.95	$0.00	78.63
2	2	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.08	114	0.0	$17.31	$1,360.95	$0.00	78.63
2 Office	2 Office	1	Window AC	0.67		Yes	1	Window AC	0.67		12.00		No	0.05	61	0.0	$9.23	$725.84	$0.00	78.63
3	3	1	Packaged AC	1.00		Yes	1	Packaged AC	1.00		14.00		No	0.16	219	0.0	$33.45	$2,268.96	$92.00	65.09
4	4	1	Window AC	0.58		Yes	1	Window AC	0.58		12.00		No	0.04	53	0.0	$8.08	$635.11	$0.00	78.63
4	4	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	76	0.0	$11.54	$907.30	$0.00	78.63
5	5	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
5	5	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
6	6	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.08	114	0.0	$17.31	$1,360.95	$0.00	78.63
6	6	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
7	7	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	76	0.0	$11.54	$907.30	$0.00	78.63
8 A-B	8 A-B	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
8 A-B	8 A-B	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
10	10	1	Packaged AC	1.00		Yes	1	Packaged AC	1.00		14.00		No	0.16	219	0.0	$33.45	$2,268.96	$92.00	65.09
11	11	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	76	0.0	$11.54	$907.30	$0.00	78.63
12	12	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	76	0.0	$11.54	$907.30	$0.00	78.63
14	14	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
15	15	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
Child Study	Child Study	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
DLC Office	DLC Office	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
DLC Office	DLC Office	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63
DLC Office	DLC Office	1	Window AC	0.83		Yes	1	Window AC	0.83		12.00		No	0.06	76	0.0	$11.54	$907.30	$0.00	78.63
Rooftop Unit	Rooftop Unit	1	Packaged AC	1.00		Yes	1	Packaged AC	1.00		14.00		No	0.16	219	0.0	$33.45	$2,268.96	$92.00	65.09
Rooftop Unit	Rooftop Unit	1	Packaged AC	2.50		Yes	1	Packaged AC	2.50		14.00		No	0.41	548	0.0	$83.62	$5,672.40	$230.00	65.09
Rooftop Unit #1 A/C	Rooftop Unit #1 A/C	1	Packaged AC	2.67		Yes	1	Packaged AC	2.67		14.00		No	0.44	585	0.0	$89.19	$6,050.56	$245.33	65.09
Rooftop Unit #2 A/C	Rooftop Unit #2 A/C	1	Packaged AC	2.67		Yes	1	Packaged AC	2.67		14.00		No	0.44	585	0.0	$89.19	$6,050.56	$245.33	65.09
Speech Rm	Speech Rm	1	Window AC	1.00		Yes	1	Window AC	1.00		12.00		No	0.07	91	0.0	$13.85	$1,088.76	$0.00	78.63

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Central Plant	Central Plant	1	Forced Draft Steam Boiler	500.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Comm. Pre-K	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Pre-K	2	Small Printer	20.0	No
Pre-K	1	Small Copier	20.0	No
Pre-K	3	Microwave	1,000.0	No
Pre-K	2	Large Copier	515.0	No
Pre-K	3	Refrigerator	50.0	No

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Montclair Valley Road Campus (4 Buildings)

Primary Property Type: K-12 School
Gross Floor Area (ft²): 172,102
Built: 1879

For Year Ending: April 30, 2016
Date Generated: June 20, 2018

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Montclair Valley Road Campus (4 Buildings) 22 Valley Road Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 6364554

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
47.1 kBtu/ft²

Source EUI
76 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	5,917,390 (73%)
Electric - Grid (kBtu)	2,187,666 (27%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	60.1
National Median Source EUI (kBtu/ft²)	97
% Diff from National Median Source EUI	-22%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	557

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report







Montclair High School

Montclair Board of Education

100 Chestnut Street
Montclair, New Jersey 07402

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Montclair High School.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local governments in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

Montclair High School is a 262,855 square foot facility constructed in 1914. The building is a four-story educational facility including but not limited to classrooms, library areas, offices, hallways and auditorium.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 40-Watt T12 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several circular T9 fluorescent, incandescent, as well as LED lamps. Exterior lighting is provided by a combination of 175-Watt and 400-Watt metal halide fixtures, 400-Watt high pressure sodium, incandescent, and linear fluorescent fixtures. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation is provided by rooftop packaged air conditioning (AC), window AC, and split system AC systems. Heating hot water is provided by three non-condensing hot water boilers.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated nine measures and recommended eight measures which together represent an opportunity for Montclair High School to reduce annual energy costs by roughly $53,673 and annual greenhouse gas emissions by 383,419 lbs CO_2e. We estimate that if all measures were implemented as recommended, the project would pay for itself in roughly 4.5 years. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Montclair High School's annual energy use by 12%.

Figure 1 – Previous 12 Month Utility Costs

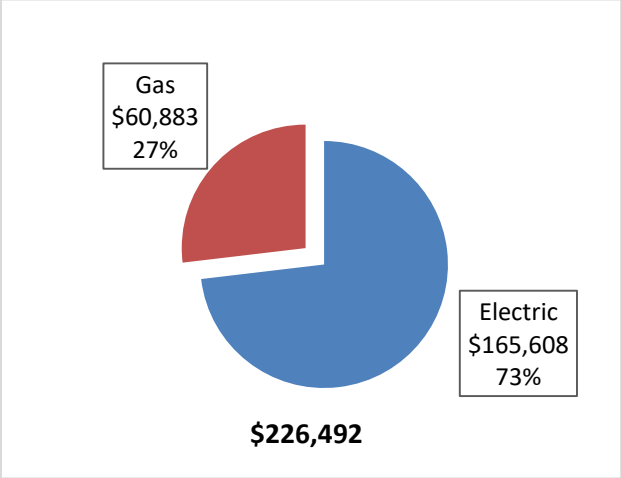
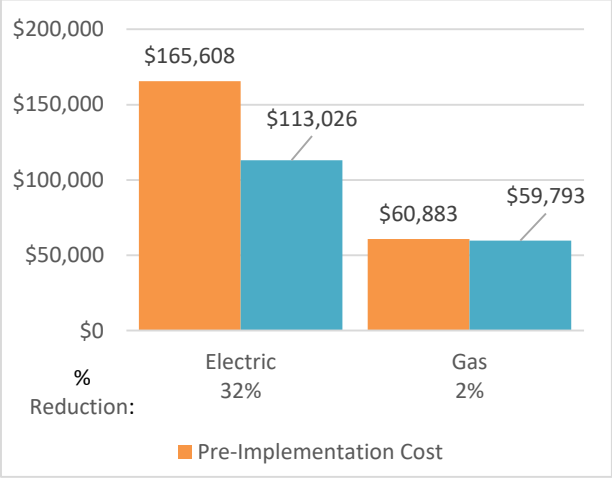


Figure 2 – Potential Post-Implementation Costs



A detailed description of Montclair High School's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

	Energy Conservation Measure	Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**297,995**	**62.4**	**0.0**	**$42,891.77**	**$206,332.89**	**$33,190.00**	**$173,142.89**	**4.0**	**300,078**
ECM 1	Install LED Fixtures	Yes	67,721	10.7	0.0	$9,747.39	$60,143.64	$8,360.00	$51,783.64	5.3	68,194
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,168	0.3	0.0	$168.04	$989.00	$50.00	$939.00	5.6	1,176
ECM 3	Retrofit Fixtures with LED Lamps	Yes	222,256	51.0	0.0	$31,990.33	$141,543.38	$24,780.00	$116,763.38	3.6	223,810
ECM 4	Install LED Exit Signs	Yes	6,850	0.4	0.0	$986.00	$3,656.87	$0.00	$3,656.87	3.7	6,898
Lighting Control Measures			**45,728**	**10.4**	**0.0**	**$6,581.77**	**$59,796.00**	**$7,470.00**	**$52,326.00**	**8.0**	**46,047**
ECM 5	Install Occupancy Sensor Lighting Controls	Yes	45,728	10.4	0.0	$6,581.77	$59,796.00	$7,470.00	$52,326.00	8.0	46,047
Variable Frequency Drive (VFD) Measures			**14,929**	**1.9**	**0.0**	**$2,148.84**	**$9,827.55**	**$0.00**	**$9,827.55**	**4.6**	**15,034**
ECM 6	Install VFDs on Hot Water Pumps	Yes	14,929	1.9	0.0	$2,148.84	$9,827.55	$0.00	$9,827.55	4.6	15,034
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**812.9**	**$6,677.78**	**$186,907.92**	**$20,088.00**	**$166,819.92**	**25.0**	**95,184**
	Install High Efficiency Hot Water Boilers	No	0	0.0	812.9	$6,677.78	$186,907.92	$20,088.00	$166,819.92	25.0	95,184
Domestic Water Heating Upgrade			**0**	**0.0**	**132.8**	**$1,090.55**	**$6,072.40**	**$0.00**	**$6,072.40**	**5.6**	**15,544**
ECM 7	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	132.8	$1,090.55	$6,072.40	$0.00	$6,072.40	5.6	15,544
Plug Load Equipment Control - Vending Machine			**6,669**	**0.0**	**0.0**	**$959.90**	**$1,610.00**	**$0.00**	**$1,610.00**	**1.7**	**6,716**
ECM 8	Vending Machine Control	Yes	6,669	0.0	0.0	$959.90	$1,610.00	$0.00	$1,610.00	1.7	6,716
TOTALS FOR ALL RECOMMENDED MEASURES			**365,320**	**74.8**	**132.8**	**$53,672.83**	**$283,638.84**	**$40,660.00**	**$242,978.84**	**4.5**	**383,419**
TOTALS FOR ALL MEASURES			**365,320**	**74.8**	**945.7**	**$60,350.60**	**$470,546.76**	**$60,748.00**	**$409,798.76**	**6.8**	**478,603**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Variable Frequency Drives (VFDs) are motor control devices. These measures control the speed of a motor so that the motor spins at peak efficiency during partial load conditions. Sensors adapt the speed to flow, temperature, or pressure settings which is much more efficient that usage a valve or damper to control flow rates, or running the motor at full speed when only partial power is needed. These measures save energy by controlling motor usage more efficiently.

Gas Heating (HVAC/Process) measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

Domestic Hot Water upgrade measures generally involve replacing older inefficient domestic water heating systems with modern energy efficient systems. New domestic hot water heating systems can provide equivalent, or greater, water heating capacity compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel used for domestic hot water heating due to improved heating efficiency or reducing standby losses.

Plug Load Equipment control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.

Energy Efficient Practices

TRC also identified seven low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Montclair High School include:

- Close Doors and Windows
- Perform Proper Lighting Maintenance
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Montclair High School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	342	kW DC STC
Electric Generation	407,448	kWh/yr
Displaced Cost	$58,650	/yr
Installed Cost	$889,200	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Pay for Performance - Existing Building (P4P EB)
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

Larger facilities with an interest in a more comprehensive whole building approach to energy conservation should consider participating in the Pay for Performance (P4P) program. Projects eligible for this project program must meet minimum savings requirements. Final incentives are calculated based on actual measured performance achieved at the end of the project. The application process is more involved, and it requires working with a qualified P4P contractor, but the process may result in greater energy savings overall and more lucrative incentives, up to 50% of project's total cost.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Tom Page	Auditor	tpag@TRCsolutions.com	(732) 855-0033

2.2 General Site Information

On November 08, 2016, TRC performed an energy audit at Montclair High School located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Montclair High School is a 262,855 square foot facility constructed in 1914. The building is a four-story educational facility including but not limited to classrooms, library areas, offices, hallways and auditorium.

Lighting at the facility consists mainly of 32-Watt T8 fluorescent fixtures with a few 40-Watt T12 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to linear fluorescent technology, the facility also has several circular T9 fluorescent, incandescent, as well as LED lamps. Exterior lighting is provided by a combination of 175-Watt and 400-Watt metal halide fixtures, 400-Watt high pressure sodium, incandescent, and linear fluorescent fixtures. Interior lighting control is provided by a combination of manual switches and occupancy sensors.

Cooling and ventilation is provided by rooftop packaged AC, window AC, and split system AC systems. Heating hot water is provided by three non-condensing hot water boilers.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Montclair High School	Weekday	7:00 am - 3:30 pm
Montclair High School	Weekend	CLOSED

2.4 Building Envelope

Montclair High School is a four-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with operable frames. The flat roof is constructed of built-up roofing material.

Figure 7 – Building Façade



2.5 On-Site Generation

TRC evaluated the potential for installing on-site generation at Montclair High School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 8 – Photovoltaic Potential

Potential	High	
System Potential	342	kW DC STC
Electric Generation	407,448	kWh/yr
Displaced Cost	$58,650	/yr
Installed Cost	$889,200	

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at Montclair High School consists mainly of 32-Watt T8 fluorescent fixtures with a few 40-Watt T12 fluorescent fixtures. These sources are inefficient in performance when compared to the latest lighting technology available in the market. Linear fluorescent fixtures are 2-foot, 4-foot, or 8-foot long, mainly troffers with diffusers having 1, 2, 3, or 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 60-Watt, 75-Watt, 100-Watt, and 125-Watt incandescent lamps. In addition to linear fluorescent and incandescent lamps, the facility also has LED linear tubes and screw-in lamps. A majority of the exit signs are incandescent based fixtures.

Interior lighting control in the building is provided by a combination of manual switches and occupancy sensors.

Figure 9 - Building Lighting Systems

Fluorescent Fixture	*Exterior Fixtures*
	

Exterior lighting is provided by a combination of 175-Watt and 400-Watt metal halide fixtures, 400-Watt high pressure sodium, 60-Watt and 100-Watt incandescent, and 32-Watt T8 linear fluorescent fixtures.

Hot Water Heating System

The hot water system consists of three Cleaver-Brooks 3,348 kBtu/hr output, non-condensing hot water boilers. The boilers have a nominal combustion efficiency of 80%. The boilers are configured in a constant flow primary distribution with three hot water pumps. Each boiler is supplied by a dedicated 5 hp pump. Baseboard heaters provide heating to the zones. The boilers are in good condition and well maintained.

Figure 10 – Hot Water Systems

Hot Water Boilers	*Hot Water Pumps*
	

Direct Expansion Air Conditioning System (DX)

The facility also has several window AC units with capacities ranging between 0.42 ton and 1.71 tons. There are three rooftop package units having capacities between 1-ton and 15-tons. In addition to the window AC units and package units, facility also has several 2-ton and 5-ton split system AC units.

Figure 11 – DX Air Conditioning System

Window AC	*Split Systems*
	

Domestic Hot Water Heating System

The domestic hot water is supplied by the same three Cleaver-Brooks heating hot water boilers by way of a heat exchanger.

Food Service Equipment

The facility has two full sized gas convection ovens which uses approximately 126 MMBtu gas per year.

Refrigeration

The facility has four stand up refrigerators with glass door and eight stand up refrigerators with solid doors. Volume of the standard refrigerators range between 5 cu. ft. and 50 cu. ft.

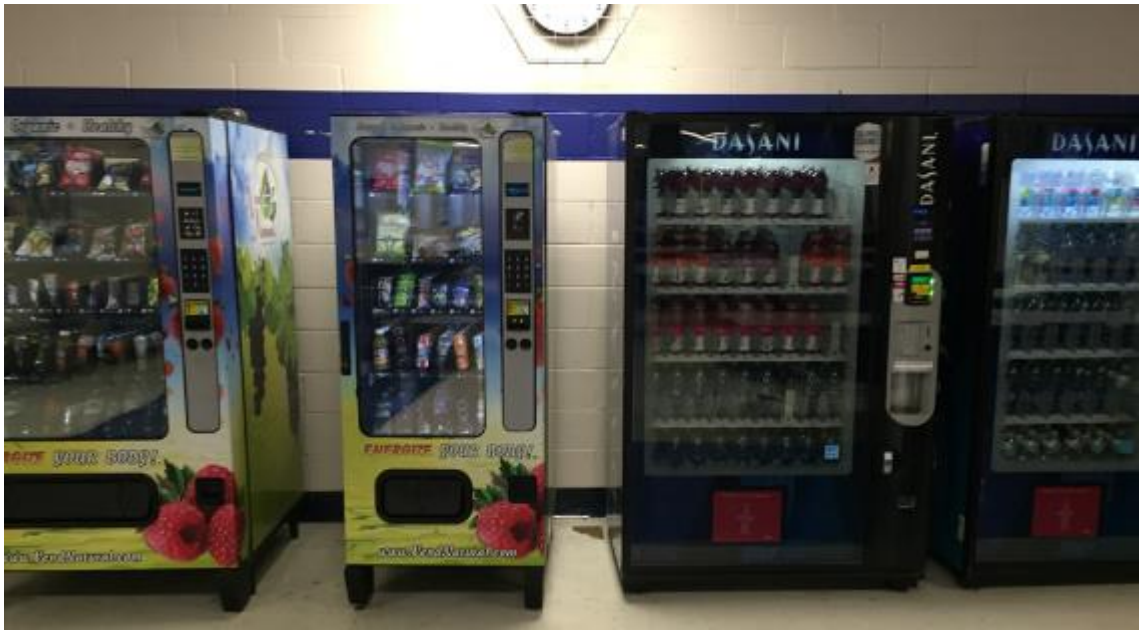
Figure 12 – Refrigeration System

Glass Door Refrigerator	*Solid Door Refrigerator*
	

Building Plug Load

There are roughly 310 computer work stations throughout the facility. All the computers are desktop units with LCD monitors. There is no centralized PC power management software installed.

Figure 13 – Vending Machines



The facility contains other systems which contribute to plug load including printers, microwaves, and televisions. In addition to the typical plug load equipment, the facility also has refrigerated and non-refrigerated vending machines.

2.7 Water-Using Systems

Facility has several locker rooms with a total of 68 showerheads with flow rates of 3.8 gallons per minute (gpm).

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

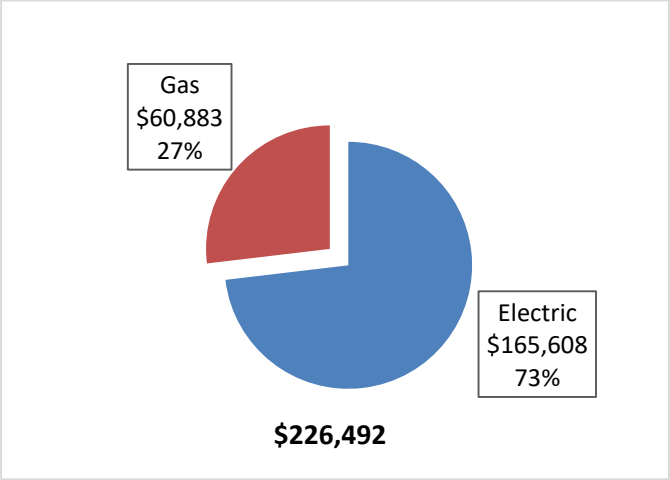
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 14 - Utility Summary

Utility Summary for Montclair High School		
Fuel	**Usage**	**Cost**
Electricity	1,150,579 kWh	$165,608
Natural Gas	74,117 Therms	$60,883
Total		**$226,492**

The current annual energy cost for this facility is $226,492 as shown in the chart below.

Figure 15 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.144/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 16 - Electric Usage & Demand

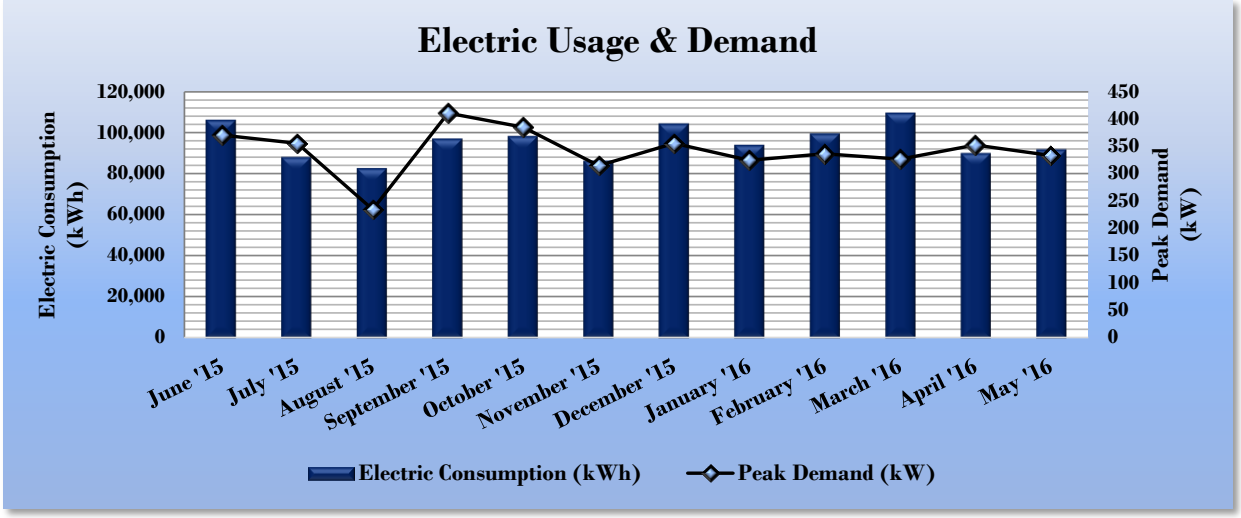


Figure 17 - Electric Usage & Demand

Electric Billing Data for Montclair High School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Total Electric Cost	TRC Estimated Usage?
6/16/15	32	106,128	371	$18,170	No
7/20/15	34	87,980	356	$15,676	No
8/17/15	28	82,671	234	$13,396	No
9/15/15	29	96,977	411	$17,107	No
10/14/15	29	98,211	385	$13,592	No
11/12/15	29	86,293	315	$11,847	No
12/15/15	33	104,378	356	$13,818	No
1/15/16	31	93,956	324	$12,039	No
2/16/16	32	99,546	337	$12,522	No
3/16/16	29	109,550	327	$13,660	No
4/14/16	29	90,007	353	$11,603	No
5/13/16	29	91,730	333	$11,725	No
Totals	**364**	**1,147,427**	**411.1**	**$165,155**	0
Annual	**365**	**1,150,579**	**411.1**	**$165,608**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.821/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Figure 18 - Natural Gas Usage

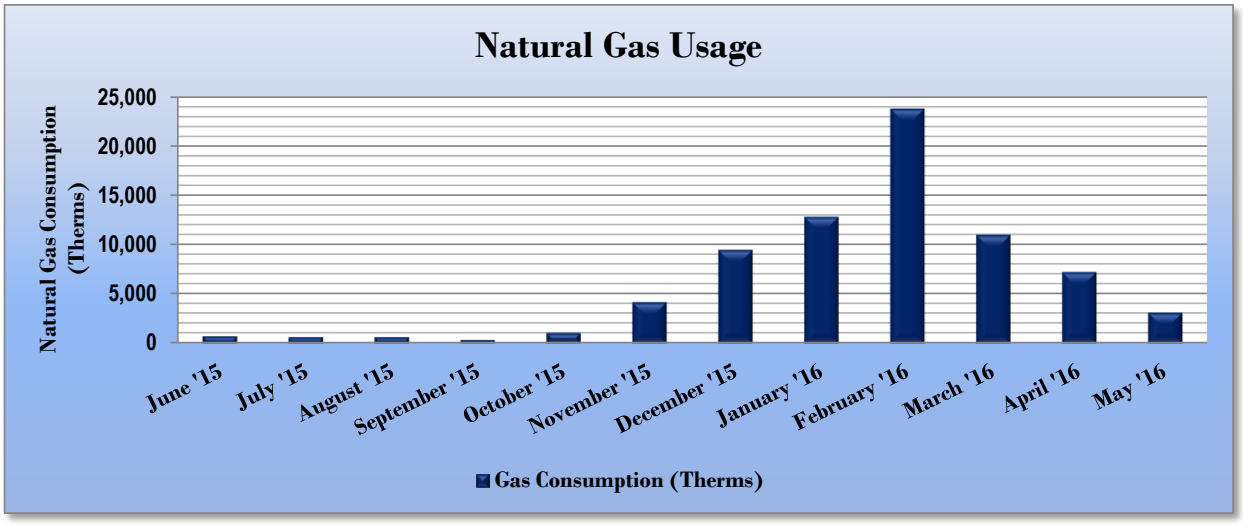


Figure 19 - Natural Gas Usage

Gas Billing Data for Montclair High School			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
6/16/15	32	694	$542
7/20/15	34	621	$495
8/17/15	28	608	$513
9/15/15	29	337	$1,292
10/14/15	29	1,048	$501
11/12/15	29	4,172	$5,080
12/15/15	33	9,448	$8,656
1/15/16	31	12,794	$10,342
2/16/16	32	23,718	$12,882
3/16/16	29	10,986	$15,079
4/15/16	30	7,216	$4,147
5/17/16	32	3,084	$1,855
Totals	**368**	**74,726**	**$61,384**
Annual	**365**	**74,117**	**$60,883**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 20 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Montclair High School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	76.5	141.4
Site Energy Use Intensity (kBtu/ft^2)	43.1	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 21 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Montclair High School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	61.1	141.4
Site Energy Use Intensity (kBtu/ft^2)	37.9	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This facility has a current score of 93.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

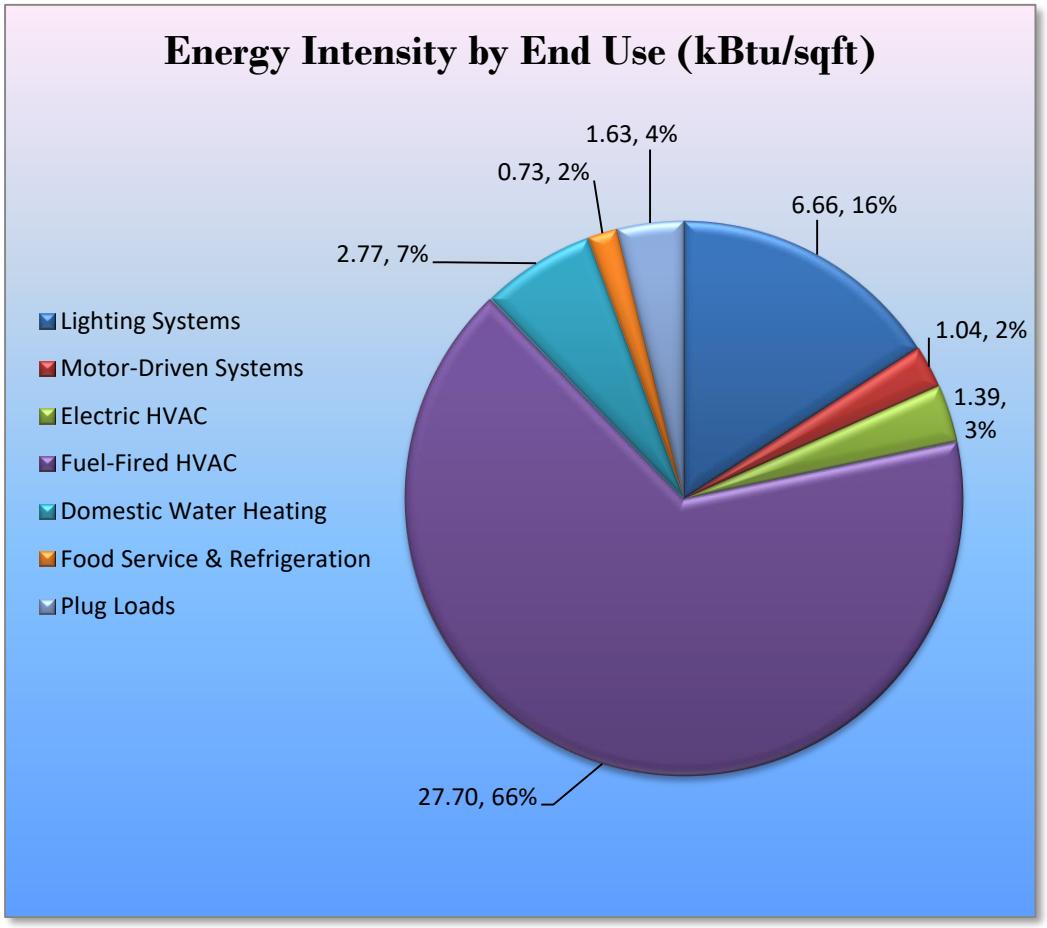
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 22 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Montclair High School regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 23 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**297,995**	**62.4**	**0.0**	**$42,891.77**	**$206,332.89**	**$33,190.00**	**$173,142.89**	**4.0**	**300,078**
ECM 1	Install LED Fixtures	67,721	10.7	0.0	$9,747.39	$60,143.64	$8,360.00	$51,783.64	5.3	68,194
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,168	0.3	0.0	$168.04	$989.00	$50.00	$939.00	5.6	1,176
ECM 3	Retrofit Fixtures with LED Lamps	222,256	51.0	0.0	$31,990.33	$141,543.38	$24,780.00	$116,763.38	3.6	223,810
ECM 4	Install LED Exit Signs	6,850	0.4	0.0	$986.00	$3,656.87	$0.00	$3,656.87	3.7	6,898
Lighting Control Measures		**45,728**	**10.4**	**0.0**	**$6,581.77**	**$59,796.00**	**$7,470.00**	**$52,326.00**	**8.0**	**46,047**
ECM 5	Install Occupancy Sensor Lighting Controls	45,728	10.4	0.0	$6,581.77	$59,796.00	$7,470.00	$52,326.00	8.0	46,047
Variable Frequency Drive (VFD) Measures		**14,929**	**1.9**	**0.0**	**$2,148.84**	**$9,827.55**	**$0.00**	**$9,827.55**	**4.6**	**15,034**
ECM 6	Install VFDs on Hot Water Pumps	14,929	1.9	0.0	$2,148.84	$9,827.55	$0.00	$9,827.55	4.6	15,034
Domestic Water Heating Upgrade		**0**	**0.0**	**132.8**	**$1,090.55**	**$6,072.40**	**$0.00**	**$6,072.40**	**5.6**	**15,544**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	132.8	$1,090.55	$6,072.40	$0.00	$6,072.40	5.6	15,544
Plug Load Equipment Control - Vending Machine		**6,669**	**0.0**	**0.0**	**$959.90**	**$1,610.00**	**$0.00**	**$1,610.00**	**1.7**	**6,716**
ECM 8	Vending Machine Control	6,669	0.0	0.0	$959.90	$1,610.00	$0.00	$1,610.00	1.7	6,716
TOTALS		**365,320**	**74.8**	**132.8**	**$53,672.83**	**$283,638.84**	**$40,660.00**	**$242,978.84**	**4.5**	**383,419**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 24 below.

Figure 24 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**297,995**	**62.4**	**0.0**	**$42,891.77**	**$206,332.89**	**$33,190.00**	**$173,142.89**	**4.0**	**300,078**
ECM 1	Install LED Fixtures	67,721	10.7	0.0	$9,747.39	$60,143.64	$8,360.00	$51,783.64	5.3	68,194
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,168	0.3	0.0	$168.04	$989.00	$50.00	$939.00	5.6	1,176
ECM 3	Retrofit Fixtures with LED Lamps	222,256	51.0	0.0	$31,990.33	$141,543.38	$24,780.00	$116,763.38	3.6	223,810
ECM 4	Install LED Exit Signs	6,850	0.4	0.0	$986.00	$3,656.87	$0.00	$3,656.87	3.7	6,898

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	19,265	4.4	0.0	$2,772.90	$45,969.38	$4,800.00	$41,169.38	14.8	19,400
Exterior	48,456	6.3	0.0	$6,974.49	$14,174.26	$3,560.00	$10,614.26	1.5	48,795

Measure Description

We recommend replacing existing fixtures containing HID lamps at this site, including metal halide and high-pressure sodium, with new high performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a HID lamp.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,168	0.3	0.0	$168.04	$989.00	$50.00	$939.00	5.6	1,176
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing T12 fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	214,714	50.0	0.0	$30,904.73	$140,935.50	$24,620.00	$116,315.50	3.8	216,215
Exterior	7,542	1.0	0.0	$1,085.61	$607.88	$160.00	$447.88	0.4	7,595

Measure Description

We recommend retrofitting existing incandescent and fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 4: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	6,850	0.4	0.0	$986.00	$3,656.87	$0.00	$3,656.87	3.7	6,898
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing all incandescent or compact fluorescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 25 below.

Figure 25 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**45,728**	**10.4**	**0.0**	**$6,581.77**	**$59,796.00**	**$7,470.00**	**$52,326.00**	**8.0**	**46,047**
ECM 5	Install Occupancy Sensor Lighting Controls	45,728	10.4	0.0	$6,581.77	$59,796.00	$7,470.00	$52,326.00	8.0	46,047

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 5: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
45,728	10.4	0.0	$6,581.77	$59,796.00	$7,470.00	$52,326.00	8.0	46,047

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in restrooms, storage rooms, classrooms, offices areas, etc. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.1.3 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 26 below.

Figure 26 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**14,929**	**1.9**	**0.0**	**$2,148.84**	**$9,827.55**	**$0.00**	**$9,827.55**	**4.6**	**15,034**
ECM 6	Install VFDs on Hot Water Pumps	14,929	1.9	0.0	$2,148.84	$9,827.55	$0.00	$9,827.55	4.6	15,034

ECM 6: Install VFDs on Hot Water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
14,929	1.9	0.0	$2,148.84	$9,827.55	$0.00	$9,827.55	4.6	15,034

Measure Description

We recommend installing a variable frequency drives (VFD) to control hot water pumps. This measure requires that a majority of the hot water coils be served by 2-way valves and that a differential pressure sensor is installed in the hot water loop. As the hot water valves close, the differential pressure increases. The VFD modulates pump speed to maintain a differential pressure setpoint. Energy savings results from reducing pump motor speed (and power) as hot water valves close. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

4.1.4 Domestic Hot Water Heating System Upgrades

Our recommendations for domestic water heating system improvements are summarized in Figure 27 below.

Figure 27 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**132.8**	**$1,090.55**	**$6,072.40**	**$0.00**	**$6,072.40**	**5.6**	**15,544**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	132.8	$1,090.55	$6,072.40	$0.00	$6,072.40	5.6	15,544

ECM 7: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	132.8	$1,090.55	$6,072.40	$0.00	$6,072.40	5.6	15,544

Measure Description

We recommend installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Low-flow showerheads can reduce hot water usage, relative to standard showerheads, which saves energy.

Low-flow devices reduce the overall water flow from the fixture, while still adequate pressure for showers. This reduces the amount of water used per day resulting in energy and water savings.

4.1.5 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment control measures are summarized in Figure 28 below.

Figure 28 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**6,669**	**0.0**	**0.0**	**$959.90**	**$1,610.00**	**$0.00**	**$1,610.00**	**1.7**	**6,716**
ECM 8	Vending Machine Control	6,669	0.0	0.0	$959.90	$1,610.00	$0.00	$1,610.00	1.7	6,716

ECM 8: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
6,669	0.0	0.0	$959.90	$1,610.00	$0.00	$1,610.00	1.7	6,716

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy use. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

4.2 ECM Evaluated but Not Recommended

The measure below have been evaluated by the auditor but is not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 29 – Summary of Measure Evaluated, but Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**812.9**	**$6,677.78**	**$186,907.92**	**$20,088.00**	**$166,819.92**	**25.0**	**95,184**
Install High Efficiency Hot Water Boilers	0	0.0	812.9	$6,677.78	$186,907.92	$20,088.00	$166,819.92	25.0	95,184
TOTALS	**0**	**0.0**	**812.9**	**$6,677.78**	**$186,907.92**	**$20,088.00**	**$166,819.92**	**25.0**	**95,184**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Hot Water Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	812.9	$6,677.78	$186,907.92	$20,088.00	$166,819.92	25.0	95,184

Measure Description

We generally evaluate replacing older inefficient hot water boilers with high efficiency hot water boilers. Significant improvements have been made in combustion technology resulting in increased overall boiler efficiency. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies between 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. The boiler efficiency increases as the return water temperature drops below 130°F.

Reasons for not Recommending

This measure has a long payback, approximately equal to the rated useful life of the replacement equipment. The measure is not recommended for implementation on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.4 for any low-flow ECM recommendations.

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

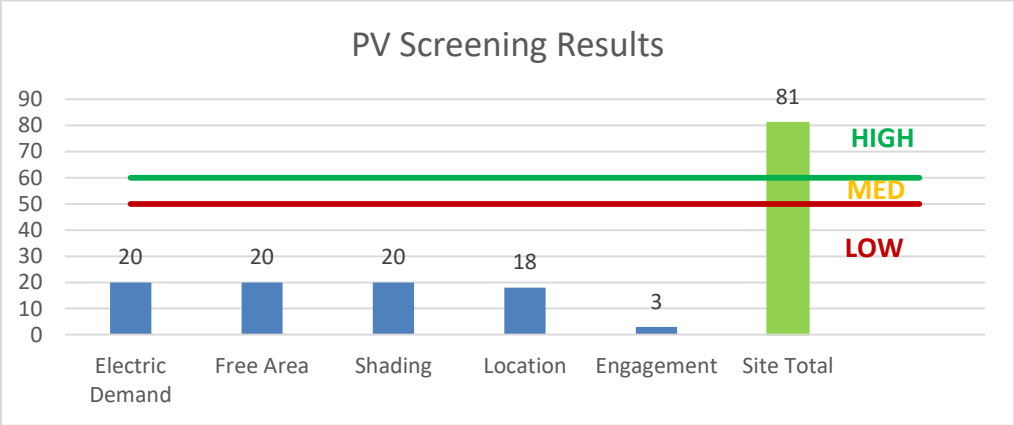
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the building may be feasible. If Montclair High School is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 30 - Photovoltaic Screening



Potential	High	
System Potential	342	kW DC STC
Electric Generation	407,448	kWh/yr
Displaced Cost	$58,650	/yr
Installed Cost	$889,200	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

A low or infrequent thermal load is the most significant factor contributing to the potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion this building is not is a good candidate for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 31 for a list of the eligible programs identified for each recommended ECM.

Figure 31 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X			X
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	X			X
ECM 3	Retrofit Fixtures with LED Lamps	X			X
ECM 4	Install LED Exit Signs				X
ECM 5	Install Occupancy Sensor Lighting Controls	X			X
ECM 6	Install VFDs on Hot Water Pumps		X		X
ECM 7	Install Low-Flow Domestic Hot Water Devices	X			X
ECM 8	Vending Machine Control				X

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Pay for Performance - Existing Buildings

Overview

The Pay for Performance – Existing Buildings (P4P EB) program is designed for larger customers with a peak demand over 200 kW in any of the preceding 12 months. Under this program the minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings. P4P is a generally a good option for medium to large sized facilities looking to implement as many measures as possible under a single project in order to achieve deep energy savings. This program has an added benefit of evaluating a broad spectrum of measures that may not otherwise qualify under other programs. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also utilize the P4P program.

Incentives

Incentives are calculated based on estimated and achieved energy savings ranging from $0.18-$0.22/kWh and $1.80-$2.50/therm, capped at the lesser of 50% total project cost, or $1 million per electric account and $1 million per natural gas account, per fiscal year, not to exceed $2 million per project. An incentive of $0.15/square foot is also available to offset the cost of developing the Energy Reduction Plan (see below) contingent on the project moving forward with measure installation.

How to Participate

To participate in the P4B EB program you will need to contact one of the pre-approved consultants and contractors ("Partners"). Under direct contract to you, the Partner will help further evaluate the measures identified in this report through development of the Energy Reduction Plan (ERP), assist you in implementing selected measures, and verify actual savings one year after the installation. At each of these three milestones your Partner will also facilitate securing program incentives.

Approval of the final scope of work is required by the program prior to installation completion. Although installation can be accomplished by a contractor of your choice (some P4P Partners are also contractors) or by internal personnel, the Partner must remain involved to ensure compliance with the program guidelines and requirements.

Detailed program descriptions, instructions for applying, applications and list of Partners can be found at: www.njcleanenergy.com/P4P.

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
3rd Flr Hallway	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.38	1,650	0.0	$237.49	$1,170.00	$200.00	4.08
Rm 302	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.60	2,638	0.0	$379.63	$1,827.00	$290.00	4.05
Rm 301	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 319	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
CSJ Study	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 317	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.04	190	0.0	$27.31	$117.00	$20.00	3.55
Rm 303	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 316	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 304	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 305	18	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.14	605	0.0	$87.15	$1,593.00	$250.00	15.41
Rm 315	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Social Studies Office	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,750	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.17	531	0.0	$76.47	$468.00	$80.00	5.07
Social Studies Office 2	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.17	759	0.0	$109.25	$468.00	$80.00	3.55
Languages Dept	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,750	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.13	398	0.0	$57.35	$351.00	$60.00	5.07
Languages Dept 2	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.17	759	0.0	$109.25	$468.00	$80.00	3.55
Rm 314	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.52	2,278	0.0	$327.86	$1,651.50	$260.00	4.24
Rm 320	18	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.14	605	0.0	$87.15	$1,593.00	$250.00	15.41
Ante Rm 320	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$40.00	5.59
Ante Rm 320	2	Incandescent: 60W Bulbs	Wall Switch	60	2,500	Relamp	No	2	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.07	293	0.0	$42.21	$31.00	$10.00	0.50
Rm 306	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.52	2,278	0.0	$327.86	$1,651.50	$260.00	4.24
Rm 313	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.52	2,278	0.0	$327.86	$1,651.50	$260.00	4.24
Rm 307	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.52	2,278	0.0	$327.86	$1,651.50	$260.00	4.24
Rm 312	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.52	2,278	0.0	$327.86	$1,651.50	$260.00	4.24
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.04	190	0.0	$27.31	$117.00	$20.00	3.55

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 310	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.60	2,638	0.0	$379.63	$1,827.00	$290.00	4.05
Rm 311	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.60	2,638	0.0	$379.63	$1,827.00	$290.00	4.05
Mop Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,000	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,000	0.01	20	0.0	$2.90	$35.90	$5.00	10.67
Team 3 Office	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.45	1,978	0.0	$284.72	$1,097.20	$200.00	3.15
Team 3 Office 2	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.16	719	0.0	$103.54	$416.80	$80.00	3.25
Team 3 Office 3	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,750	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.06	199	0.0	$28.68	$150.40	$30.00	4.20
Team 3 Office 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,750	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.06	199	0.0	$28.68	$150.40	$30.00	4.20
Team 3 Office 5	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,750	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.06	199	0.0	$28.68	$150.40	$30.00	4.20
Team 3 Office 6	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,750	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.06	199	0.0	$28.68	$150.40	$30.00	4.20
Team 3 Office 7	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	93	1,750	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.06	199	0.0	$28.68	$150.40	$30.00	4.20
Stairwell 1	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Stairwell 2	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Rm 204	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 205	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 206	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 207	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 208	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 209	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Computer Rm 210	28	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	28	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.77	3,357	0.0	$483.17	$2,448.00	$385.00	4.27
Mop Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,000	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,000	0.01	20	0.0	$2.90	$35.90	$5.00	10.67
2nd Flr Front Hallway	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,500	None	No	6	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
2nd Flr Front Hallway	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.08	360	0.0	$51.77	$266.40	$50.00	4.18
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.08	360	0.0	$51.77	$266.40	$50.00	4.18
English Dept	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$467.00	$80.00	3.74

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Faculty Rm	9	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	0.43	1,899	0.0	$273.36	$1,126.20	$215.00	3.33
Faculty Women's Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.08	360	0.0	$51.77	$445.50	$65.00	7.35
Faculty Men's Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.11	480	0.0	$69.02	$504.00	$75.00	6.22
Library	59	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	59	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	1.61	7,073	0.0	$1,018.10	$4,801.50	$765.00	3.96
Library	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.07	325	0.0	$46.80	$270.00	$35.00	5.02
Center for Excellence	5	Halogen Incandescent: 65W Spotlight Bulbs MR16 (Track Lighting)	Wall Switch	65	2,500	Relamp	Yes	5	LED Screw-In Lamps: 9W Plug-In Spotlights (MR16)	Occupancy Sensor	9	1,750	0.19	844	0.0	$121.45	$485.00	$60.00	3.50
Center for Excellence	11	Halogen Incandescent: 65W Spotlight Bulbs MR16 (Recessed Cans)	Wall Switch	65	2,500	Relamp	Yes	11	LED Screw-In Lamps: 9W Plug-In Spotlights (MR16)	Occupancy Sensor	9	1,750	0.42	1,856	0.0	$267.20	$743.00	$90.00	2.44
Library Computer Rm 1	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.01	50	0.0	$7.20	$116.00	$0.00	16.11
Library Computer Rm 2	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.01	50	0.0	$7.20	$116.00	$0.00	16.11
Library Computer Rm 3	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.01	50	0.0	$7.20	$116.00	$0.00	16.11
Library Computer Rm 4	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.01	50	0.0	$7.20	$116.00	$0.00	16.11
Library Computer Rm 5	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.01	50	0.0	$7.20	$116.00	$0.00	16.11
Library Storage	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,500	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.09	389	0.0	$56.03	$350.00	$40.00	5.53
Library Storage	2	Linear Fluorescent - T12: 8' T12 (75W) - 2L	Wall Switch	158	2,500	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 8' Lamps	Occupancy Sensor	72	1,750	0.14	619	0.0	$89.05	$520.00	$20.00	5.61
Storage Rm	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	840	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	840	0.13	191	0.0	$27.53	$351.00	$60.00	10.57
Rm 202	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 203	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 211	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 212	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 213	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 214	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 215	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Unit 2 Office	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.19	0	0.0	$0.00	$526.50	$90.00	0.00
Unit 2 Office 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.04	0	0.0	$0.00	$117.00	$20.00	0.00
Unit 2 Office 3	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.04	0	0.0	$0.00	$117.00	$20.00	0.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Unit 2 Office 4	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.04	0	0.0	$0.00	$117.00	$20.00	0.00
Unit 2 Speech Therapy	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.09	0	0.0	$0.00	$234.00	$40.00	0.00
Unit 2 Conf Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	0	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	0	0.09	0	0.0	$0.00	$234.00	$40.00	0.00
End Connecting Hallway	14	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	14	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lab Rm 216	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	18	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.74	3,237	0.0	$465.91	$1,893.60	$340.00	3.33
Rm 216 Office	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.41	1,798	0.0	$258.84	$1,022.00	$185.00	3.23
Rm 217	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.66	2,877	0.0	$414.14	$1,743.20	$310.00	3.46
2nd Flr Center Hallway	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Lab Rm 225	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54
Lab Rm 224	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54
Lab Rm 223	24	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	24	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.98	4,316	0.0	$621.21	$2,614.80	$465.00	3.46
Rm 223 Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.08	360	0.0	$51.77	$266.40	$50.00	4.18
Chemical Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.16	719	0.0	$103.54	$416.80	$80.00	3.25
Display Case	2	Incandescent: 60W Bulbs	Wall Switch	60	2,500	Relamp	No	2	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.07	293	0.0	$42.21	$31.00	$10.00	0.50
Science Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Science Office	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,500	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.13	584	0.0	$84.05	$467.00	$50.00	4.96
2nd Flr Connecting Hallway	22	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	22	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 218	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	18	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.74	3,237	0.0	$465.91	$1,893.60	$340.00	3.33
Rm 218 Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.02	95	0.0	$13.66	$58.50	$10.00	3.55
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.08	360	0.0	$51.77	$266.40	$50.00	4.18
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.08	360	0.0	$51.77	$420.40	$65.00	6.87
Faculty Restroom 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.08	360	0.0	$51.77	$445.50	$65.00	7.35
Faculty Restroom 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.08	360	0.0	$51.77	$445.50	$65.00	7.35
Mop Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,500	0.01	50	0.0	$7.24	$35.90	$5.00	4.27
Rm 219	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 220	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54
Rm 221	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54
Rm 222	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.62	2,697	0.0	$388.26	$1,668.00	$295.00	3.54
Dental Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Back Stairwell 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Back Stairwell 1	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Back Stairwell 2	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Back Stairwell 2	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main Office	42	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	42	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	1.15	5,035	0.0	$724.75	$3,267.00	$525.00	3.78
Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.02	95	0.0	$13.66	$58.50	$10.00	3.55
Restroom	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,750	0.01	61	0.0	$8.73	$48.20	$30.00	2.08
Conf Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,750	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.09	266	0.0	$38.24	$234.00	$40.00	5.07
Copy Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	114	1,750	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	0.15	451	0.0	$64.89	$380.53	$80.00	4.63
Communication Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Main Office 2	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.27	1,199	0.0	$172.56	$855.00	$135.00	4.17
Restroom 1	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,750	0.01	61	0.0	$8.73	$164.20	$10.00	17.66
Restroom 2	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,750	0.01	61	0.0	$8.73	$164.20	$10.00	17.66
Office 100A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Office 100B	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Office 100C	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Office 100D	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Office 100E	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Office 100F	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Rm 100	14	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	14	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.20	879	0.0	$126.59	$772.60	$105.00	5.27
Guidance Center	23	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	23	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.63	2,757	0.0	$396.89	$1,885.50	$300.00	3.99

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Guidance Center	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	0.05	211	0.0	$30.37	$95.13	$55.00	1.32
Main Hallway (Front)	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.41	1,798	0.0	$258.84	$1,417.50	$220.00	4.63
Main Hallway (Front)	6	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	6	LED Exit Signs: 2 W Lamp	None	2	8,760	0.09	1,390	0.0	$200.10	$645.33	$0.00	3.23
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Connecting Hallway	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.17	759	0.0	$109.25	$468.00	$80.00	3.55
Health Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Attendance Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Athletic Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Stairwell 9	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Stairwell 10	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Back Stairwell	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Display Case	2	Incandescent: 2 x 60W Screw-in Bulbs	Wall Switch	120	2,500	Relamp	No	2	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.15	638	0.0	$91.87	$31.00	$20.00	0.12
Foyer	3	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	2,500	Relamp	No	3	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.10	440	0.0	$63.31	$93.00	$15.00	1.23
Foyer	6	Metal Halide: (1) 70W Lamp	Wall Switch	95	2,500	Relamp	No	6	LED Screw-In Lamps: 18W Conmcob LED Bulb	Wall Switch	18	2,500	0.30	1,328	0.0	$191.18	$273.00	$0.00	1.43
Foyer	3	Metal Halide: (1) 100W Lamp	Wall Switch	128	2,500	Relamp	No	3	LED Screw-In Lamps: 30W Conmcob LED Bulb	Wall Switch	30	2,500	0.19	845	0.0	$121.66	$298.20	$0.00	2.45
MFEE	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.03	120	0.0	$17.26	$174.50	$10.00	9.53
Rm 102	21	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	21	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.30	1,319	0.0	$189.88	$1,293.90	$175.00	5.89
Rm 103	21	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	21	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.30	1,319	0.0	$189.88	$1,293.90	$175.00	5.89
Rm 105	21	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	21	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.30	1,319	0.0	$189.88	$1,293.90	$175.00	5.89
Rm 106	12	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	12	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.17	754	0.0	$108.50	$970.80	$130.00	7.75
Rm 107	24	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	24	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.34	1,508	0.0	$217.00	$1,401.60	$190.00	5.58
Math Office	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,750	Relamp	No	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.45	1,395	0.0	$200.74	$1,228.50	$210.00	5.07
Rm 109	18	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	18	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.26	1,131	0.0	$162.75	$1,186.20	$160.00	6.31
Stair 8	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Girls' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 101	18	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	Yes	18	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,750	0.26	1,131	0.0	$162.75	$1,186.20	$160.00	6.31
End Hallway	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.32	1,423	0.0	$204.84	$877.50	$150.00	3.55
End Hallway	1	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	2	8,760	0.02	232	0.0	$33.35	$107.56	$0.00	3.23
Small Gym	32	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,500	Fixture Replacement	Yes	32	LED - Fixtures: Low-Bay	Occupancy Sensor	58	1,750	5.34	23,405	0.0	$3,368.76	$46,512.80	$4,940.00	12.34
Small Gym	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Back Entrance Gym (Display Cases)	18	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	2,500	Relamp	No	18	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.60	2,639	0.0	$379.88	$279.00	$90.00	0.50
Back Entrance Gym	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Faculty Women's Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Gym Stairwell	3	Incandescent: 75W Screw-in Bulbs	Wall Switch	75	2,500	Relamp	No	3	LED Screw-In Lamps: 13W LED Screw-In Bulbs	Wall Switch	13	2,500	0.12	535	0.0	$76.97	$69.93	$15.00	0.71
Main Gym	49	LED Screw-In Lamps: 23W Screw-In Bulbs	Wall Switch	23	2,500	None	Yes	49	LED Screw-In Lamps: 23W Screw-In Bulbs	Occupancy Sensor	23	1,750	0.22	972	0.0	$139.91	$1,350.00	$175.00	8.40
Main Gym	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Stairwell 1 to Locker Rms	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Stairwell 2 to Locker Rms	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.06	285	0.0	$40.97	$175.50	$30.00	3.55
Locker Rm	30	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.82	3,597	0.0	$517.68	$2,565.00	$405.00	4.17
Locker Rm	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Showers	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.22	949	0.0	$136.56	$585.00	$100.00	3.55
Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Math Center	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.11	480	0.0	$69.02	$350.00	$60.00	4.20
Balcony Stairwell	2	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	2,500	Relamp	No	2	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.07	293	0.0	$42.21	$31.00	$10.00	0.50
Stair 2	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.15	664	0.0	$95.59	$409.50	$70.00	3.55
Drivers Ed	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.41	1,798	0.0	$258.84	$1,417.50	$220.00	4.63
Back Hallway	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	26	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.56	2,467	0.0	$355.05	$1,521.00	$260.00	3.55
Back Hallway	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Cafeteria	44	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	44	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	2.12	9,285	0.0	$1,336.45	$5,535.87	$1,055.00	3.35
Cafeteria	5	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	2	8,760	0.08	1,159	0.0	$166.75	$537.78	$0.00	3.23

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	15	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	No	15	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,500	0.55	2,415	0.0	$347.60	$1,427.00	$300.00	3.24
Kitchen	4	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	4	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	2,500	0.08	334	0.0	$48.00	$252.80	$0.00	5.27
Rm 110	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.68	2,997	0.0	$431.40	$2,002.50	$320.00	3.90
Rm 111	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	25	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	1.20	5,276	0.0	$759.35	$2,918.33	$570.00	3.09
Faculty Men's Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.03	120	0.0	$17.26	$174.50	$10.00	9.53
Girls' Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.08	360	0.0	$51.77	$445.50	$65.00	7.35
Auditorium Foyer	20	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,500	Relamp	No	20	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,500	0.23	1,006	0.0	$144.83	$718.00	$100.00	4.27
Auditorium Foyer	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.35	1,518	0.0	$218.49	$936.00	$160.00	3.55
Auditorium Foyer	35	Halogen Incandescent: 65W Spotlight Bulbs MR16 (Track Lighting)	Wall Switch	65	2,500	Relamp	No	35	LED Screw-In Lamps: 9W Plug-In Spotlights	Wall Switch	9	2,500	1.28	5,635	0.0	$811.07	$1,505.00	$175.00	1.64
Men's Rm	1	Circular Fluorescent - T9: Circline 30W T9 Fluorescent	Wall Switch	30	2,500	LED Retrofit	Yes	1	LED - Fixtures: 17W LED Circline Retrofit	Occupancy Sensor	17	1,750	0.01	52	0.0	$7.49	$65.26	$0.00	8.71
Men's Rm	1	Polylux 2D Fluorescent: F382D/835	Wall Switch	38	2,500	LED Retrofit	Yes	1	LED - Fixtures: 16W LED 2D Polylux	Occupancy Sensor	16	1,750	0.02	77	0.0	$11.09	$188.51	$0.00	17.00
Women's Rm	1	Circular Fluorescent - T9: Circline 30W T9 Fluorescent	Wall Switch	30	2,500	LED Retrofit	Yes	1	LED - Fixtures: 17W LED Circline Retrofit	Occupancy Sensor	17	1,750	0.01	52	0.0	$7.49	$65.26	$0.00	8.71
Women's Rm	1	Polylux 2D Fluorescent: F382D/835	Wall Switch	38	2,500	LED Retrofit	Yes	1	LED - Fixtures: 16W LED 2D Polylux	Occupancy Sensor	16	1,750	0.02	77	0.0	$11.09	$188.51	$0.00	17.00
Display Cases	16	Halogen Incandescent: 65W Spotlight Bulbs MR16 (Track Lighting)	Wall Switch	65	2,500	Relamp	No	16	LED Screw-In Lamps: 9W Plug-In Spotlights (MR16)	Wall Switch	9	2,500	0.59	2,576	0.0	$370.78	$688.00	$80.00	1.64
Front of Auditorium	12	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	4,380	Relamp	No	12	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	4,380	0.40	3,083	0.0	$443.70	$186.00	$60.00	0.28
Auditorium Stairwell	4	Circular Fluorescent - T9: Circline 30W T9 Fluorescent	Wall Switch	30	2,500	LED Retrofit	No	4	LED - Fixtures: 17W LED Circline Retrofit	Wall Switch	17	2,500	0.03	150	0.0	$21.52	$261.04	$0.00	12.13
Auditorium Stairwell	1	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	2	8,760	0.02	232	0.0	$33.35	$107.56	$0.00	3.23
Mop Closet	1	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	1,000	Relamp	No	1	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	1,000	0.03	59	0.0	$8.44	$15.50	$5.00	1.24
Basement Hallways	64	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	64	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	1.38	6,072	0.0	$873.97	$3,744.00	$640.00	3.55
Basement Hallways	6	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	2,500	Relamp	No	6	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	2,500	0.20	880	0.0	$126.63	$93.00	$30.00	0.50
Basement Hallways	9	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	9	LED Exit Signs: 2 W Lamp	None	2	8,760	0.14	2,085	0.0	$300.15	$968.00	$0.00	3.23
Wrestling Rm	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.38	1,678	0.0	$241.58	$1,359.00	$210.00	4.76
Boys' Locker Rm	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.57	2,518	0.0	$362.38	$2,038.50	$315.00	4.76
Boys' Locker Rm	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Showers	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.17	759	0.0	$109.25	$468.00	$80.00	3.55

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mop Closet	1	Incandescent: 60W Screw-in Bulbs	Wall Switch	60	1,000	Relamp	No	1	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	1,000	0.03	59	0.0	$8.44	$15.50	$5.00	1.24
Girls' Locker Rm	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.57	2,518	0.0	$362.38	$2,038.50	$315.00	4.76
Girls' Locker Rm	2	Exit Signs: Incandescent	None	25	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	2	8,760	0.03	463	0.0	$66.70	$215.11	$0.00	3.23
Showers	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.17	759	0.0	$109.25	$468.00	$80.00	3.55
Rm 1A	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.41	1,798	0.0	$258.84	$1,417.50	$220.00	4.63
Rm 1B	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.41	1,798	0.0	$258.84	$1,417.50	$220.00	4.63
Food Science	27	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	27	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.74	3,237	0.0	$465.91	$2,389.50	$375.00	4.32
Women's Rm 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Women's Rm 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Rm 2A	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.41	1,798	0.0	$258.84	$1,417.50	$220.00	4.63
Rm 11	23	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	23	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.63	2,757	0.0	$396.89	$1,885.50	$300.00	3.99
Rm 2B	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 10	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.66	2,877	0.0	$414.14	$1,944.00	$310.00	3.95
Storage Rm 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Storage Rm 2	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Rm 9	20	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	20	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	0.96	4,221	0.0	$607.48	$2,442.67	$470.00	3.25
Rm 8	26	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,500	Relamp	Yes	26	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,750	1.25	5,487	0.0	$789.72	$3,013.47	$590.00	3.07
Rm 7	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32
Rm 3	44	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	44	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	1.20	5,275	0.0	$759.26	$3,654.00	$580.00	4.05
Men's Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.08	360	0.0	$51.77	$445.50	$65.00	7.35
Team Offices	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.55	2,398	0.0	$345.12	$1,710.00	$270.00	4.17
Mop Closet	1	Incandescent: 60W Screw-in Bulbs	Wall Switch	65	1,000	Relamp	No	1	LED Screw-In Lamps: 9W LED Screw-In Bulbs	Wall Switch	9	1,000	0.04	64	0.0	$9.27	$15.50	$5.00	1.13
Rm 5	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.33	1,439	0.0	$207.07	$972.00	$155.00	3.95
Rm 4	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.46	2,038	0.0	$293.35	$1,534.50	$240.00	4.41
Rm 13A	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.49	2,158	0.0	$310.61	$1,593.00	$250.00	4.32

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 13B	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.27	1,199	0.0	$172.56	$855.00	$135.00	4.17
Boys' Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Boys' Rm	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,500	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,750	0.01	61	0.0	$8.73	$48.20	$10.00	4.37
Faculty Men's Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.05	240	0.0	$34.51	$233.00	$20.00	6.17
Custodial Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	700	0.05	96	0.0	$13.80	$233.00	$20.00	15.43
Custodian	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,750	0.16	719	0.0	$103.54	$621.00	$95.00	5.08
Auditorium	54	Incandescent: 125W Screw-in Bulbs	Wall Switch	100	2,500	Relamp	No	54	LED Screw-In Lamps: 20W LED Screw-In Bulbs	Wall Switch	20	2,500	2.83	12,420	0.0	$1,787.67	$2,458.62	$270.00	1.22
Cleaning Supplies Rm	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,000	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	700	0.08	144	0.0	$20.71	$291.50	$50.00	11.66
Auditorium Back Stage	6	Incandescent: 100W Screw-in Bulbs	Wall Switch	100	1,500	Relamp	No	6	LED Screw-In Lamps: 15W LED Screw-In Bulbs	Wall Switch	15	1,500	0.33	880	0.0	$126.63	$160.50	$30.00	1.03
Rm 112	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.66	2,877	0.0	$414.14	$1,743.20	$310.00	3.46
Rm 113	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,500	Relamp	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,750	0.66	2,877	0.0	$414.14	$1,743.20	$310.00	3.46
Aud. Exterior Perimeter	20	High-Pressure Sodium: (1) 400W Lamp	None	465	4,380	Fixture Replacement	No	20	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	146	4,380	4.18	32,136	0.0	$4,625.49	$7,813.54	$2,000.00	1.26
Aud. Exterior Perimeter	2	Metal Halide: (1) 400W Lamp	None	458	4,380	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	146	4,380	0.41	3,143	0.0	$452.40	$781.35	$200.00	1.29
Aud. Exterior Perimeter	7	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	7	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	50	4,380	0.76	5,818	0.0	$837.37	$1,232.56	$700.00	0.64
Main Entrance	6	High-Pressure Sodium: (1) 400W Lamp	None	465	4,380	Fixture Replacement	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	146	4,380	1.25	9,641	0.0	$1,387.65	$2,344.06	$600.00	1.26
Main Entrance	3	Incandescent: 100W Screw-in Bulbs	None	100	4,380	Relamp	No	3	LED Screw-In Lamps: 15W LED Screw-In Bulbs	None	15	4,380	0.17	1,284	0.0	$184.87	$80.25	$15.00	0.35
Side Entrance	1	Incandescent: 60W Screw-in Bulbs	None	60	4,380	Relamp	No	1	LED Screw-In Lamps: 9W LED Screw-In Bulbs	None	9	4,380	0.03	257	0.0	$36.97	$15.50	$5.00	0.28
Gym Entrance	2	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	2	LED - Fixtures: Wall Sconces	None	50	4,380	0.22	1,662	0.0	$239.25	$667.58	$20.00	2.71
Gym Entrance	8	Incandescent: 60W Screw-in Bulbs	None	60	4,380	Relamp	No	8	LED Screw-In Lamps: 9W LED Screw-In Bulbs	None	9	4,380	0.27	2,055	0.0	$295.80	$124.00	$40.00	0.28
Trash Area	4	Incandescent: 100W Screw-in Bulbs	None	100	4,380	Relamp	No	4	LED Screw-In Lamps: 15W LED Screw-In Bulbs	None	15	4,380	0.22	1,713	0.0	$246.50	$107.00	$20.00	0.35
Trash Area	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	None	114	4,380	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	None	58	4,380	0.04	282	0.0	$40.60	$95.13	$20.00	1.85
Boiler Rm	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,500	Relamp	No	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.35	1,518	0.0	$218.49	$936.00	$160.00	3.55
Boiler Rm	1	Incandescent: 100W Screw-in Bulbs	Wall Switch	100	2,500	Relamp	No	1	LED Screw-In Lamps: 15W LED Screw-In Bulbs	Wall Switch	15	2,500	0.06	244	0.0	$35.17	$26.75	$5.00	0.62
Courtyard	4	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	4	LED - Fixtures: Wall Sconces	None	50	4,380	0.43	3,324	0.0	$478.50	$1,335.16	$40.00	2.71
Whole School	36	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	36	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Classrooms	69	Supply Fan	0.3	69.5%	No	2,745	No	69.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms	Boiler Rm	2	Air Compressor	1.0	82.5%	No	4,957	No	82.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classroom Labs	Classroom Labs	4	Exhaust Fan	0.5	82.5%	No	1,000	No	82.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Auditorium Restrooms / Lobby	Auditorium Restrooms / Lobby	5	Supply Fan	0.3	69.5%	No	2,745	No	69.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Rm	Whole School	3	Heating Hot Water Pump	5.0	89.5%	No	2,745	No	89.5%	Yes	3	1.88	14,929	0.0	$2,148.84	$9,827.55	$0.00	4.57
Boiler Rm	Whole School	2	Boiler Feed Water Pump	1.5	84.0%	No	2,745	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Classrooms & Offices	Classrooms & Offices	2	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms & Offices	Classrooms & Offices	9	Window AC	0.58		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms & Offices	Classrooms & Offices	7	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms & Offices	Classrooms & Offices	13	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms & Offices	Classrooms & Offices	6	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Math Office	Math Office	1	Window AC	1.71		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Offices	Offices	2	Ductless Mini-Split AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Science Office	1	Packaged AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	L.G.I.	1	Packaged AC	15.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Library	1	Packaged AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Outside	Auditorium Area	5	Split-System AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Rm	Whole School	2	Non-Condensing Hot Water Boiler	3,348.00	Yes	2	Condensing Hot Water Boiler	3,348.00	93.00%	Ec	0.00	0	542.0	$4,451.85	$124,605.28	$13,392.00	24.98
Boiler Rm	Whole School	1	Non-Condensing Hot Water Boiler	3,348.00	Yes	1	Condensing Hot Water Boiler	3,348.00	93.00%	Ec	0.00	0	271.0	$2,225.93	$62,302.64	$6,696.00	24.98

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Locker Room Showers	68	Showerhead	3.50	2.00	0.00	0	132.8	$1,090.55	$6,072.40	$0.00	5.57

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Stand-Up Refrigerator, Glass Door (31 - 50 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	3	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Various	5	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Cafeteria	2	Stand-Up Refrigerator, Glass Door (≤15 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Gas Convection Oven (Full Size)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Montclair HS	310	Desktop Computer + Monitor	150.0	Yes
Montclair HS	12	TVs (med. CRT)	150.0	No
Montclair HS	14	Printers (sm.)	80.0	Yes
Montclair HS	8	Copy Machine (Lg.)	240.0	Yes
Montclair HS	4	Server Racks	360.0	No
Montclair HS	5	Microwave Ovens (med.)	900.0	No
Montclair HS	30	Smart Boards	316.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Montclair HS	2	Refrigerated	Yes	0.00	3,224	0.0	$464.00	$460.00	$0.00	0.99
Montclair HS	3	Non-Refrigerated	Yes	0.00	1,028	0.0	$147.90	$690.00	$0.00	4.67
Montclair HS	2	Glass Fronted Refrigerated	Yes	0.00	2,418	0.0	$348.00	$460.00	$0.00	1.32

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Montclair High School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 262,855
Built: 1914

For Year Ending: April 30, 2016
Date Generated: December 25, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Montclair High School 100 Chestnut Street Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724557

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
43.2 kBtu/ft²

Source EUI
76.8 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	3,960,838 (35%)
Natural Gas (kBtu)	7,392,776 (65%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	75.4
National Median Source EUI (kBtu/ft²)	134.2
% Diff from National Median Source EUI	-43%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	832

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Nishuane School

Montclair Board of Education

32 Cedar Street

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Nishuane School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey School Districts in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

The Nishuane School is a three-story building totaling 87,440 square feet constructed in 1908. The building has a flat roof and exterior walls are finished with brick masonry. The windows throughout the facility are double pane. Interior lighting consists mainly of T8 linear fluorescent fixtures and lighting control is provided by manual wall switches. Heating is provided by two non-condensing gas fired steam boilers and cooling is provided by window air conditioning units.

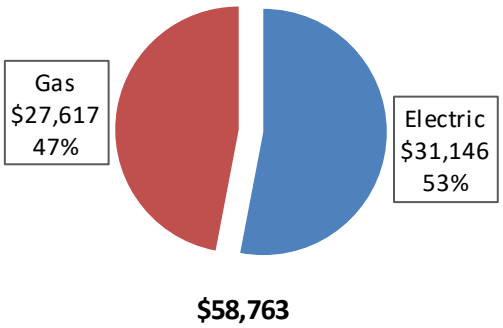
A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

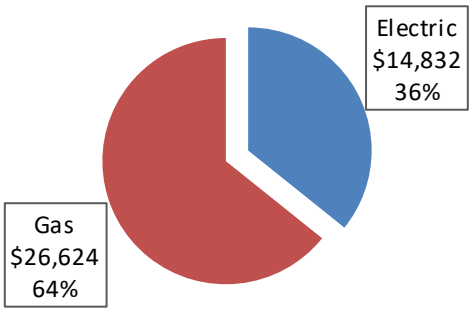
TRC evaluated nine measures. Eight measures were recommended for implementation which together represent an opportunity for the Nishuane School to reduce annual energy costs by roughly $13,415 and annual greenhouse gas emissions by 105,904 lbs CO_2e. The measures would pay for themselves in roughly 7.0 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce the Nishuane School's annual energy use by 10.7%.

Figure 1 – Previous 12 Month Utility Costs



$58,763

Figure 2 – Potential Post-Implementation Costs



$41,455

A detailed description of the Nishuane School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4. Measure without an "ECM #" in the table below has been evaluated, but are not recommended for implementation.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Natural Gas Savings (MMBtu)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**74,741**	**29.4**	**0.0**	**0.0**	**$10,187.54**	**$88,999.19**	**$12,230.00**	**$76,769.19**	**7.54**	**75,264**
ECM 1	Install LED Fixtures	Yes	18,852	5.5	0.0	0.0	$2,569.58	$22,808.47	$1,340.00	$21,468.47	8.35	18,984
ECM 2	Retrofit Fixtures with LED Lamps	Yes	53,955	23.8	0.0	0.0	$7,354.32	$63,609.40	$10,890.00	$52,719.40	7.17	54,332
ECM 3	Install LED Exit Signs	Yes	1,934	0.1	0.0	0.0	$263.64	$2,581.32	$0.00	$2,581.32	9.79	1,948
Lighting Control Measures			**12,879**	**5.6**	**0.0**	**0.0**	**$1,755.52**	**$14,110.00**	**$1,535.00**	**$12,575.00**	**7.16**	**12,969**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	10,575	4.6	0.0	0.0	$1,441.40	$9,910.00	$1,535.00	$8,375.00	5.81	10,649
ECM 5	Install High/Low Lighitng Controls	Yes	2,305	1.0	0.0	0.0	$314.12	$4,200.00	$0.00	$4,200.00	13.37	2,321
Motor Upgrades			**1,901**	**1.6**	**0.0**	**0.0**	**$259.16**	**$2,933.28**	**$0.00**	**$2,933.28**	**11.32**	**1,915**
ECM 6	Premium Efficiency Motors	Yes	1,901	1.6	0.0	0.0	$259.16	$2,933.28	$0.00	$2,933.28	11.32	1,915
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**44.9**	**44.9**	**$369.56**	**$122,929.93**	**$6,614.00**	**$116,315.93**	**314.74**	**5,257**
	Install High Efficiency Steam Boilers	No	0	0.0	44.9	44.9	$369.56	$122,929.93	$6,614.00	$116,315.93	314.74	5,257
Domestic Water Heating Upgrade			**0**	**0.0**	**120.7**	**120.7**	**$993.49**	**$207.93**	**$0.00**	**$207.93**	**0.21**	**14,133**
ECM 7	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	120.7	120.7	$993.49	$207.93	$0.00	$207.93	0.21	14,133
Plug Load Equipment Control - Vending Machine			**1,612**	**0.0**	**0.0**	**0.0**	**$219.70**	**$718.80**	**$0.00**	**$718.80**	**3.27**	**1,623**
ECM 8	Vending Machine Control	Yes	1,612	0.0	0.0	0.0	$219.70	$718.80	$0.00	$718.80	3.27	1,623
TOTALS FOR ALL RECOMMENDED MEASURES			**91,134**	**36.7**	**120.7**	**120.7**	**$13,415.41**	**$106,969.20**	**$13,765.00**	**$93,204.20**	**6.95**	**105,904**
TOTALS FOR ALL MEASURES			**91,134**	**36.7**	**165.6**	**165.6**	**$13,784.97**	**$229,899.13**	**$20,379.00**	**$209,520.13**	**15.20**	**111,161**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing old standard efficiency motors with motors of the current efficiency standard (EISA 2007). Motors will be replaced with the same size motors. This measure saves energy by reducing the power used by the motors due to improved electrical efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing old inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide heating equivalent to older systems, but use less energy. These measures save energy by reducing the fuel used by the heating due to improved combustion and heat transfer efficiency.

Domestic Water Heating upgrade measures generally involve replacing old inefficient domestic water heating systems with modern energy efficient systems. New domestic water heating systems can provide equivalent or greater capacity as older systems, but use less energy. These measures save energy by reducing the fuel used by the domestic water heating systems due to improved efficiency or the removal of standby losses.

Plug Load Equipment control measures generally involve installing automation that limits the power use or operation of equipment plugged into an electrical receptacle based on occupancy.

Energy Efficient Practices

TRC also identified 10 low cost (or no-cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at the Nishuane School include:

- Reduce Air Leakage
- Close Doors and Windows
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for the Nishuane School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	77	kW DC STC
Electric Generation	91,736	kWh/yr
Displaced Cost	$7,980	/yr
Installed Cost	$200,200	

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

This facility also qualifies for the Direct Install program which, through an authorized network of participating contractors, can assist with the implementation of a group of measures versus installing individual measures or phasing implementation. This program is designed to be turnkey and will provide an incentive up to 70% of the cost of the project identified by the designated contractor.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.4 for additional information on the ESIP Program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	(973) 509-4050
Designated Representative			
Kimberly Raison	Custodian		(973) 509-4237
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	(732) 855-2879

2.2 General Site Information

On November 08, 2016, TRC performed an energy audit at the Nishuane School located in Montclair, New Jersey. TRC's Auditor met with Kimberly Raison to review the facility operations and focus the investigation on specific energy-using systems.



Image 1 – Auditorium

The 87,440 square feet school building is a three-story facility comprised of classrooms, gymnasium, administration offices, nurse room, auditorium, technology room, dance rooms, kitchen, mechanical room, and storage areas. The original building was constructed in 1908 and expanded to accommodate additional classrooms and other spaces in 1917, 1923, and 2002.

2.3 Building Occupancy

The school operates on a 10-month schedule and is open Monday through Friday. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 395 students and staff.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Nishuane School	Weekday	8:00 AM - 3:30 PM
Nishuane School	Weekend	Closed

2.4 Building Envelope

The building has cast-in-place concrete perimeter wall footings with concrete foundation walls and a flat roof covered with a black synthetic rubber: EPDM roofing (ethylene propylene diene monomer). Exterior walls are finished with brick masonry. The windows throughout the facility are double pane glass with aluminum frames and are in acceptable condition with some units showing signs of outside air infiltration. Exterior doors are constructed of metal. Overall, the building envelope appears to be in acceptable condition.



Image 2 – Building Envelope

2.5 On-site Generation

The Nishuane School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Typical lighting throughout the school building is provided by recessed fluorescent fixtures with one or two 32-Watt T8 lamps and electronic ballasts. The auditorium is illuminated with 60-Watt screw-in incandescent lamps while the gymnasium is lit with 400-Watt metal halide lamps. Some of the storage rooms and closets are illuminated with a mixture of incandescent lamps and compact fluorescent lamps. Exit signs throughout the facility are incandescent. Lighting control is provided mainly by manual wall switches. The facility has minimal exterior lighting which consists of 150-Watt metal halide outdoor wall-mounted fixtures and 250-Watt metal halide parking lot fixtures. They are controlled with photocells.

Steam Heating System

The steam system consists of two H. B. Smith 3,959 MBh output steam boilers. The boilers are 30 years old and have an estimated combustion efficiency of 75%. They have passed their useful service life. The boilers operate in lead/lag operation with only one boiler operating at a time. Each boiler has 0.8 hp forced draft fan with discharge dampers to control the volume of combustion air. There are three constant speed 5 hp feed water pumps. The water level in the boilers is controlled by a valve. Steam is supplied to the radiators for heating at 15 psig. Space temperatures are controlled by local thermostats. The school should consider re-evaluating the building heating load and installing modular steam boilers when these boilers are replaced.



Image 3 – Steam Heating System (Boilers)

Air Conditioning (DX)

There are 26 window units and one split air conditioner (AC) are used to cool the building. Window units range in size from 0.5 to 1.25 tons and average four years of age. The unit serving room B11 is significantly less efficient than others and appears to be in poor condition. The 1.5-ton Mitsubishi split AC system is five years old and provides cooling to the server room. There is one air handler unit located in the fan room that provides constant fresh air to the hallways using a single constant speed 5 hp supply fan.

Domestic Hot Water



Domestic hot water for the school is provided by one Universal gas fired non-condensing hot water heater with an input rating of 156 MBh and a nominal efficiency of 80%. The water heater is seven years old and has 82-gallon storage tank. The water heater is in good condition.

Image 4 – Domestic Hot Water

Food Service & Refrigeration

The school houses a small non-commercial kitchen for light cooking. The kitchen appliances include gas cooking range, gas warmers, a stand-up refrigerator and freezer. The kitchen is well maintained.

Plug load & Vending Machines

There are approximately 68 computer work stations throughout the facility and they are mostly desktop units with LCD monitors. There is no centralized PC power management software installed.

There is one server closest in the facility that has cooling provided by a split AC. The facility has one refrigerated beverage vending machine located in the teacher room.

2.7 Water-Using Systems

There are several restrooms at this facility. A sampling of restrooms found that all the faucets are rated for 2.2 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf) and the urinals are rated at 2 gpf. There are no restrooms with showers.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are many factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

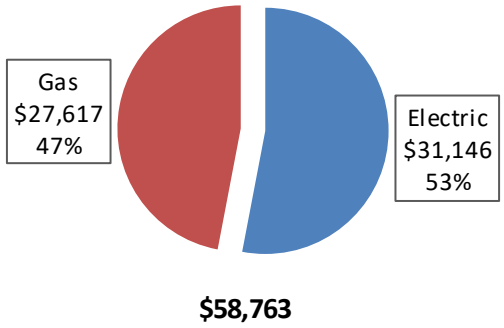
The following energy consumption and cost data is based on the last 12-month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 7 - Utility Summary

Utility Summary for Nishuane School		
Fuel	**Usage**	**Cost**
Electricity	197,890 kWh	$31,146
Natural Gas	33,552 Therms	$27,617
Total		**$58,763**

The current utility cost for this site is $58,763 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



$58,763

3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.136/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects lower occupancy in the summer months and confirms the school's 10-month operation.

Figure 9 - Electric Usage & Demand

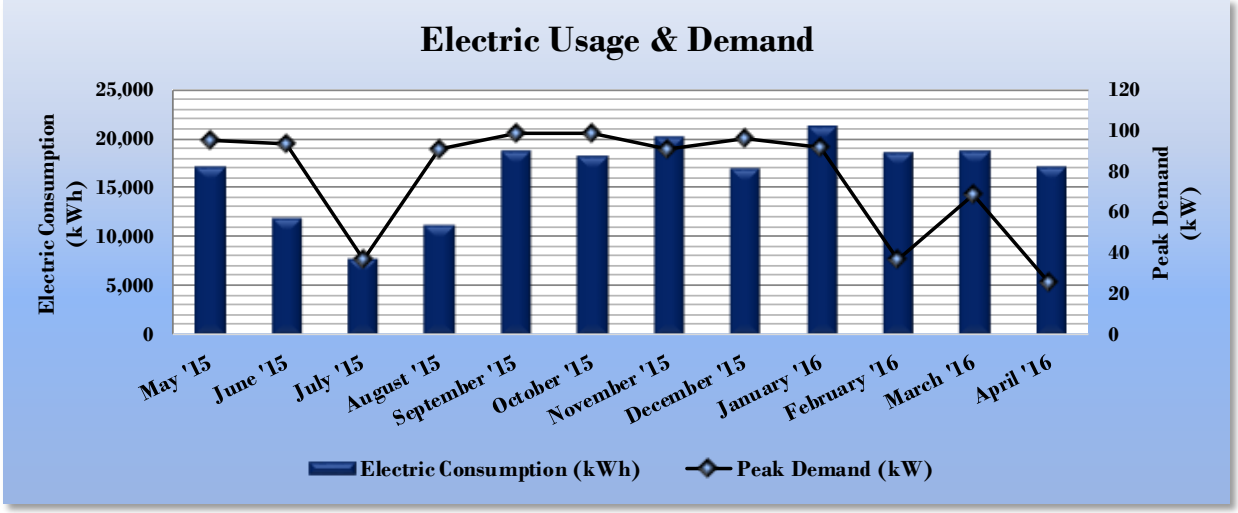


Figure 10 - Electric Usage & Demand

Electric Billing Data for Nishuane School						
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost	TRC Estimated Usage?
6/12/15	30	17,220	95	$413	$3,513	No
7/14/15	31	11,910	93	$405	$2,768	No
8/13/15	30	7,710	37	$160	$1,486	No
9/14/15	30	11,130	91	$432	$2,697	No
10/14/15	31	18,720	99	$431	$2,755	No
11/15/15	30	18,210	99	$431	$2,681	No
12/15/15	30	20,260	91	$398	$2,884	No
1/14/16	31	17,040	96	$418	$2,387	No
2/13/16	31	21,180	92	$402	$2,804	No
3/15/16	31	18,540	36	$159	$2,278	No
4/12/16	29	18,840	69	$414	$2,567	Yes
5/14/16	31	17,130	25	$111	$2,327	Yes
Totals	**365**	**197,890**	**98.7**	**$4,172**	**$31,146**	2
Annual	**365**	**197,890**	**98.7**	**$4,172**	**$31,146**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.823/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 11 - Natural Gas Usage

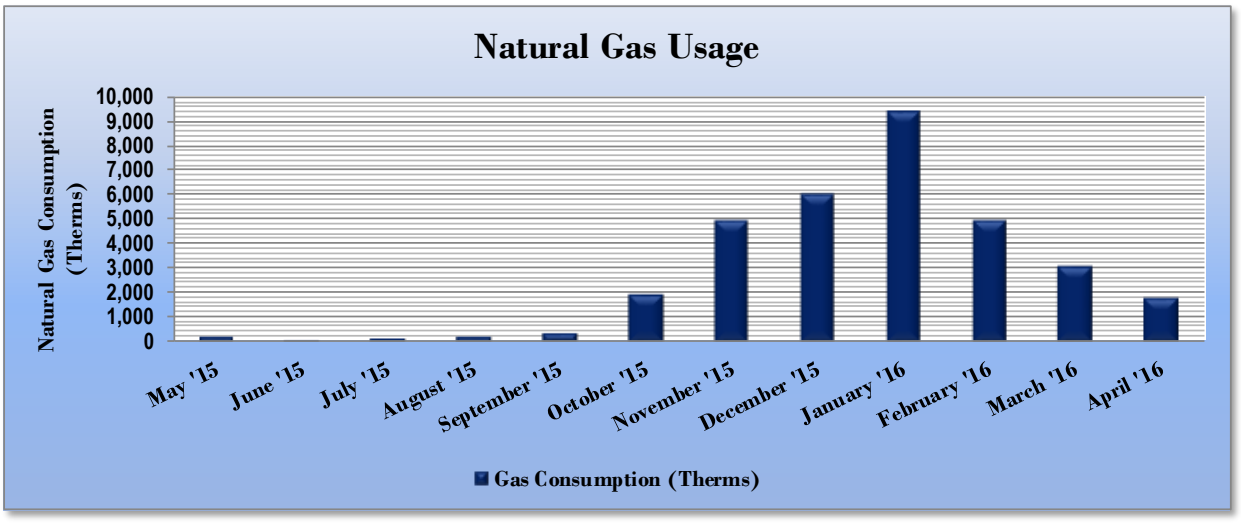


Figure 12 - Natural Gas Usage

Gas Billing Data for Nishuane School				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/12/15	30	218	$103	Yes
7/14/15	31	128	$104	Yes
8/13/15	30	190	$101	Yes
9/14/15	30	254	$136	Yes
10/14/15	31	388	$640	No
11/15/15	30	1,999	$2,289	No
12/15/15	30	4,960	$4,224	No
1/14/16	31	6,045	$5,283	No
2/13/16	31	9,434	$6,959	No
3/15/16	31	4,981	$4,670	No
4/12/16	29	3,134	$1,799	No
5/14/16	31	1,823	$1,308	No
Totals	**365**	**33,552**	**$27,617**	4
Annual	**365**	**33,552**	**$27,617**	

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the Energy Use Intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Nishuane School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	64.5	141.4
Site Energy Use Intensity (kBtu/ft^2)	46.1	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Nishuane School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	51.9	141.4
Site Energy Use Intensity (kBtu/ft^2)	41.2	58.2

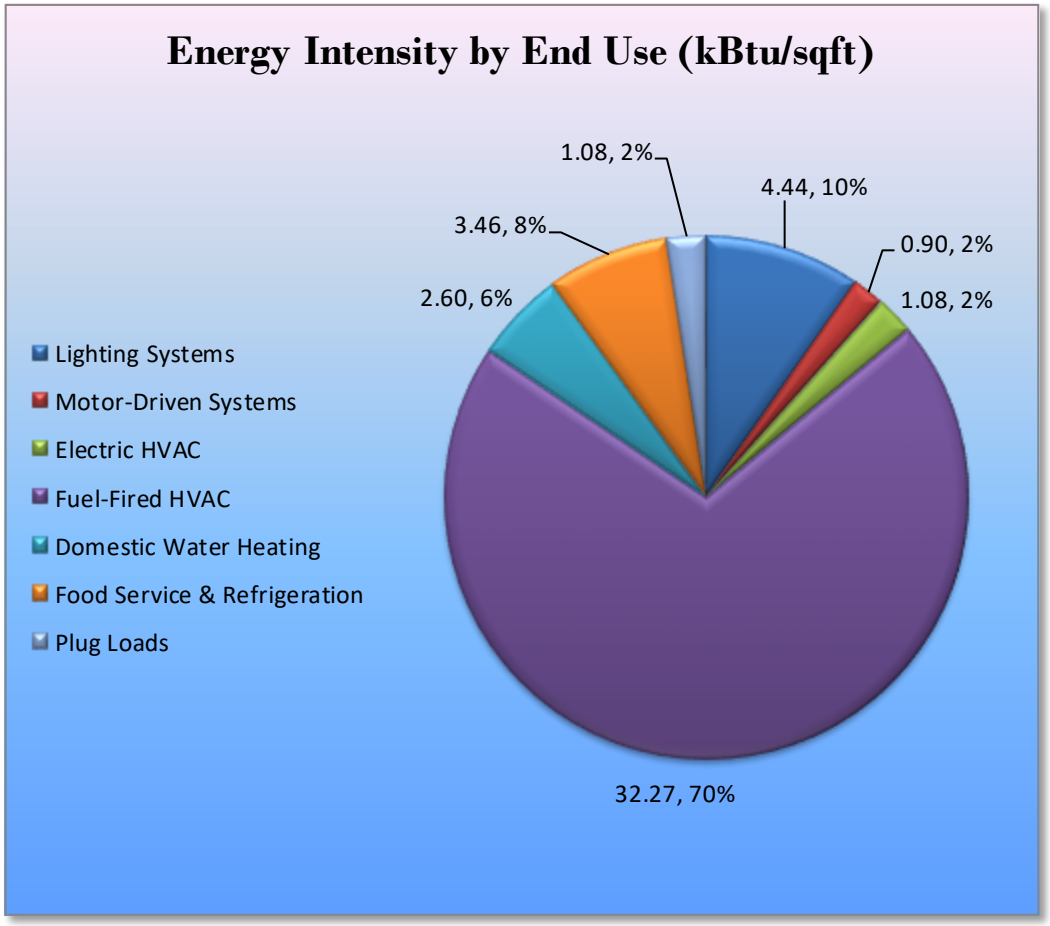
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 86.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 15 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the Nishuane School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based on the NJCEP prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**74,741**	**29.4**	**0.0**	**$10,187.54**	**$88,999.19**	**$12,230.00**	**$76,769.19**	**7.54**	**75,264**
ECM 1	Install LED Fixtures	18,852	5.5	0.0	$2,569.58	$22,808.47	$1,340.00	$21,468.47	8.35	18,984
ECM 2	Retrofit Fixtures with LED Lamps	53,955	23.8	0.0	$7,354.32	$63,609.40	$10,890.00	$52,719.40	7.17	54,332
ECM 3	Install LED Exit Signs	1,934	0.1	0.0	$263.64	$2,581.32	$0.00	$2,581.32	9.79	1,948
Lighting Control Measures		**12,879**	**5.6**	**0.0**	**$1,755.52**	**$14,110.00**	**$1,535.00**	**$12,575.00**	**7.16**	**12,969**
ECM 4	Install Occupancy Sensor Lighting Controls	10,575	4.6	0.0	$1,441.40	$9,910.00	$1,535.00	$8,375.00	5.81	10,649
ECM 5	Install High/Low Lighitng Controls	2,305	1.0	0.0	$314.12	$4,200.00	$0.00	$4,200.00	13.37	2,321
Motor Upgrades		**1,901**	**1.6**	**0.0**	**$259.16**	**$2,933.28**	**$0.00**	**$2,933.28**	**11.32**	**1,915**
ECM 6	Premium Efficiency Motors	1,901	1.6	0.0	$259.16	$2,933.28	$0.00	$2,933.28	11.32	1,915
Domestic Water Heating Upgrade		**0**	**0.0**	**120.7**	**$993.49**	**$207.93**	**$0.00**	**$207.93**	**0.21**	**14,133**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	120.7	$993.49	$207.93	$0.00	$207.93	0.21	14,133
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$219.70**	**$718.80**	**$0.00**	**$718.80**	**3.27**	**1,623**
ECM 8	Vending Machine Control	1,612	0.0	0.0	$219.70	$718.80	$0.00	$718.80	3.27	1,623
TOTALS		**91,134**	**36.7**	**120.7**	**$13,415.41**	**$106,969.20**	**$13,765.00**	**$93,204.20**	**6.95**	**105,904**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting upgrades are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**74,741**	**29.4**	**0.0**	**$10,187.54**	**$88,999.19**	**$12,230.00**	**$76,769.19**	**7.54**	**75,264**
ECM 1	Install LED Fixtures	18,852	5.5	0.0	$2,569.58	$22,808.47	$1,340.00	$21,468.47	8.35	18,984
ECM 2	Retrofit Fixtures with LED Lamps	53,955	23.8	0.0	$7,354.32	$63,609.40	$10,890.00	$52,719.40	7.17	54,332
ECM 3	Install LED Exit Signs	1,934	0.1	0.0	$263.64	$2,581.32	$0.00	$2,581.32	9.79	1,948

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	10,037	4.3	0.0	$1,368.09	$18,901.70	$340.00	$18,561.70	13.57	10,107
Exterior	8,815	1.1	0.0	$1,201.49	$3,906.77	$1,000.00	$2,906.77	2.42	8,876

Measure Description

This measure evaluates replacing existing fixtures containing metal halide lamps and halogen incandescent spot luminaire with new high-performance LED light fixtures. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	53,955	23.8	0.0	$7,354.32	$63,609.40	$10,890.00	$52,719.40	7.17	54,332
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent lamps with LED tube lamps and replacing incandescent and compact fluorescent lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in/plug-in LED lamps can be used as a direct replacement for most other screw-in/plug-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,934	0.1	0.0	$263.64	$2,581.32	$0.00	$2,581.32	9.79	1,948
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing incandescent lighting in exit signs with LEDs. LED sources require virtually no maintenance and LED exit signs have a life expectancy of at least 20 years. Many manufacturers can provide retrofit kits that meet fire and safety code requirements. Retrofit kits are less expensive and simpler to install than replacement signs, however, new fixtures would have a longer useful life and are therefore recommended.

A reduction in maintenance costs will be realized with the proposed retrofit because lamps will not have to be replaced as frequently.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**12,879**	**5.6**	**0.0**	**$1,755.52**	**$14,110.00**	**$1,535.00**	**$12,575.00**	**7.16**	**12,969**
ECM 4	Install Occupancy Sensor Lighting Controls	10,575	4.6	0.0	$1,441.40	$9,910.00	$1,535.00	$8,375.00	5.81	10,649
ECM 5	Install High/Low Lighitng Controls	2,305	1.0	0.0	$314.12	$4,200.00	$0.00	$4,200.00	13.37	2,321

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
10,575	4.6	0.0	$1,441.40	$9,910.00	$1,535.00	$8,375.00	5.81	10,649

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in restrooms, storage rooms, classrooms and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,305	1.0	0.0	$314.12	$4,200.00	$0.00	$4,200.00	13.37	2,321

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are interior corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high-level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period.

For this application the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.1.3 Motor Upgrades

Our recommendations for motor upgrade measures are summarized in Figure 19 below.

Figure 19 - Summary of Motor Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**1,901**	**1.6**	**0.0**	**$259.16**	**$2,933.28**	**$0.00**	**$2,933.28**	**11.32**	**1,915**
ECM 6	Premium Efficiency Motors	1,901	1.6	0.0	$259.16	$2,933.28	$0.00	$2,933.28	11.32	1,915

ECM 6: Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,901	1.6	0.0	$259.16	$2,933.28	$0.00	$2,933.28	11.32	1,915

Measure Description

This measure evaluates replacing the 5 hp air handler supply fan and the three 5 hp boiler feed pump standard efficiency motors with EISA 2007 efficiency motors. The evaluation assumes existing motors will be replaced with the same size motors. It is important that the speed of each new motor match the speed of the motor it replaces as closely as possible. The base case motor efficiencies are obtained from nameplate information. Proposed case premium motor efficiencies are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the annual operating hours.

4.1.4 Domestic Water Heating Upgrade

Our recommendations for domestic water heating measures are summarized in Figure 20 below.

Figure 20 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**120.7**	**$993.49**	**$207.93**	**$0.00**	**$207.93**	**0.21**	**14,133**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	120.7	$993.49	$207.93	$0.00	$207.93	0.21	14,133

ECM 7: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	120.7	$993.49	$207.93	$0.00	$207.93	0.21	14,133

Measure Description

This measure evaluates the savings from installing low flow domestic water devices to reduce overall water flow in general and hot water flow in particular. Low flow faucet aerators reduce the water flow, relative to standard aerators, from the fixture.

All of the low flow devices reduce the overall water flow from the fixture which generally reduces the amount of hot water used resulting in energy and water savings.

4.1.5 Plug Load Equipment Control - Vending Machine

Our recommendations for plug load equipment control measures are summarized in Figure 21 below.

Figure 21 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$219.70**	**$718.80**	**$0.00**	**$718.80**	**3.27**	**1,623**
ECM 8	Vending Machine Control	1,612	0.0	0.0	$219.70	$718.80	$0.00	$718.80	3.27	1,623

ECM 8: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,612	0.0	0.0	$219.70	$718.80	$0.00	$718.80	3.27	1,623

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor based controls to reduce the energy use. These controls power down the machine when the surrounding area is vacant, then monitor the surrounding temperature and power up the cooling system at regular intervals to keep the product cool. Savings are a function of the activity level around the vending machine.

4.2 ECM Evaluated but Not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 22 – Summary of Evaluated but Not Recommended ECM

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**44.9**	**$369.56**	**$122,929.93**	**$6,614.00**	**$116,315.93**	**314.74**	**5,257**
Install High Efficiency Steam Boilers	0	0.0	44.9	$369.56	$122,929.93	$6,614.00	$116,315.93	314.74	5,257
TOTALS	**0**	**0.0**	**44.9**	**$369.56**	**$122,929.93**	**$6,614.00**	**$116,315.93**	**314.74**	**5,257**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install High Efficiency Steam Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	44.9	$369.56	$122,929.93	$6,614.00	$116,315.93	314.74	5,257

Measure Description

This measure evaluates replacing old inefficient steam boilers with high efficiency steam boilers. Significant improvements have been made in combustion technology resulting in increases in overall boiler efficiency. Savings result from improved combustion efficiency and reduced standby losses at low loads. The school should consider re-evaluating the building heating load and installing modular steam boilers when these are replaced.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended based on energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost-effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Perform Routine Motor Maintenance

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gpf and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.4 for any low-flow ECM recommendations.

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

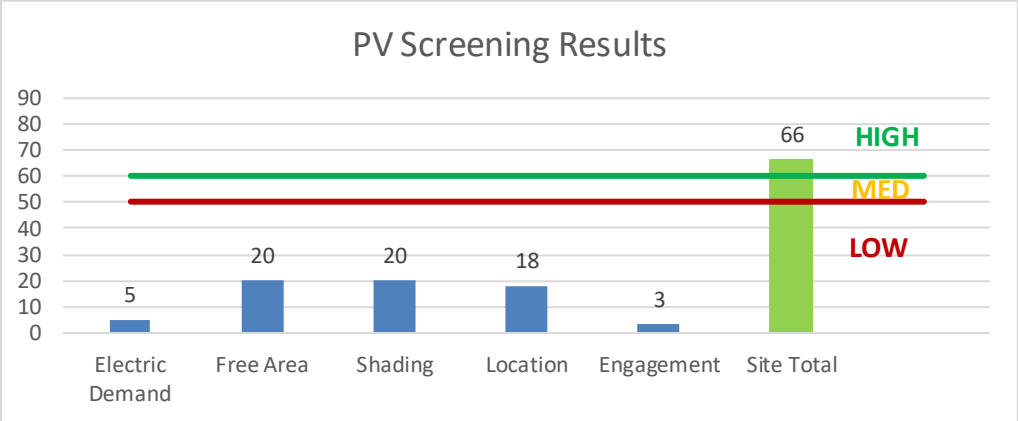
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear meet these minimum criteria for cost-effective PV installation.

Figure 23 - Photovoltaic Screening



Potential	High	
System Potential	77	kW DC STC
Electric Generation	91,736	kWh/yr
Displaced Cost	$7,980	/yr
Installed Cost	$200,200	

Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

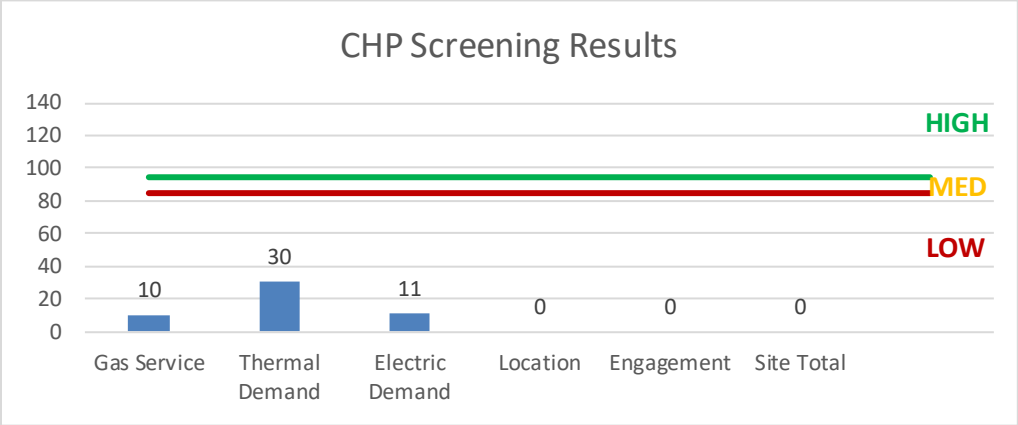
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 24 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

In our opinion, the facility is not a good candidate for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 25 for a list of the eligible programs identified for each recommended ECM.

Figure 25 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x		x			
ECM 2	Retrofit Fixtures with LED Lamps	x		x			
ECM 3	Install LED Exit Signs			x			
ECM 4	Install Occupancy Sensor Lighting Controls	x		x			
ECM 5	Install High/Low Lighitng Controls			x			
ECM 6	Premium Efficiency Motors			x			
ECM 7	Install Low-Flow Domestic Hot Water Devices			x			
ECM 8	Vending Machine Control			x			

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to mid-sized facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and install those measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor assigned to the county where your facility is located; a complete list is provided on the Direct Install website identified below. The contractor will be paid the program incentive directly which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps mentioned above, and the remaining 30% of the cost is your responsibility to the contractor.

Since Direct Install offers a free assessment, LGEA applicants that do not meet the audit program eligibility requirements, but do meet the Direct Install requirements, may be moved directly into this program.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
2nd Floor Main Hallway	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	25	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	924	1.20	2,786	0.0	$379.68	$3,178.33	$500.00	7.05
2nd Floor Main Hallway	4	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	322	0.0	$43.94	$430.22	$0.00	9.79
Room 201	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.66	1,519	0.0	$207.08	$1,944.00	$310.00	7.89
Room 202	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 202	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 203A	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.16	380	0.0	$51.77	$467.00	$80.00	7.48
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.66	$117.00	$20.00	7.10
Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.66	$117.00	$20.00	7.10
Room 203	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 203	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 204	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.52	1,203	0.0	$163.93	$1,227.50	$210.00	6.21
Room 204	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 205	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 205	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 206	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 206	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 207	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 207	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 208	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.41	950	0.0	$129.42	$993.50	$170.00	6.36
Room 208	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 209	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.41	950	0.0	$129.42	$993.50	$170.00	6.36
Room 209	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 210	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 210	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 211	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.66	1,519	0.0	$207.08	$1,674.00	$275.00	6.76

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 211A	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,320	0.07	170	0.0	$23.17	$190.27	$40.00	6.48
Room 212	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 213	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 214	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 215	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.44	1,013	0.0	$138.05	$1,052.00	$180.00	6.32
Room 215	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 216	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 217	6	Linear Fluorescent - T5: 4' T5 (28W) - 1L	Wall Switch	30	1,320	Relamp	Yes	6	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	924	0.08	181	0.0	$24.64	$331.40	$50.00	11.42
Auditorium	4	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	322	0.0	$43.94	$430.22	$0.00	9.79
Auditorium	38	Incandescent: 60W A Lamp	Wall Switch	60	1,320	Relamp	No	38	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,320	1.27	2,942	0.0	$400.99	$2,042.61	$380.00	4.15
Stage	105	Compact Fluorescent: 32W CFL	Wall Switch	32	1,320	Fixture Replacement	No	105	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	22	1,320	0.66	1,530	0.0	$208.57	$6,683.36	$0.00	32.04
Stage	6	Halogen Incandescent: 575W Flood Light	Wall Switch	575	1,320	Fixture Replacement	No	6	LED - Fixtures: Architectural Flood/Spot Luminaire	Wall Switch	85	1,320	1.93	4,463	0.0	$608.32	$7,349.71	$300.00	11.59
1st Floor Room 101	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 100	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.16	380	0.0	$51.77	$467.00	$80.00	7.48
Room 102	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.68	1,583	0.0	$215.70	$2,002.50	$320.00	7.80
Room 102	2	Compact Fluorescent: 23W CFL	Wall Switch	23	1,320	Relamp	No	2	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	1,320	0.01	21	0.0	$2.86	$127.30	$0.00	44.58
Hallway	25	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,320	Relamp	Yes	25	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	924	1.20	2,786	0.0	$379.68	$3,178.33	$500.00	7.05
Hallway	4	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	322	0.0	$43.94	$430.22	$0.00	9.79
Closet	1	Compact Fluorescent: 23W CFL	Wall Switch	23	180	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	180	0.00	1	0.0	$0.19	$63.65	$0.00	326.94
Main Office	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.46	1,076	0.0	$146.68	$1,110.50	$190.00	6.28
Main Office	3	Compact Fluorescent: 23W CFL	Wall Switch	23	1,320	Relamp	No	3	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	1,320	0.01	31	0.0	$4.28	$190.95	$0.00	44.58
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.83	$58.50	$10.00	7.10
Nurse Room	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.46	1,076	0.0	$146.68	$1,110.50	$190.00	6.28
Data Center	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.66	$117.00	$20.00	7.10
Room 104	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 104	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 105	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 105	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 106	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room 107	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,320	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	924	0.08	190	0.0	$25.88	$266.40	$50.00	8.36
Room 108	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$181.19	$1,498.50	$245.00	6.92
Room 108	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Closet	1	Compact Fluorescent: 23W CFL	Wall Switch	23	180	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	180	0.00	1	0.0	$0.19	$63.65	$0.00	326.94
Boys Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.83	$58.50	$10.00	7.10
Room 109	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.66	1,519	0.0	$207.08	$1,674.00	$275.00	6.76
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.04	100	0.0	$13.66	$117.00	$20.00	7.10
Teacher Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.11	253	0.0	$34.51	$350.00	$60.00	8.40
Room 110	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.44	1,013	0.0	$138.05	$1,052.00	$180.00	6.32
Room 111	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.44	1,013	0.0	$138.05	$1,052.00	$180.00	6.32
Room 111	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53
Room 112	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Gym Office	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.14	317	0.0	$43.14	$408.50	$70.00	7.85
Gymnasium	8	Metal Halide: (1) 400W Lamp	Wall Switch	458	1,320	Fixture Replacement	Yes	8	LED - Fixtures: Downlight Pendant	Occupancy Sensor	125	924	1.94	4,499	0.0	$613.28	$6,628.64	$320.00	10.29
Gymnasium	2	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$21.97	$215.11	$0.00	9.79
Ground Floor Custodian Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.01	27	0.0	$3.62	$35.90	$5.00	8.53
Custodian	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	540	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	378	0.19	181	0.0	$24.71	$525.50	$90.00	17.63
Custodian	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	540	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	540	0.04	35	0.0	$4.74	$95.13	$20.00	15.85
Custodian	3	Incandescent: 60W A Lamp	Wall Switch	60	540	Relamp	Yes	3	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	378	0.11	100	0.0	$13.64	$277.26	$50.00	16.67
Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	180	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	180	0.04	14	0.0	$1.86	$117.00	$20.00	52.09
Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	180	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	180	0.02	7	0.0	$0.99	$71.80	$10.00	62.58

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Art Room	36	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	36	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.98	2,279	0.0	$310.61	$2,338.00	$400.00	6.24
Dance Room	29	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.79	1,836	0.0	$250.22	$1,928.50	$330.00	6.39
Adult Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.83	$58.50	$10.00	7.10
Dance Room Office	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.33	760	0.0	$103.54	$818.00	$140.00	6.55
Hallway	8	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	8	LED Exit Signs: 2 W Lamp	None	6	8,760	0.04	645	0.0	$87.88	$860.44	$0.00	9.79
Hallway	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	26	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	924	0.71	1,646	0.0	$224.33	$2,321.00	$260.00	9.19
Hallway	13	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	Yes	13	LED - Linear Tubes: (1) 4' Lamp	High/Low Control	15	924	0.19	431	0.0	$58.77	$866.70	$65.00	13.64
Hallway	1	Incandescent: 60W A Lamp	Wall Switch	60	1,320	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,320	0.03	77	0.0	$10.55	$53.75	$10.00	4.15
Book Room	2	Compact Fluorescent: 23W CFL	Wall Switch	23	1,320	Relamp	No	2	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	1,320	0.01	21	0.0	$2.86	$127.30	$0.00	44.58
Book Room	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.22	506	0.0	$69.03	$584.00	$100.00	7.01
Storage	1	Compact Fluorescent: 23W CFL	Wall Switch	23	180	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	180	0.00	1	0.0	$0.19	$63.65	$0.00	326.94
Room B6	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$181.19	$1,498.50	$245.00	6.92
Room B5	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.57	1,329	0.0	$181.19	$1,498.50	$245.00	6.92
Room B11A	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Room B11	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.49	1,139	0.0	$155.31	$1,169.00	$200.00	6.24
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	180	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	180	0.04	14	0.0	$1.86	$117.00	$20.00	52.09
Storage	5	Compact Fluorescent: 23W CFL	Wall Switch	23	180	Relamp	No	5	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	16	180	0.02	7	0.0	$0.97	$318.25	$0.00	326.94
Technology Room	32	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	32	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.87	2,026	0.0	$276.10	$2,412.00	$390.00	7.32
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.02	50	0.0	$6.83	$58.50	$10.00	7.10
Boys Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.11	253	0.0	$34.51	$504.00	$75.00	12.43
Girls Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.11	253	0.0	$34.51	$504.00	$75.00	12.43
Cafeteria	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,320	Relamp	No	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,320	0.43	1,002	0.0	$136.56	$1,170.00	$200.00	7.10
Room B12	19	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	62	1,320	Relamp	No	19	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,320	0.41	952	0.0	$129.73	$1,111.50	$190.00	7.10
Room B13	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	924	0.38	886	0.0	$120.79	$935.00	$160.00	6.42
Kitchen	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,320	0.13	301	0.0	$40.97	$351.00	$60.00	7.10

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Compressor Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	180	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	180	0.02	7	0.0	$0.93	$58.50	$10.00	52.09
Boiler Room	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	540	Relamp	No	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	540	0.32	307	0.0	$41.90	$877.50	$150.00	17.36
Boiler Room	2	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$21.97	$215.11	$0.00	9.79
Fan Room	2	Incandescent: 60W A Lamp	Wall Switch	60	1,320	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,320	0.07	155	0.0	$21.10	$107.51	$20.00	4.15
School Stairwells	42	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,320	Relamp	Yes	42	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	924	1.15	2,659	0.0	$362.38	$3,857.00	$420.00	9.48
Elevator Room	1	Incandescent: 60W A Lamp	Wall Switch	60	180	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	180	0.03	11	0.0	$1.44	$53.75	$10.00	30.41
Parking Lot pole Lighting	4	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,380	Fixture Replacement	No	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	75	4,380	0.58	4,433	0.0	$604.18	$1,562.71	$400.00	1.92
Perimeter Light	6	Metal Halide: (1) 150W Lamp	Daylight Dimming	190	4,380	Fixture Replacement	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	45	4,380	0.57	4,382	0.0	$597.31	$2,344.06	$600.00	2.92
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	1,320	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,320	0.02	53	0.0	$7.24	$71.80	$10.00	8.53

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Air Compressor	1	Air Compressor	1.5	82.0%	No	540	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boiler	1	Combustion Air Fan	0.8	79.0%	No	650	No	79.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers	3	Boiler Feed Water Pump	5.0	80.5%	No	780	Yes	86.5%	No		0.71	564	0.0	$76.88	$2,132.91	$0.00	27.74
Elevator Room	Elevator Room	1	Other	20.0	91.0%	No	650	No	91.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Fan Roon	Fan Roon	1	Supply Fan	5.0	69.0%	No	1,440	Yes	89.5%	No		0.92	1,337	0.0	$182.27	$800.37	$0.00	4.39
Boiler Room	Boiler	1	Combustion Air Fan	0.8	79.0%	No	200	No	79.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 201	Room 201	1	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top	Room 217	1	Split-System AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 203A	Room 203A	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 213	Room 213	1	Window AC	0.58		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main office	Main office	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main office	Main office	1	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse Office	Nurse Office	1	Window AC	0.66		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse Office	Nurse Office	1	Window AC	1.17		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 104	Room 104	2	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 106	Room 106	2	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 107-Library	Room 107-Library	3	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teacher Room	Teacher Room	1	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 110	Room 110	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 111, 112	Room 111, 112	2	Window AC	1.23		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 112	Room 112	1	Window AC	1.23		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Dance Room	Dance Room	1	Window AC	1.23		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room B6,B12	Room B6,B12	2	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Tech Room	Tech Room	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room B11A	Room B11A	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room B11	Room B11	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Forced Draft Steam Boiler	3,307.00	Yes	2	Forced Draft Steam Boiler	3,307.00	82.40%	Et	0.00	0	44.9	$369.56	$122,929.93	$6,614.00	314.74

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	3	Faucet Aerator (Kitchen)	3.00	2.20	0.00	0	8.6	$70.96	$21.51	$0.00	0.30
School	26	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	112.1	$922.53	$186.42	$0.00	0.20

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Stand-Up Refrigerator, Glass Door (>50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Yes	No	0.00	0	0.0	$0.00	$2,878.43	$300.00	0.00
Kitchen	1	Gas Rack Oven (Double)	Yes	No	0.00	0	0.0	$0.00	$9,290.04	$2,000.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	68	Desktop Computer with LCD Monitor	205.0	Yes
School	4	Copy Machine	850.0	Yes
School	3	Printer	460.0	Yes
School	5	Microwave	1,000.0	No
Teacher Room	1	Refrigerator	250.0	No
Teacher Room	1	Refrigerator	250.0	No
Custodian Room	1	Refrigerator	250.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teacher Room	1	Refrigerated	Yes	0.00	1,612	0.0	$219.70	$718.80	$0.00	3.27

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Nishuane Elementary School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 87,440
Built: 1908

For Year Ending: April 30, 2016
Date Generated: December 20, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Nishuane Elementary School 32 Cedar Avenue Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5730319

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
44.4 kBtu/ft²

Source EUI
62.7 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	672,347 (17%)
Natural Gas (kBtu)	3,207,913 (83%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	65.4
National Median Source EUI (kBtu/ft²)	92.4
% Diff from National Median Source EUI	-32%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	245

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Northeast School

Montclair Board of Education

603 Grove Street

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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Appendix A: Equipment Inventory & Recommendations

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Northeast School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey school districts in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

The Northeast School is a three-story building totaling 56,549 square feet, originally constructed in 1935. The building has a flat and pitched roof sections. Exterior walls are finished with stone blocks, masonry brick and concrete façade. Interior lighting is provided mainly by 32-Watt linear fluorescent T8 fixtures which are mostly controlled by manual wall switches. Heating is provided by two steam boilers and rooftop furnaces. The cooling system consists of window air conditioners (ACs), split system ACs and rooftop packaged units.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated 13 measures. Eight measures were recommended for implementation which together represent an opportunity for Northeast School to reduce annual energy costs by roughly $15,213 and annual greenhouse gas emissions by 120,163 lbs CO_2e. The measures would pay for themselves in roughly 4.5 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce Northeast School's annual energy use by 23.9%.

Figure 1 – Previous 12 Month Utility Costs

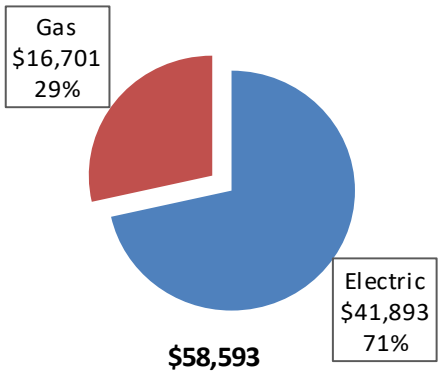
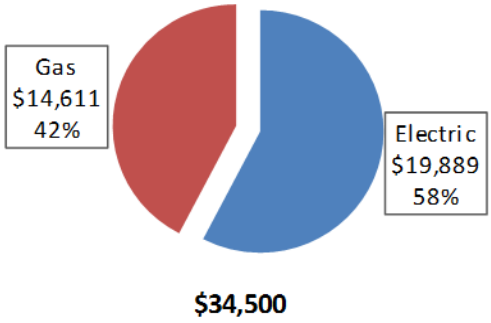


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Northeast School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4. Measures without an "ECM #" in the table below have been evaluated, but are not recommended for implementation.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**81,330**	**23.4**	**0.0**	**$10,792.69**	**$64,690.58**	**$9,450.00**	**$55,240.58**	**5.12**	**81,899**
ECM 1	Install LED Fixtures	Yes	14,553	3.5	0.0	$1,931.16	$14,906.34	$800.00	$14,106.34	7.30	14,654
ECM 2	Retrofit Fixtures with LED Lamps	Yes	65,649	19.9	0.0	$8,711.80	$48,278.47	$8,650.00	$39,628.47	4.55	66,108
ECM 3	Install LED Exit Signs	Yes	1,128	0.1	0.0	$149.73	$1,505.77	$0.00	$1,505.77	10.06	1,136
Lighting Control Measures			**14,651**	**4.4**	**0.0**	**$1,944.29**	**$11,334.00**	**$1,585.00**	**$9,749.00**	**5.01**	**14,754**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	13,200	3.9	0.0	$1,751.66	$9,734.00	$1,585.00	$8,149.00	4.65	13,292
ECM 5	Install High/Low Lighitng Controls	Yes	1,452	0.4	0.0	$192.63	$1,600.00	$0.00	$1,600.00	8.31	1,462
Variable Frequency Drive (VFD) Measures			**2,021**	**1.0**	**0.0**	**$268.21**	**$6,015.30**	**$0.00**	**$6,015.30**	**22.43**	**2,035**
	Install VFDs on Hot Water Pumps	No	2,021	1.0	0.0	$268.21	$6,015.30	$0.00	$6,015.30	22.43	2,035
Electric Unitary HVAC Measures			**17,182**	**13.5**	**0.0**	**$2,280.11**	**$97,008.17**	**$5,080.50**	**$91,927.67**	**40.32**	**17,302**
	Install High Efficiency Electric AC	No	17,182	13.5	0.0	$2,280.11	$97,008.17	$5,080.50	$91,927.67	40.32	17,302
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**117.2**	**$1,062.45**	**$109,206.70**	**$6,832.00**	**$102,374.70**	**96.36**	**13,725**
	Install High Efficiency Steam Boilers	No	0	0.0	102.5	$929.18	$97,243.63	$5,232.00	$92,011.63	99.02	12,003
	Install High Efficiency Furnaces	No	0	0.0	14.7	$133.28	$11,963.07	$1,600.00	$10,363.07	77.76	1,722
HVAC System Improvements			**9,165**	**2.1**	**0.0**	**$1,216.23**	**$2,900.00**	**$1,000.00**	**$1,900.00**	**1.56**	**9,229**
ECM 6	Install Dual Enthalpy Outside Economizer Control	Yes	9,165	2.1	0.0	$1,216.23	$2,900.00	$1,000.00	$1,900.00	1.56	9,229
Domestic Water Heating Upgrade			**0**	**0.0**	**113.3**	**$1,027.01**	**$4,613.91**	**$150.00**	**$4,463.91**	**4.35**	**13,267**
	Install High Efficiency Gas Water Heater	No	0	0.0	15.6	$141.39	$4,449.00	$150.00	$4,299.00	30.40	1,827
ECM 7	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	97.7	$885.62	$164.91	$0.00	$164.91	0.19	11,441
Plug Load Equipment Control - Vending Machine			**2,821**	**0.0**	**0.0**	**$374.32**	**$1,437.60**	**$0.00**	**$1,437.60**	**3.84**	**2,840**
ECM 8	Vending Machine Control	Yes	2,821	0.0	0.0	$374.32	$1,437.60	$0.00	$1,437.60	3.84	2,840
TOTALS FOR PROPOSED MEASURES			**107,967**	**29.9**	**97.7**	**$15,213.15**	**$80,527.09**	**$12,035.00**	**$68,492.09**	**4.50**	**120,163**
TOTALS FOR ALL MEASURES			**127,170**	**44.4**	**230.5**	**$18,965.32**	**$297,206.26**	**$24,097.50**	**$273,108.76**	**14.40**	**155,052**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Electric Unitary HVAC measures generally involve replacing old inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide cooling equivalent to older air condition systems, but use less energy. These measures save energy by reducing the power used by the air condition system due to improved electrical efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing old inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide heating equivalent to older systems, but use less energy. These measures save energy by reducing the fuel used by the heating due to improved combustion and heat transfer efficiency.

HVAC System Improvements generally involve the installation of automated controls to reduce heating and cooling demand when conditions allow. These measures could encompass changing temperature setpoints, using outside air for free cooling, or limiting excessive outside air during extreme outdoor air temperatures. These measures save energy by reducing the demand on the systems and the amount of time systems operate.

Domestic Water Heating upgrade measures generally involve replacing old inefficient domestic water heating systems with modern energy efficient systems. New domestic water heating systems can provide equivalent or greater capacity as older systems, but use less energy. These measures save energy by reducing the fuel used by the domestic water heating systems due to improved efficiency or the removal of standby losses.

Plug Load Equipment control measures generally involve installing automation that limits the power use or operation of equipment plugged into an electrical receptacle based on occupancy.

Energy Efficient Practices

TRC also identified nine low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at Northeast School include:

- Reduce Air Leakage
- Close Doors and Windows
- Ensure Lighting Controls Are Operating Properly
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for the Northeast School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	90	kW DC STC
Electric Generation	107,224	kWh/yr
Displaced Cost	$9,330	/yr
Installed Cost	$234,000	

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

This facility also qualifies for the Direct Install program which, through an authorized network of participating contractors, can assist with the implementation of a group of measures versus installing individual measures or phasing implementation. This program is designed to be turnkey and will provide an incentive up to 70% of the cost of the project identified by the designated contractor.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	(973) 509-4050
Designated Representative			
Steve Yekel	Custodian		(973) 509-4293
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 09, 2016, TRC performed an energy audit at the Northeast School located in Montclair, New Jersey. TRC's auditor met with Steve Yekel to review the facility operations and focus the investigation on specific energy-using systems.

The 56,549-square foot building is a three-story facility comprised of classrooms, administrative offices, music room, multipurpose room, kitchen, media center, storage and mechanical spaces. The original building was built in 1935, the multipurpose room and additional classrooms were added in 1957. In 2000, a new section was built in the center to accommodate additional classrooms. The building is used primarily for elementary programs.

2.3 Building Occupancy

The school operates on a 10-month schedule and is open Monday through Friday. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 410 students and staff.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Notheast School	Weekday	7:00 AM - 5:30 PM
Notheast School	Weekend	Closed

2.4 Building Envelope



Image 1 – Building Envelope

The three-story building has a reinforced concrete foundation. The original building has a basement. The roofing system consists of a pitched concrete tile roof on the front facing section and perimeter, and a membrane type roof on the back of the building where the HVAC equipment resides. Exterior walls are finished with stone, concrete blocks, and masonry brick. The windows throughout the facility are double paned with aluminum frames which are in good condition and well maintained. Exterior doors are constructed of metal. The door seals were found to be in good condition. Overall, the building's envelope is in good condition.

2.5 On-site Generation

The Northeast School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Interior lighting at the facility is provided mainly by 32-Watt linear fluorescent T8 lamps with electronic ballasts. Most of the fixtures are 2-lamp or 4-lamp, 4-foot long troffers with diffusers. The main portion of the multipurpose room is illuminated with 250-Watt mercury vapor lamps while the stage area has halogen incandescent lamps. The front entrance hallway is lit with a combination of 32-Watt linear fluorescent T8 lamps and 40-Watt candelabra incandescent lamps while the media center is illuminated with compact fluorescent lamps (CFLs) in addition to 32-Watt linear fluorescent T8 lamps. A small number of 60-Watt incandescent screw-in lamps are found in spaces such as storage and closet rooms, Dean's office and some restrooms. Exit signs throughout the facility are primarily provided by incandescent sources. Lighting control is provided mostly by manual wall switches. The facility exterior lighting consists of 150-Watt metal halide and LED wall mounted area fixtures which are controlled with timers.

Steam and Heating Hot Water System

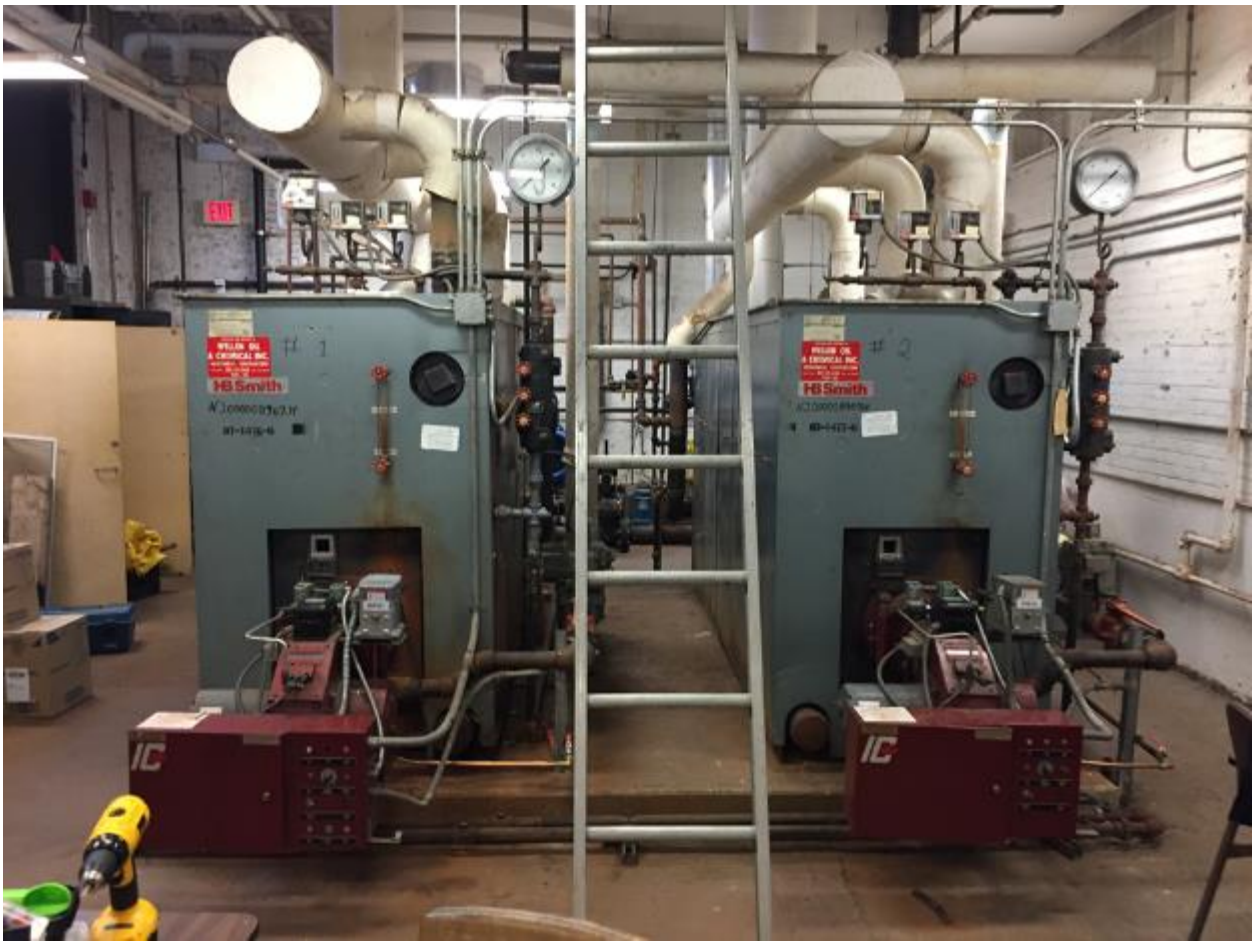


Image 2 – Steam Heating System

The steam system is comprised of two steam boilers and both steam and hot water distribution. Two 2,616 MBh output steam boilers, each with an estimated nominal combustion efficiency of 75%, operate in a lead/lag configuration. The boilers are 30 years old and have passed their useful service life. Each boiler has a 3 hp combustion air fan, a 0.75 hp feed water pump, and a control valve that maintains the boiler water level. Steam is supplied directly to the radiators and heating unit ventilators serving the old wing at 15 psi. Some unit ventilators serving the old section of the building appear in poor condition.

Heating hot water is supplied to unit ventilators located in the newer area through a heat exchanger. Two constant speed 3 hp pumps circulate the heating hot water.

The school should consider re-evaluating the building heating load and installing modular boilers when these are replaced. In addition to the steam system, four rooftop units equipped with gas-fired furnace sections are used to provide supplemental heating to the media center and other spaces. Local thermostats are used to control the temperature in the various zones.

Air Conditioning (DX)



Image 3 – Air Conditioning

Cooling is provided by a combination of window air conditioners (AC), split system ACs, and rooftop packaged units. There are 12 window ACs ranging from 0.8 to 1.5 tons. They are in relatively good condition except the unit serving the main office which appears in poor condition. There are ten Carrier split system ACs which are sized from 2 to 3.5 tons and serve various spaces of the facility. The units utilize a scroll compressor and a direct-expansion (DX) coil. They are all 18 years old, have passed their useful service live and appear in poor condition.

One 12.5-ton Carrier rooftop packaged unit (RTU1) is used to condition the media center. The unit provides constant air volume by utilizing a scroll compressor and a direct-expansion coil. The unit is also equipped with a gas fired furnace section that provides heating as needed. One 2-ton and two 8.5-ton Carrier packaged units (RTU2, RTU7, RTU8), also equipped with gas fired furnace sections, are used to provide cooling and heating to various spaces. The rooftop packaged units are 17 years old and appear in poor condition. Cooling and heating systems used to be controlled by an Automated Logic Corporation control system. The site contact stated that the system was out of service for long before the survey. Air is exhausted from the kitchen and restrooms through roof mounted exhaust fans. The multipurpose room has one exhaust fan located in the fan room.

Domestic Hot Water

Domestic hot water for the facility is provided by two natural gas fired water heaters. A Bradford White non-condensing water heater with an input rating of 76 MBh and a nominal efficiency of 82% has a 75-gallon storage tank and is located in boiler room. This water heater is seven years old and appear in good condition. It serves the old section of the building.

Domestic hot water for the new section consists of one A.O. Smith gas fired non-condensing water heater with an input rating of 75 MBh and an estimated combustion efficiency of 80%. It has a 75-gallon storage tank and is located in the storage room. The heater is 18 years old.





Image 4 – Domestic Hot Water System

Food Service & Refrigeration

The school houses one small kitchen. The kitchen includes gas convection ovens, insulated food holding cabinets, two standup refrigerators and one standup freezer. The kitchen is well maintained.

Plug load & Vending Machines

The building has approximately 48 computers with LCD monitors that are used daily, plus a server, four large photocopiers, and three printers. The computers, monitors, and printers seemed to be all recent models with power management software designed to reduce power when they sit idle for more than a few minutes. The building has two vending machines located in the teacher room.

2.7 Water-Using Systems

There are several restrooms at this facility. A sampling of restrooms found that all of the faucets are rated for 2.2 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf) and the urinals are rated at 2 gpf. The kitchen has one faucet that is rated for 3 gpm.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

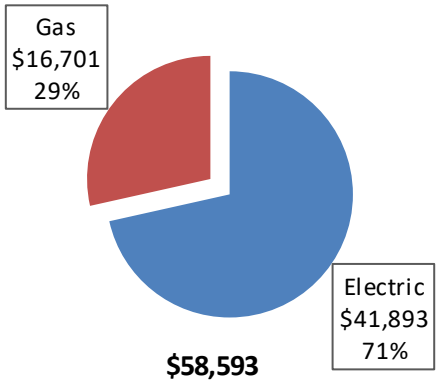
The following energy consumption and cost data is based on the last 12-month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 7 - Utility Summary

Utility Summary for Northeast School		
Fuel	**Usage**	**Cost**
Electricity	274,425 kWh	$41,893
Natural Gas	18,426 Therms	$16,701
Total		**$58,593**

The current utility cost for this site is $58,593 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.133/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects lower occupancy in the summer months, although the building is cooled.

Figure 9 - Electric Usage & Demand

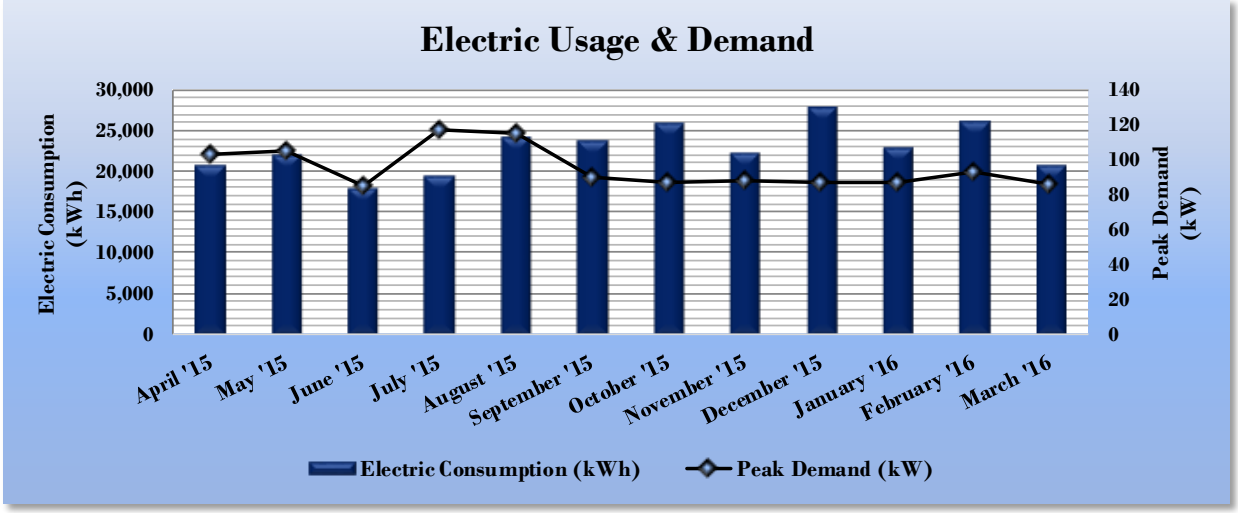


Figure 10 - Electric Usage & Demand

Electric Billing Data for Northeast School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
5/1/15	31	20,850	103	$404	$4,164
6/1/15	30	22,125	105	$850	$4,291
7/1/15	31	18,000	85	$469	$3,441
8/1/15	31	19,500	117	$456	$4,014
9/1/15	30	24,150	116	$368	$3,501
10/1/15	31	23,775	90	$509	$3,330
11/1/15	30	25,875	87	$504	$3,490
12/1/15	31	22,275	88	$393	$2,956
1/1/16	31	27,825	87	$380	$3,534
2/1/16	28	22,950	87	$383	$3,004
3/1/16	31	26,250	93	$380	$3,408
4/1/16	30	20,850	86	$382	$2,760
Totals	**365**	**274,425**	**117**	**$5,476**	**$41,893**
Annual	**365**	**274,425**	**117**	**$5,476**	**$41,893**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.906/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 11 - Natural Gas Usage

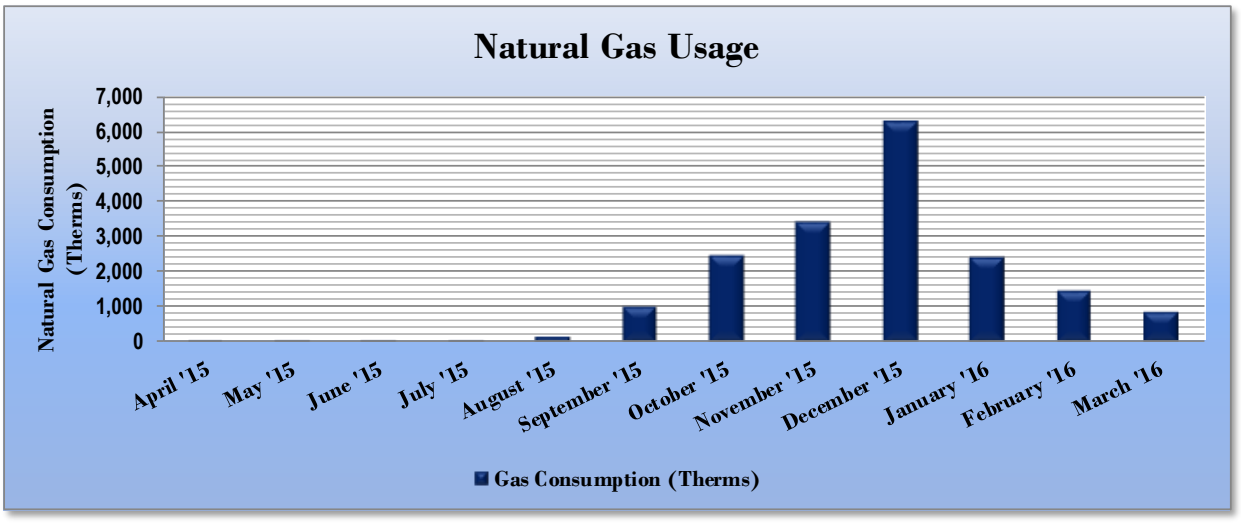


Figure 12 - Natural Gas Usage

Gas Billing Data for Northeast School			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
5/1/15	31	84	$150
6/1/15	30	66	$140
7/1/15	31	54	$133
8/1/15	31	43	$129
9/1/15	30	170	$199
10/1/15	31	1,030	$1,738
11/1/15	30	2,489	$2,624
12/1/15	31	3,442	$3,203
1/1/16	31	6,283	$4,622
2/1/16	28	2,415	$2,277
3/1/16	31	1,472	$903
4/1/16	30	878	$582
Totals	**365**	**18,426**	**$16,701**
Annual	**365**	**18,426**	**$16,701**

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the Energy Use Intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Northeast School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	86.2	141.4
Site Energy Use Intensity (kBtu/ft^2)	49.1	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Northeast School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	63.9	141.4
Site Energy Use Intensity (kBtu/ft^2)	40.9	58.2

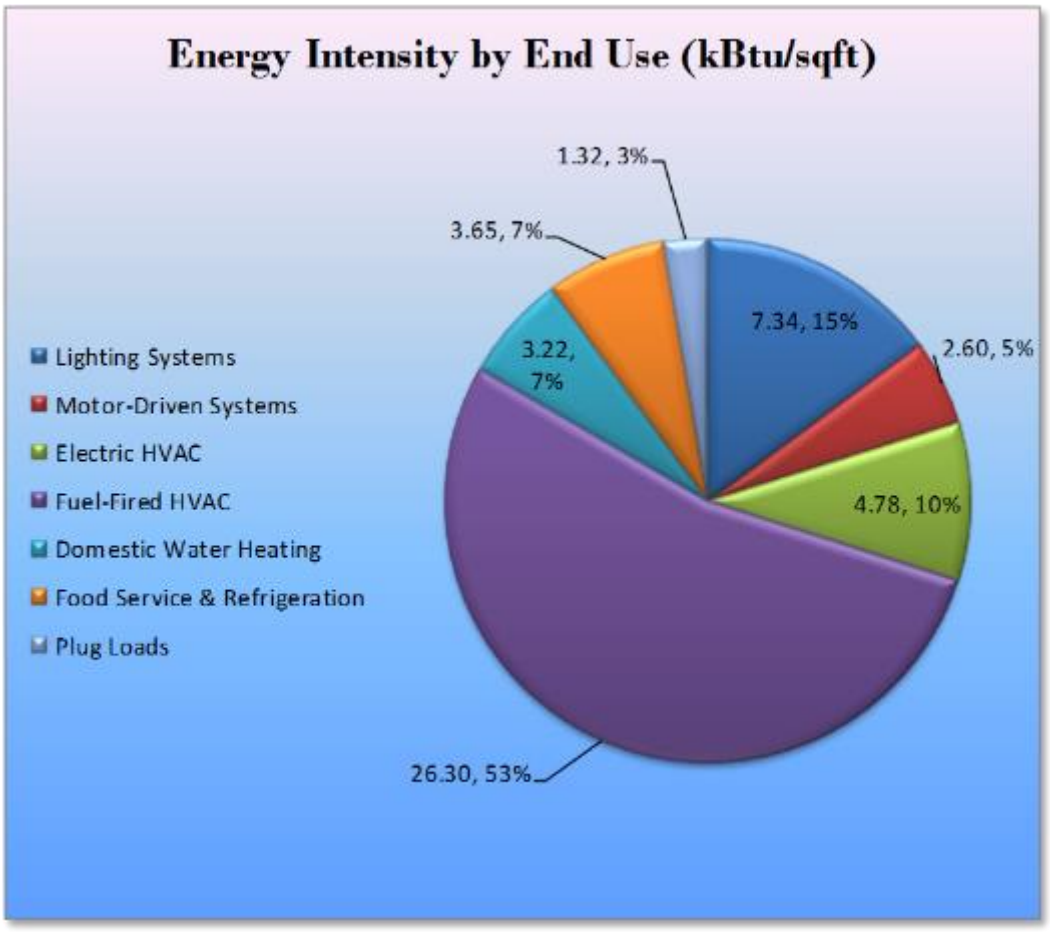
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 76.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 15 - Energy Balance (% and kBtu/SF)



4 Energy Conservation Measures

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the Northeast School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJ prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**81,330**	**23.4**	**0.0**	**$10,792.69**	**$64,690.58**	**$9,450.00**	**$55,240.58**	**5.12**	**81,899**
ECM 1	Install LED Fixtures	14,553	3.5	0.0	$1,931.16	$14,906.34	$800.00	$14,106.34	7.30	14,654
ECM 2	Retrofit Fixtures with LED Lamps	65,649	19.9	0.0	$8,711.80	$48,278.47	$8,650.00	$39,628.47	4.55	66,108
ECM 3	Install LED Exit Signs	1,128	0.1	0.0	$149.73	$1,505.77	$0.00	$1,505.77	10.06	1,136
Lighting Control Measures		**14,651**	**4.4**	**0.0**	**$1,944.29**	**$11,334.00**	**$1,585.00**	**$9,749.00**	**5.01**	**14,754**
ECM 4	Install Occupancy Sensor Lighting Controls	13,200	3.9	0.0	$1,751.66	$9,734.00	$1,585.00	$8,149.00	4.65	13,292
ECM 5	Install High/Low Lighting Controls	1,452	0.4	0.0	$192.63	$1,600.00	$0.00	$1,600.00	8.31	1,462
HVAC System Improvements		**9,165**	**2.1**	**0.0**	**$1,216.23**	**$2,900.00**	**$1,000.00**	**$1,900.00**	**1.56**	**9,229**
ECM 6	Install Dual Enthalpy Outside Economizer Control	9,165	2.1	0.0	$1,216.23	$2,900.00	$1,000.00	$1,900.00	1.56	9,229
Domestic Water Heating Upgrade		**0**	**0.0**	**97.7**	**$885.62**	**$164.91**	**$0.00**	**$164.91**	**0.19**	**11,441**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	97.7	$885.62	$164.91	$0.00	$164.91	0.19	11,441
Plug Load Equipment Control - Vending Machine		**2,821**	**0.0**	**0.0**	**$374.32**	**$1,437.60**	**$0.00**	**$1,437.60**	**3.84**	**2,840**
ECM 8	Vending Machine Control	2,821	0.0	0.0	$374.32	$1,437.60	$0.00	$1,437.60	3.84	2,840
TOTALS		**107,967**	**29.9**	**97.7**	**$15,213.15**	**$80,527.09**	**$12,035.00**	**$68,492.09**	**4.50**	**120,163**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendation for lighting upgrades are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**81,330**	**23.4**	**0.0**	**$10,792.69**	**$64,690.58**	**$9,450.00**	**$55,240.58**	**5.12**	**81,899**
ECM 1	Install LED Fixtures	14,553	3.5	0.0	$1,931.16	$14,906.34	$800.00	$14,106.34	7.30	14,654
ECM 2	Retrofit Fixtures with LED Lamps	65,649	19.9	0.0	$8,711.80	$48,278.47	$8,650.00	$39,628.47	4.55	66,108
ECM 3	Install LED Exit Signs	1,128	0.1	0.0	$149.73	$1,505.77	$0.00	$1,505.77	10.06	1,136

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	9,440	2.8	0.0	$1,252.71	$12,171.60	$100.00	$12,071.60	9.64	9,506
Exterior	5,113	0.7	0.0	$678.45	$2,734.74	$700.00	$2,034.74	3.00	5,148

Measure Description

This measure evaluates replacing select interior and exterior fixtures. Consider replacing wall mounted fixtures containing 150-Watt metal halide lamps with new high-performance LED light fixtures on the building exterior. Additionally, consider replacing the mercury vapor fixtures located in the multipurpose room. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled. In many cases, replacement fixtures can be purchased with on-board switching controls.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	65,649	19.9	0.0	$8,711.80	$48,278.47	$8,650.00	$39,628.47	4.55	66,108
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T8 lamps with LED tube lamps and replacing incandescent and compact fluorescent screw-in/plug-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in/plug-in LED lamps can be used as a direct replacement for most other screw-in/plug-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,128	0.1	0.0	$149.73	$1,505.77	$0.00	$1,505.77	10.06	1,136
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing incandescent lighting in exit signs with LEDs. LED sources require virtually no maintenance and LED exit signs have a life expectancy of at least 20 years. Many manufacturers can provide retrofit kits that meet fire and safety code requirements. Retrofit kits are less expensive and simpler to install than replacement signs, however, new fixtures would have a longer useful life and are therefore recommended.

A reduction in maintenance costs will be realized with the proposed retrofit because lamps will not have to be replaced as frequently.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**14,651**	**4.4**	**0.0**	**$1,944.29**	**$11,334.00**	**$1,585.00**	**$9,749.00**	**5.01**	**14,754**
ECM 4	Install Occupancy Sensor Lighting Controls	13,200	3.9	0.0	$1,751.66	$9,734.00	$1,585.00	$8,149.00	4.65	13,292
ECM 5	Install High/Low Lighting Controls	1,452	0.4	0.0	$192.63	$1,600.00	$0.00	$1,600.00	8.31	1,462

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
13,200	3.9	0.0	$1,751.66	$9,734.00	$1,585.00	$8,149.00	4.65	13,292

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in many restrooms, storage rooms, classrooms and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

ECM 5: Install High/Low Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,452	0.4	0.0	$192.63	$1,600.00	$0.00	$1,600.00	8.31	1,462

Measure Description

This measure evaluates installing occupancy sensors to provide dual level lighting control for light fixtures in spaces that are infrequently occupied but require continuous or night lighting for safety or security reasons. Typical areas for such lighting control are interior corridors.

The light fixtures operate at default low levels when the area is not occupied to provide minimal lighting to meet security or safety requirements. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. The lighting systems are switched to the high-level setting when an occupant is detected. Fixtures are automatically switched back to low level after an area has been vacant for a preset period.

For this application the occupancy sensors will generally be ceiling or fixture mounted. Sufficient sensor coverage should be provided to turn lights on in an area as an occupant approaches the area.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.1.3 HVAC System Improvements

Our recommendations for HVAC system improvement measures are summarized in Figure 19 below.

Figure 19 - Summary of HVAC System Improvement ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**9,165**	**2.1**	**0.0**	**$1,216.23**	**$2,900.00**	**$1,000.00**	**$1,900.00**	**1.56**	**9,229**
ECM 6	Install Dual Enthalpy Outside Economizer Control	9,165	2.1	0.0	$1,216.23	$2,900.00	$1,000.00	$1,900.00	1.56	9,229

ECM 6: Install Dual Enthalpy Outside Economizer Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
9,165	2.1	0.0	$1,216.23	$2,900.00	$1,000.00	$1,900.00	1.56	9,229

Measure Description

Dual enthalpy economizers are used to control a ventilation system's outside air intake in order to reduce a facility's total cooling load. A dual enthalpy economizer monitors the air temperature and humidity of both the outside and return air. The control supplies the lowest energy (temperature and humidity) air to the air handling system. When outside air conditions allow, outside air can be used for cooling in place of the air handling system's compressor. This reduces the demand on the cooling system, lowering its usage hours, saving energy.

Savings result from using outside air instead of mechanical cooling whenever possible.

4.1.4 Domestic Water Heating Upgrade

Our recommendations for domestic water heating measures are summarized in Figure 20 below.

Figure 20 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**97.7**	**$885.62**	**$164.91**	**$0.00**	**$164.91**	**0.19**	**11,441**
ECM 7	Install Low-Flow Domestic Hot Water Devices	0	0.0	97.7	$885.62	$164.91	$0.00	$164.91	0.19	11,441

ECM 7: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	97.7	$885.62	$164.91	$0.00	$164.91	0.19	11,441

Measure Description

This measure evaluates the savings from installing low flow domestic water devices to reduce overall water flow in general and hot water flow in particular. Low flow faucet aerators reduce the water flow, relative to standard aerators, from the fixture.

All of the low flow devices reduce the overall water flow from the fixture which generally reduces the amount of hot water used resulting in energy and water savings.

4.1.5 Plug Load Equipment Control - Vending Machine

Our recommendations for plug load equipment measures are summarized in Figure 21 below.

Figure 21 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**2,821**	**0.0**	**0.0**	**$374.32**	**$1,437.60**	**$0.00**	**$1,437.60**	**3.84**	**2,840**
ECM 8	Vending Machine Control	2,821	0.0	0.0	$374.32	$1,437.60	$0.00	$1,437.60	3.84	2,840

ECM 8: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,821	0.0	0.0	$374.32	$1,437.60	$0.00	$1,437.60	3.84	2,840

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor based controls to reduce the energy use. These controls power down the machine when the surrounding area is vacant, then monitor the surrounding temperature and power up the cooling system at regular intervals to keep the product cool. Savings are a function of the activity level around the vending machine.

4.2 ECMs Evaluated but Not Recommended

The measures below have been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in each measure description section.

Figure 22 – Summary of Evaluated but Not Recommended ECMs

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures	**2,021**	**1.0**	**0.0**	**$268.21**	**$6,015.30**	**$0.00**	**$6,015.30**	**22.43**	**2,035**
Install VFDs on Hot Water Pumps	2,021	1.0	0.0	$268.21	$6,015.30	$0.00	$6,015.30	22.43	2,035
Electric Unitary HVAC Measures	**17,182**	**13.5**	**0.0**	**$2,280.11**	**$97,008.17**	**$5,080.50**	**$91,927.67**	**40.32**	**17,302**
Install High Efficiency Electric AC	17,182	13.5	0.0	$2,280.11	$97,008.17	$5,080.50	$91,927.67	40.32	17,302
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**117.2**	**$1,062.45**	**$109,206.70**	**$6,832.00**	**$102,374.70**	**96.36**	**13,725**
Install High Efficiency Steam Boilers	0	0.0	102.5	$929.18	$97,243.63	$5,232.00	$92,011.63	99.02	12,003
Install High Efficiency Furnaces	0	0.0	14.7	$133.28	$11,963.07	$1,600.00	$10,363.07	77.76	1,722
Domestic Water Heating Upgrade	**0**	**0.0**	**15.6**	**$141.39**	**$4,449.00**	**$150.00**	**$4,299.00**	**30.40**	**1,827**
Install High Efficiency Gas Water Heater	0	0.0	15.6	$141.39	$4,449.00	$150.00	$4,299.00	30.40	1,827
TOTALS	**19,203**	**14.6**	**132.8**	**$3,752.17**	**$216,679.18**	**$12,062.50**	**$204,616.68**	**54.53**	**34,889**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Install VFDs on Hot Water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
2,021	1.0	0.0	$268.21	$6,015.30	$0.00	$6,015.30	22.43	2,035

Measure Description

This measure evaluates installing a variable frequency drive (VFD) to control the two 3 hp hot water pump. This measure requires that a majority of the hot water coils be served by 2-way valves and that a differential pressure sensor is installed in the hot water loop. As the hot water valves close, the differential pressure increases. The VFD modulates pump speed to maintain a differential pressure setpoint. Energy savings result from reducing pump motor speed (and power) as hot water valves close. The magnitude of energy savings is based on the amount of time at reduced loads.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Electric AC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
17,182	13.5	0.0	$2,280.11	$97,008.17	$5,080.50	$91,927.67	40.32	17,302

Measure Description

This measure evaluates replacing rooftop packaged and split system air conditioners with high efficiency packaged and split system air conditioners. There have been significant improvements in both compressor and fan motor efficiencies in the past several years. Therefore, electricity savings can be achieved by replacing old units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the old and new unit, the cooling load, and the annual operating hours.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	102.5	$929.18	$97,243.63	$5,232.00	$92,011.63	99.02	12,003

Measure Description

This measure evaluates replacing the two old and inefficient steam boilers with high efficiency boilers. Significant improvements have been made in combustion technology resulting in increases in overall boiler efficiency. Savings result from improved combustion efficiency and reduced standby losses at low loads. The school should consider re-evaluating the building heating load and the entire distribution system and installing modular boilers when these are replaced.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Furnaces

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	14.7	$133.28	$11,963.07	$1,600.00	$10,363.07	77.76	1,722

Measure Description

This measure evaluates replacing existing gas fired standard furnaces section of the rooftop packaged units with condensing furnaces. Improved combustion technology and heat exchanger design optimize the heat recovery from the combustion gases which significantly improves the furnace efficiency. Savings result from improved system efficiency. Condensing furnaces do have acidic condensate that needs to be drained.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone. Typically, a furnace section of a packaged heating-cooling unit is replaced when the entire unit is replaced. When the package units are replaced, ensure that efficient heating sections are included as needed.

Install High Efficiency Gas Water Heater

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	15.6	$141.39	$4,449.00	$150.00	$4,299.00	30.40	1,827

Measure Description

This measure evaluates the savings from replacing the 18 year old tank water heater with a high efficiency tank water heater. Improvements in combustion efficiency and reductions in heat loss have improved the overall efficiency of water heaters. Savings result from less gas used during combustion and less time operating during standby to maintain the water tank temperature.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost-effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced further by increasing the facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.4 for any low-flow ECM recommendations.

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before deciding to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

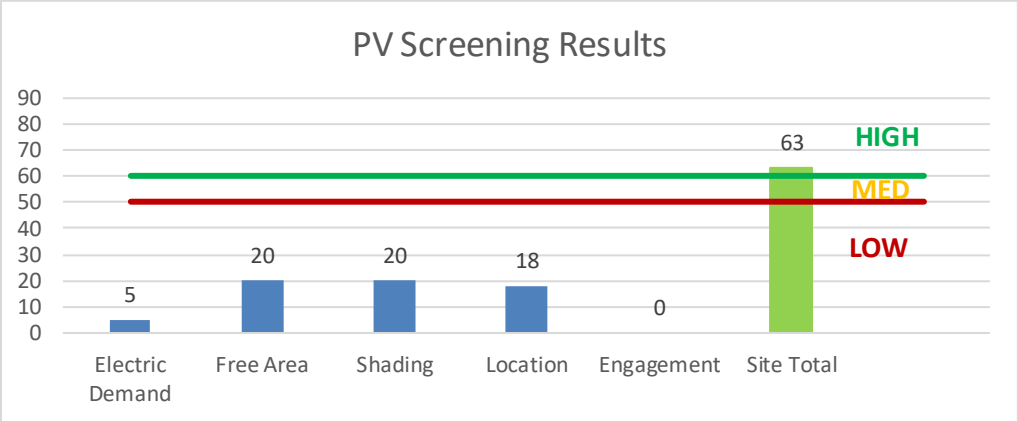
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear meet these minimum criteria for cost-effective PV installation.

Figure 23 - Photovoltaic Screening



Potential	High	
System Potential	90	kW DC STC
Electric Generation	107,224	kWh/yr
Displaced Cost	$9,330	/yr
Installed Cost	$234,000	

Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

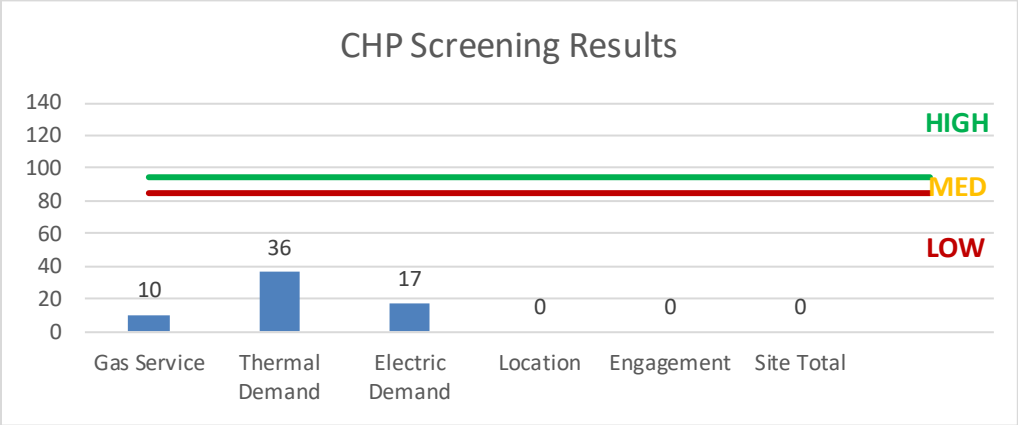
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 24 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

In our opinion, this facility has a low penitential for DR curtailment.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 25 for a list of the eligible programs identified for each recommended ECM.

Figure 25 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	x		x			
ECM 2	Retrofit Fixtures with LED Lamps	x		x			
ECM 3	Install LED Exit Signs			x			
ECM 4	Install Occupancy Sensor Lighting Controls	x		x			
ECM 5	Install High/Low Lighitng Controls			x			
ECM 6	Install Dual Enthalpy Outside Economizer Control	x		x			
ECM 7	Install Low-Flow Domestic Hot Water Devices			x			
ECM 8	Vending Machine Control			x			

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to mid-sized facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and install those measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor assigned to the county where your facility is located; a complete list is provided on the Direct Install website identified below. The contractor will be paid the program incentive directly which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps mentioned above, and the remaining 30% of the cost is your responsibility to the contractor.

Since Direct Install offers a free assessment, LGEA applicants that do not meet the audit program eligibility requirements, but do meet the Direct Install requirements, may be moved directly into this program.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple year.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,978	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	1,978	0.06	225	0.0	$29.88	$150.40	$30.00	4.03
Kitchen	2	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.07	232	0.0	$30.79	$107.51	$20.00	2.84
Basement Hallway	7	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	7	LED Exit Signs: 2 W Lamp	None	6	8,760	0.04	564	0.0	$74.86	$752.89	$0.00	10.06
Basement Hallway	26	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	26	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,385	0.71	2,466	0.0	$327.28	$2,321.00	$260.00	6.30
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.02	75	0.0	$9.96	$58.50	$10.00	4.87
Room 9	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.68	2,371	0.0	$314.69	$1,694.50	$290.00	4.46
Room 9	1	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.03	116	0.0	$15.39	$53.75	$10.00	2.84
Art Room	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.44	1,518	0.0	$201.40	$1,052.00	$180.00	4.33
Storage	8	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	Yes	8	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	9	1,385	0.28	977	0.0	$129.68	$546.02	$100.00	3.44
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Room 11	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
SSAC Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Boiler Room	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.24	826	0.0	$109.57	$643.50	$110.00	4.87
Women Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Women Bathroom	2	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.07	232	0.0	$30.79	$107.51	$20.00	2.84
Men Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Gymnasium	20	Mercury Vapor: (1) 250W Lamp	Wall Switch	290	1,978	Fixture Replacement	Yes	20	LED - Fixtures: Downlight Pendant	Occupancy Sensor	75	1,385	3.11	10,805	0.0	$1,433.83	$16,571.60	$800.00	11.00
Stage	60	Halogen Incandescent: PAR38 90W	Wall Switch	90	1,978	Relamp	No	60	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	15	1,978	2.95	10,236	0.0	$1,358.36	$3,225.18	$600.00	1.93
Stage	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.09	300	0.0	$39.85	$234.00	$40.00	4.87
Stage	1	Compact Fluorescent: 52W CFL	Wall Switch	52	1,978	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	36	1,978	0.01	35	0.0	$4.71	$63.65	$0.00	13.52
Stage	1	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	81	0.0	$10.69	$107.56	$0.00	10.06
Girls Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.08	285	0.0	$37.76	$445.50	$65.00	10.08
Custodian	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	540	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	540	0.02	20	0.0	$2.72	$58.50	$10.00	17.83
Room 12	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.33	1,138	0.0	$151.05	$818.00	$140.00	4.49
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 13	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Room 14	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Deen Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.02	75	0.0	$9.96	$58.50	$10.00	4.87
Deen Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,978	0.04	127	0.0	$16.90	$95.13	$20.00	4.44
Deen Office	1	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.03	116	0.0	$15.39	$53.75	$10.00	2.84
New Wing Hallway	7	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	7	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,385	0.34	1,169	0.0	$155.09	$865.93	$140.00	4.68
Data Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,978	0.04	127	0.0	$16.90	$95.13	$20.00	4.44
Elevator Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	540	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	540	0.04	35	0.0	$4.61	$95.13	$20.00	16.28
Room 15	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.29	1,002	0.0	$132.94	$686.80	$140.00	4.11
Electrical Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	540	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	540	0.04	41	0.0	$5.44	$117.00	$20.00	17.83
Computer Room	25	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	25	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.68	2,371	0.0	$314.69	$1,694.50	$290.00	4.46
Room 16	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.29	1,002	0.0	$132.94	$686.80	$140.00	4.11
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.02	75	0.0	$9.96	$58.50	$10.00	4.87
Room 18 (Media Center)	42	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	42	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	2.02	7,012	0.0	$930.57	$4,459.60	$920.00	3.80
Room 18 (Media Center)	18	Compact Fluorescent: Recessed 32W CFL 4-pin	Wall Switch	32	1,978	Relamp	Yes	18	LED - Fixtures: Downlight Solid State Retrofit	Occupancy Sensor	22	1,385	0.19	668	0.0	$88.67	$1,377.70	$40.00	15.09
Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.14	501	0.0	$66.47	$401.40	$80.00	4.84
Sub Basement	6	Incandescent: 60W A Lamp	Wall Switch	60	540	Relamp	No	6	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	540	0.20	190	0.0	$25.22	$322.52	$60.00	10.41
1st Floor New wing Room 35	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.14	501	0.0	$66.47	$401.40	$80.00	4.84
Hallway	8	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	8	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,385	0.38	1,336	0.0	$177.25	$961.07	$160.00	4.52
Boys Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.11	379	0.0	$50.35	$504.00	$75.00	8.52
Girls Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.11	379	0.0	$50.35	$504.00	$75.00	8.52
Room 33	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.58	2,004	0.0	$265.88	$1,257.60	$260.00	3.75
Room 32	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.58	2,004	0.0	$265.88	$1,257.60	$260.00	3.75
Custodian	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	540	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	540	0.02	20	0.0	$2.72	$58.50	$10.00	17.83
Storage1	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.02	75	0.0	$9.96	$58.50	$10.00	4.87

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 30	12	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.58	2,004	0.0	$265.88	$1,257.60	$260.00	3.75
Room 30	1	Compact Fluorescent: 32W CFL	Wall Switch	32	1,978	Relamp	No	1	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	22	1,978	0.01	22	0.0	$2.90	$63.65	$0.00	21.96
Child Study Team	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.29	1,002	0.0	$132.94	$686.80	$140.00	4.11
Room 29	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,385	0.29	1,002	0.0	$132.94	$686.80	$140.00	4.11
Old Section hallway	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,978	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	1,385	0.29	1,002	0.0	$132.94	$770.80	$120.00	4.90
Old Section hallway	5	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	5	LED Exit Signs: 2 W Lamp	None	6	8,760	0.03	403	0.0	$53.47	$537.78	$0.00	10.06
Old Section hallway	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,385	0.22	759	0.0	$100.70	$668.00	$80.00	5.84
Room 28	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Fan Room	2	Incandescent: 60W A Lamp	Wall Switch	60	1,978	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.07	232	0.0	$30.79	$107.51	$20.00	2.84
Room 26	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Room 27	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Room 25	21	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.57	1,992	0.0	$264.34	$1,344.50	$230.00	4.22
Front Entrance Hallway	16	Incandescent: Candelabra 40W Lamp	Wall Switch	40	1,978	Relamp	No	16	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,978	0.33	1,128	0.0	$149.72	$703.25	$160.00	3.63
Front Entrance Hallway	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.24	826	0.0	$109.57	$643.50	$110.00	4.87
Front Entrance Hallway	1	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	81	0.0	$10.69	$107.56	$0.00	10.06
Room 14A	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.33	1,138	0.0	$151.05	$818.00	$140.00	4.49
Room 14B	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.33	1,138	0.0	$151.05	$818.00	$140.00	4.49
Boys Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Room 22	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.60	2,087	0.0	$276.93	$1,403.00	$240.00	4.20
Room 23	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.60	2,087	0.0	$276.93	$1,403.00	$240.00	4.20
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,978	0.04	150	0.0	$19.92	$117.00	$20.00	4.87
Room 21	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.60	2,087	0.0	$276.93	$1,403.00	$240.00	4.20
Custodian	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	540	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	540	0.01	10	0.0	$1.32	$48.20	$10.00	28.97
Closet	1	Incandescent: 60W A Lamp	Wall Switch	60	540	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	540	0.03	32	0.0	$4.20	$53.75	$10.00	10.41
Room 20	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,978	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,385	0.60	2,087	0.0	$276.93	$1,403.00	$240.00	4.20

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 19	27	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	Yes	27	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,336	0.74	2,472	0.0	$328.01	$1,695.50	$290.00	4.28
Teacher	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,909	0.04	145	0.0	$19.23	$117.00	$20.00	5.04
Music Room	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,336	0.49	1,648	0.0	$218.67	$1,169.00	$200.00	4.43
Music Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,909	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,909	0.07	246	0.0	$32.63	$190.27	$40.00	4.61
Main Office	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	Yes	11	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,336	0.30	1,007	0.0	$133.63	$759.50	$130.00	4.71
Main Office	1	Incandescent: 60W A Lamp	Wall Switch	60	1,909	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	1,909	0.03	112	0.0	$14.86	$53.75	$10.00	2.94
Nurse Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,909	0.04	145	0.0	$19.23	$117.00	$20.00	5.04
Principal Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,909	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,336	0.08	275	0.0	$36.45	$291.50	$50.00	6.63
Exterior Wallpack	7	Metal Halide: (1) 150W Lamp	Daylight Dimming	190	4,380	Fixture Replacement	No	7	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	45	4,380	0.67	5,113	0.0	$678.45	$2,734.74	$700.00	3.00
Exterior Wallpack	9	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	9	4,380	None	No	9	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	9	4,380	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
New Section	7	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	7	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Boilers	2	Combustion Air Fan	3.0	80.7%	No	585	No	80.7%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Compressor	1	Air Compressor	2.0	82.0%	No	585	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers	2	Boiler Feed Water Pump	0.8	71.0%	No	585	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers	1	Other	0.8	76.0%	No	585	No	76.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	DWH	1	Other	0.3	71.0%	No	975	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Elevator Room	Elevator	1	Other	75.0	94.0%	No	689	No	94.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Hot Water System	2	Heating Hot Water Pump	3.0	88.5%	No	689	No	88.5%	Yes	2	1.02	2,021	0.0	$268.21	$6,015.30	$0.00	22.43
School	School	21	Supply Fan	0.3	78.0%	No	689	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Fan Room	Multipurpose Room	1	Exhaust Fan	3.0	84.0%	No	689	No	84.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop	Kitchen	1	Exhaust Fan	0.5	78.0%	No	689	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rooftop	Restrooms	3	Exhaust Fan	0.3	78.0%	No	689	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 9	Room 9	2	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 25	Room 25	1	Window AC	1.19		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 24A	Room 24A	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 24B	Room 24B	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 22	Room 22	1	Window AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 23	Room 23	1	Window AC	1.25		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 20	Room 20	1	Window AC	1.54		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 19	Room 19	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main Office	Main Office	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.20	252	0.0	$33.43	$1,360.95	$0.00	40.71
Teacher Room	Teacher Room	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Principal Office	Principal Office	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Unit #1	Media Center (Room 18)	1	Packaged AC	12.50		Yes	1	Packaged AC	12.50		11.50		Yes	3.37	6,845	0.0	$908.40	$18,323.13	$1,237.50	18.81
Roof Top Unit #7,8	School Facility	2	Packaged AC	8.50		Yes	2	Packaged AC	8.50		11.50		Yes	4.58	9,310	0.0	$1,235.43	$31,795.80	$1,741.00	24.33
Roof Top Unit #2	School Facility	1	Packaged AC	2.00		Yes	1	Packaged AC	2.00		14.00		Yes	0.81	1,489	0.0	$197.56	$5,037.92	$434.00	23.30
Roof Top Unit #3,4,5,9	School Facility	4	Split-System AC	3.50		Yes	4	Split-System AC	3.50		14.00		No	3.22	4,080	0.0	$541.43	$20,947.08	$1,288.00	36.31
Roof Top Unit #10,11, 12,	School Facility	3	Split-System AC	2.00		Yes	3	Split-System AC	2.00		14.00		No	1.38	1,749	0.0	$232.04	$8,977.32	$552.00	36.31
Roof Top Unit #13,14,15	School Facility	3	Split-System AC	3.00		Yes	3	Split-System AC	3.00		14.00		No	2.07	2,623	0.0	$348.06	$13,465.98	$828.00	36.31

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Forced Draft Steam Boiler	2,616.00	Yes	2	Forced Draft Steam Boiler	2,616.00	82.80%	Et	0.00	0	22.7	$205.77	$97,243.63	$5,232.00	447.16
Roof Top Unit #1	Media Center (Room 18)	1	Furnace	200.00	Yes	1	Furnace	200.00	95.00%	AFUE	0.00	0	1.4	$12.36	$4,531.47	$400.00	334.26
Roof Top Unit #2	School Facility	1	Furnace	32.80	Yes	1	Furnace	32.80	95.00%	AFUE	0.00	0	0.2	$1.73	$743.16	$400.00	198.45
Roof Top Unit #7,8	School Facility	2	Furnace	147.60	Yes	2	Furnace	147.60	95.00%	AFUE	0.00	0	1.7	$15.43	$6,688.44	$800.00	381.74

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Storage Room	School	1	Storage Tank Water Heater (> 50 Gal)	Yes	1	Storage Tank Water Heater (> 50 Gal)	Natural Gas	80.00%	EF	0.00	0	25.2	$228.45	$4,449.00	$150.00	18.82

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
School	22	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	94.8	$859.57	$157.74	$0.00	0.18
Kitchen	1	Faucet Aerator (Kitchen)	3.00	2.20	0.00	0	2.9	$26.05	$7.17	$0.00	0.28

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Gas Rack Oven (Single)	Yes	No	0.00	0	0.0	$0.00	$4,838.75	$1,000.00	0.00
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Yes	No	0.00	0	0.0	$0.00	$2,878.43	$300.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	48	Desktop Computer wi5th LCD Monitors	205.0	Yes
School	4	Copy Machine	850.0	Yes
School	3	Printer	460.0	Yes
Teacher Room	1	Refrigeartor	250.0	Yes

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teacher Room	1	Glass Fronted Refrigerated	Yes	0.00	1,209	0.0	$160.42	$718.80	$0.00	4.48
Teacher Room	1	Refrigerated	Yes	0.00	1,612	0.0	$213.90	$718.80	$0.00	3.36

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Northeast Elementary School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 56,549
Built: 1935

For Year Ending: April 30, 2016
Date Generated: December 20, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Northeast Elementary School 603 Grove Street Montclair, New Jersey 07043	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5730312

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
49.2 kBtu/ft²

Source EUI
86.4 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	940,342 (34%)
Natural Gas (kBtu)	1,839,872 (66%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	63
National Median Source EUI (kBtu/ft²)	110.8
% Diff from National Median Source EUI	-22%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	202

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Renaissance at Rand

Montclair Board of Education

176 North Fullerton Avenue
Montclair, New Jersey 07402

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Renaissance at Rand.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey higher education facilities in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

Renaissance at Rand is a 37,167 square foot facility constructed in 1924. The building is a three-story educational facility including classrooms, multipurpose rooms, offices, hallways, mechanical spaces, and other areas.

Lighting at the facility consists of a combination of 32-Watt T8 fluorescent fixtures and a few 40-Watt T12 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to the linear fluorescent, the facility also has inefficient circular fluorescent and incandescent lamps. Exterior lighting is provided by a combination of mercury vapor, metal halide, and incandescent fixtures. Interior lighting control is provided by manual switches.

Cooling and ventilation is provided by a combination of window air conditioners (AC) and split system AC systems. Heating hot water is distributed to the building's rooftop unit from natural draft steam boiler, via a heat exchanger.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated and recommended five measures which together represent an opportunity for Renaissance at Rand to reduce annual energy costs by roughly $11,823 and annual greenhouse gas emissions by 75,372 lbs CO_2e. We estimate that if all high priority measures are implemented as recommended, the project will pay for itself in roughly 4.7 years. TRC has defined high priority measures as the evaluated measures that have a simple payback less than the typical equipment life of the proposed equipment. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Renaissance at Rand's annual energy use by 10%.

Figure 1 – Previous 12 Month Utility Costs

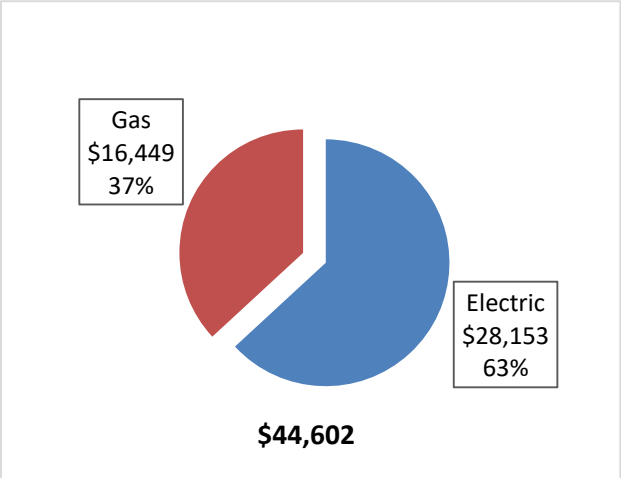
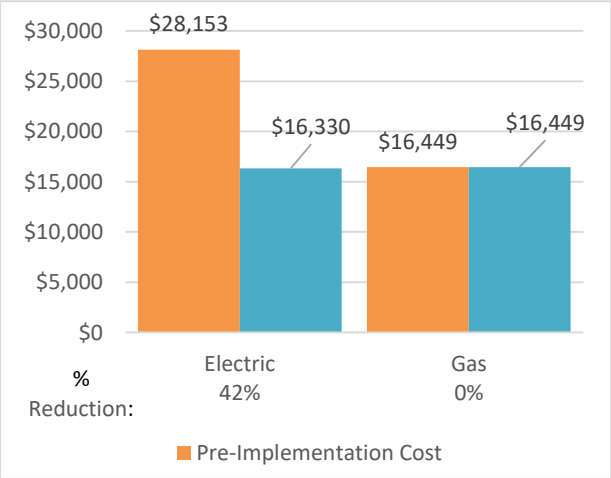


Figure 2 – Potential Post-Implementation Costs



A detailed description of the Renaissance at Rand's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the evaluated energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**64,637**	**17.0**	**0.0**	**$10,209.81**	**$50,995.44**	**$8,305.00**	**$42,690.44**	**4.2**	**65,089**
ECM 1	Install LED Fixtures	Yes	27,030	4.7	0.0	$4,269.52	$18,883.42	$2,095.00	$16,788.42	3.9	27,219
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	308	0.2	0.0	$48.65	$585.00	$50.00	$535.00	11.0	310
ECM 3	Retrofit Fixtures with LED Lamps	Yes	37,299	12.2	0.0	$5,891.64	$31,527.01	$6,160.00	$25,367.01	4.3	37,560
Lighting Control Measures			**8,599**	**2.8**	**0.0**	**$1,358.33**	**$14,622.00**	**$1,835.00**	**$12,787.00**	**9.4**	**8,660**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	8,599	2.8	0.0	$1,358.33	$14,622.00	$1,835.00	$12,787.00	9.4	8,660
Plug Load Equipment Control - Vending Machine			**1,612**	**0.0**	**0.0**	**$254.60**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 5	Vending Machine Control	Yes	1,612	0.0	0.0	$254.60	$230.00	$0.00	$230.00	0.9	1,623
TOTALS			**74,848**	**19.8**	**0.0**	**$11,822.74**	**$65,847.44**	**$10,140.00**	**$55,707.44**	**4.7**	**75,372**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Plug Load Equipment control measures generally involve installing automated devices that limit the power usage or operation of equipment that is plugged into an electric outlet when not in use.

Energy Efficient Practices

TRC also identified seven low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Renaissance at Rand include:

- Close Doors and Windows
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Renaissance at Rand. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	54	kW DC STC
Electric Generation	64,334	kWh/yr
Displaced Cost	$10,160	/yr
Installed Cost	$140,400	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

This facility may also qualify for the Direct Install program which can provide turnkey installation of multiple measures, through an authorized network of participating contractors. This program can provide substantially higher incentives than SmartStart, up to 70% of the cost of selected measures, although measure eligibility will have to be assessed and be verified by the designated Direct Install contractor and, in most cases, they will perform the installation work.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce electric loads at commercial facilities, when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak power demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8 or: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Emidio D'Andrea	Business Administrator	edandrea@montclair.k12.nj.us	(973) 509-4050
John Eschmann	Director of Facilities	jeschmann@montclair.k12.nj.us	(973) 509-4044
Designated Representative			
Matthew Wolchko	Project Architect	mwolchko@planetpsa.com	(973) 586-2400
TRC Energy Services			
Tom Page	Auditor	tpag@TRCsolutions.com	(732) 855-0033

2.2 General Site Information

On November 16, 2016, TRC performed an energy audit at the Renaissance at Rand located in Montclair, New Jersey. TRC's team met with John Eschmann to review the facility operations and help focus our investigation on specific energy-using systems.

Renaissance at Rand is a 37,167 square foot facility constructed in 1924. The building is a three-story educational facility including classrooms, multipurpose rooms, offices, hallways, mechanical spaces, and other areas.

Lighting at the facility consists of a combination of 32-Watt T8 fluorescent fixtures and a few 40-Watt T12 fluorescent fixtures; all of which are inefficient in performance when compared to the latest lighting technology available in the market. In addition to the linear fluorescent, the facility also has inefficient circular fluorescent and incandescent lamps. Exterior lighting is provided by a combination of mercury vapor, metal halide, and incandescent fixtures. Interior lighting control is provided by manual switches.

Cooling and ventilation is provided by a combination of window air conditioning (AC) and split system AC systems. Heating hot water is distributed to the building's rooftop unit from natural draft steam boiler, via a heat exchanger.

2.3 Building Occupancy

The typical schedule is presented in the table below.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Renaissance at Rand	Weekday	7:00 am - 3:30 pm
Renaissance at Rand	Weekend	CLOSED

2.4 Building Envelope

Renaissance at Rand is a three-story building. The construction is of concrete masonry block with brick exterior and double pane clear windows with operable frames. The flat roof is constructed of built-up roofing material.

Figure 7 – Building Façade



2.5 On-Site Generation

TRC evaluated the potential for installing on-site generation for the Renaissance at Rand. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 8 – Photovoltaic Potential

Potential	High	
System Potential	54	kW DC STC
Electric Generation	64,334	kWh/yr
Displaced Cost	$10,160	/yr
Installed Cost	$140,400	

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the Renaissance at Rand consists of a combination of 32-Watt T8 fluorescent fixtures and 40-Watt T12 fluorescent fixtures which are inefficient in performance when compared to the latest lighting technology available in the market. Most of the fixtures are 2-foot or 4-foot long troffers with diffusers having 1, 2, 3, and 4-lamp configurations. In addition to the fluorescent fixtures, the facility is also served by 60-Watt and 100-Watt incandescent lamps. All the exit signs are LED based fixtures.

Interior lighting control in the building is provided by manual switches.

Figure 9 - Building Lighting Systems

Fluorescent Fixture	*Exterior Security Light*
	

The building's exterior lighting consists primarily of 100-Watt and 175-Watt metal halide, 175-Watt and 400-Watt mercury vapor, and 100-Watt incandescent fixtures. Fixtures are a combination of pole and building mounted.

Steam to Hot Water Heating System

The hot water system consists of two H.B. Smith 3,576 kBtu/hr output, natural draft steam boilers. The boilers have a nominal combustion efficiency of 83% and are about eight years old. The boilers are connected to steam to water heat exchanger to convert the steam to heating hot water. The hot water is circulated by two hot water pumps. Each boiler is supplied by a dedicated 3 hp pump operating at constant speed.

Figure 10 – Hot Water System

Natural Gas Boiler	*Heating Hot Water Pumps*
	

The boilers are in good condition and well maintained.

Direct Expansion Air Conditioning System (DX)

The facility has several window AC units with capacities ranging between 0.42 ton and 2.0 tons. In addition to the window AC units, there is also a split system serving the computer lab.

Figure 11 – DX Air Conditioning System

Window AC	*Split System*
	

Domestic Hot Water Heating System

The domestic hot water heating system at the facility consists of one A.O. Smith gas fired hot water heater with an input rating of 75 kBtu/hr and nominal efficiency of 80%. Storage tank capacity is 74 gallons.

Figure 12 – Domestic Hot Water System

DHW Heater	*DHW Heater Nameplate*
	

Refrigeration

The facility has four stand-up refrigerators and a chest refrigerator. Capacities of the refrigerators are 6, 16, 20, 32, and 24 cubic feet.

Building Plug Load

There are roughly 50 computer work stations throughout the facility. All the computers are desktop units with LCD monitors. There is no centralized PC power management software installed.

The facility contains other systems which contribute to plug load including printers, microwaves, and televisions. In addition to the typical plug load equipment, the facility also has a refrigerated vending machine at the teacher's room.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

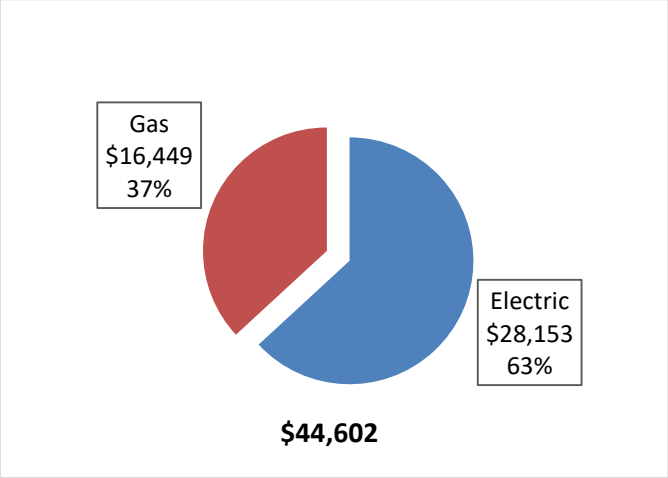
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 13 - Utility Summary

Utility Summary for Renaissance at Rand		
Fuel	**Usage**	**Cost**
Electricity	178,232 kWh	$28,153
Natural Gas	18,492 Therms	$16,449
Total		**$44,602**

The current annual energy cost for this facility is $44,602 as shown in the chart below.

Figure 14 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost over the past 12 months was $0.158/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below. The usage profile is consistent with a facility which experiences a reduction of use in the summer months.

Figure 15 - Electric Usage & Demand

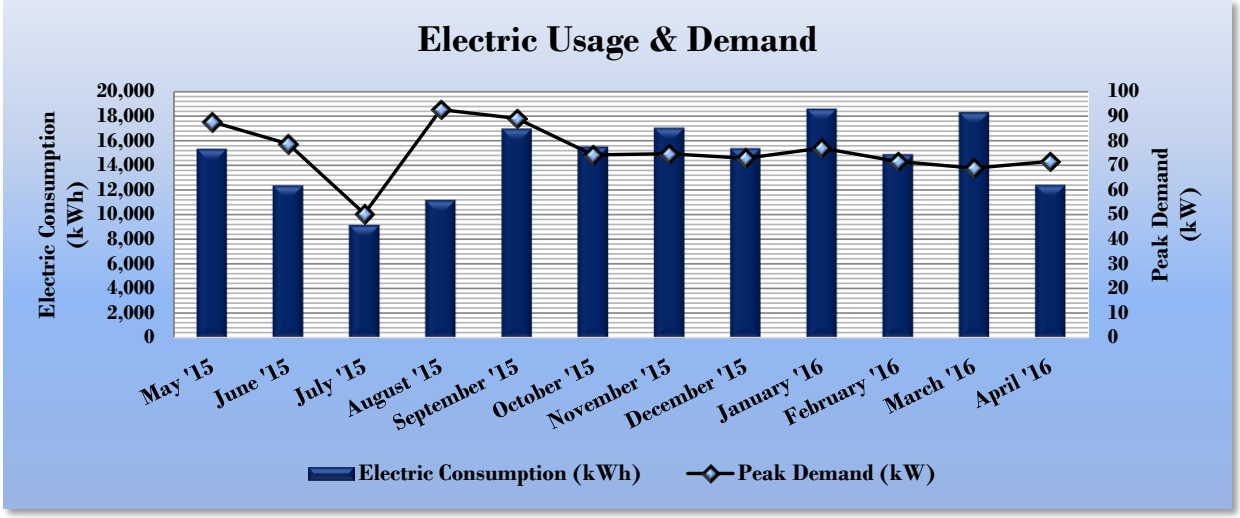


Figure 16 - Electric Usage & Demand

Electric Billing Data for Renaissance at Rand					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Total Electric Cost	TRC Estimated Usage?
6/15/15	26	15,345	88	$3,069	No
7/15/15	30	12,375	79	$2,651	No
8/13/15	29	9,180	50	$1,846	No
9/14/15	32	11,205	93	$2,625	No
10/13/15	29	16,965	89	$2,495	No
11/12/15	30	15,525	74	$2,244	No
12/15/15	33	17,055	75	$2,378	No
1/15/16	31	15,390	73	$2,097	No
2/18/16	34	18,585	77	$2,444	No
3/16/16	27	14,895	72	$2,017	No
4/15/16	30	18,315	69	$2,397	No
5/17/16	32	12,420	72	$1,737	No
Totals	**363**	**177,255**	**92.7**	**$27,998**	0
Annual	**365**	**178,232**	**92.7**	**$28,153**	

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.890/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below. The usage profile is consistent with a facility dominated by winter heating.

Figure 17 - Natural Gas Usage

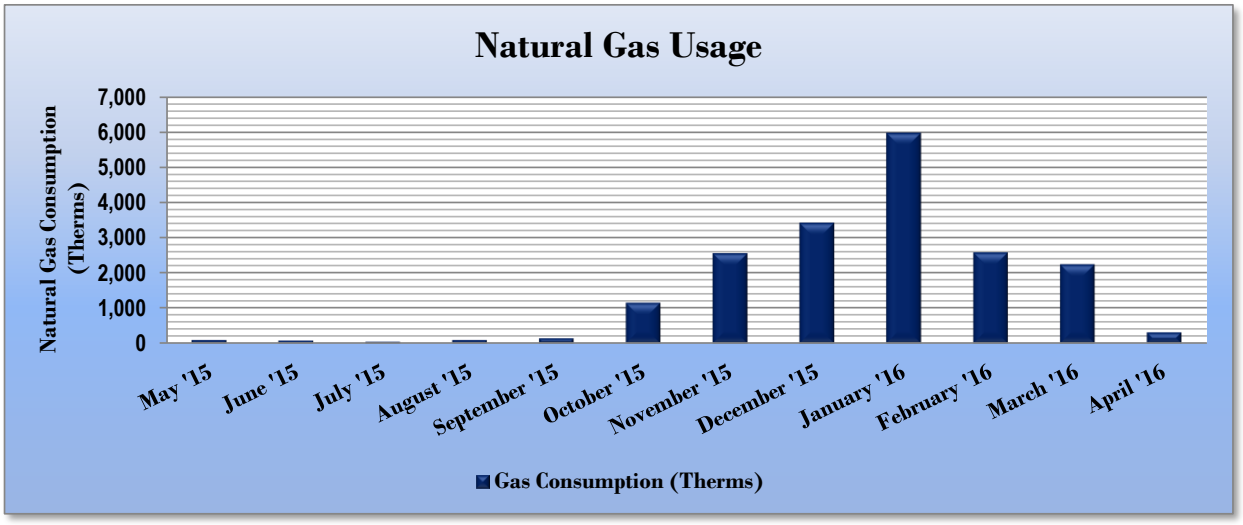


Figure 18 - Natural Gas Usage

Gas Billing Data for Renaissance at Rand			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
6/16/15	32	94	$156
7/20/15	34	81	$148
8/17/15	28	47	$226
9/15/15	29	93	$300
10/14/15	29	138	$182
11/12/15	29	1,145	$1,676
12/15/15	33	2,554	$2,531
1/15/16	31	3,414	$3,054
2/18/16	34	5,960	$4,388
3/17/16	28	2,576	$2,336
4/15/16	29	2,232	$1,313
5/17/16	32	310	$275
Totals	**368**	**18,644**	**$16,584**
Annual	**365**	**18,492**	**$16,449**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 19 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Renaissance at Rand	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	103.6	141.4
Site Energy Use Intensity (kBtu/ft^2)	66.1	58.2

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 20 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Renaissance at Rand	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	82.0	141.4
Site Energy Use Intensity (kBtu/ft^2)	59.2	58.2

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This facility has a current score of 65.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

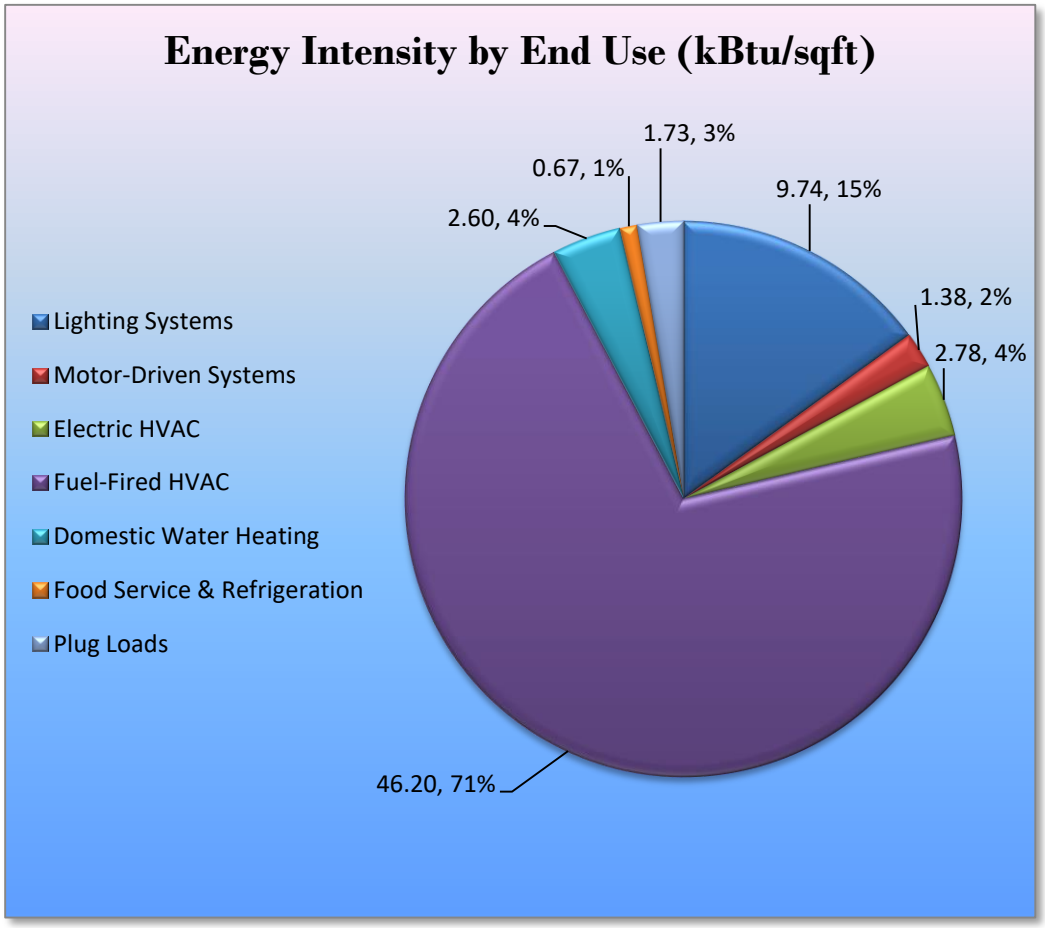
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager® to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 21 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Renaissance at Rand regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 High Priority ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 22 – Summary of High Priority ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**64,637**	**17.0**	**0.0**	**$10,209.81**	**$50,995.44**	**$8,305.00**	**$42,690.44**	**4.2**	**65,089**
ECM 1	Install LED Fixtures	27,030	4.7	0.0	$4,269.52	$18,883.42	$2,095.00	$16,788.42	3.9	27,219
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	308	0.2	0.0	$48.65	$585.00	$50.00	$535.00	11.0	310
ECM 3	Retrofit Fixtures with LED Lamps	37,299	12.2	0.0	$5,891.64	$31,527.01	$6,160.00	$25,367.01	4.3	37,560
Lighting Control Measures		**8,599**	**2.8**	**0.0**	**$1,358.33**	**$14,622.00**	**$1,835.00**	**$12,787.00**	**9.4**	**8,660**
ECM 4	Install Occupancy Sensor Lighting Controls	8,599	2.8	0.0	$1,358.33	$14,622.00	$1,835.00	$12,787.00	9.4	8,660
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$254.60**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 5	Vending Machine Control	1,612	0.0	0.0	$254.60	$230.00	$0.00	$230.00	0.9	1,623
TOTALS		**74,848**	**19.8**	**0.0**	**$11,822.74**	**$65,847.44**	**$10,140.00**	**$55,707.44**	**4.7**	**75,372**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 23 below.

Figure 23 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**64,637**	**17.0**	**0.0**	**$10,209.81**	**$50,995.44**	**$8,305.00**	**$42,690.44**	**4.2**	**65,089**
ECM 1	Install LED Fixtures	27,030	4.7	0.0	$4,269.52	$18,883.42	$2,095.00	$16,788.42	3.9	27,219
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	308	0.2	0.0	$48.65	$585.00	$50.00	$535.00	11.0	310
ECM 3	Retrofit Fixtures with LED Lamps	37,299	12.2	0.0	$5,891.64	$31,527.01	$6,160.00	$25,367.01	4.3	37,560

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	8,665	2.3	0.0	$1,368.61	$10,872.32	$1,170.00	$9,702.32	7.1	8,725
Exterior	18,365	2.4	0.0	$2,900.91	$8,011.11	$925.00	$7,086.11	2.4	18,494

Measure Description

We recommend replacing existing fixtures containing HID lamps with new high-performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a HID lamp.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	308	0.2	0.0	$48.65	$585.00	$50.00	$535.00	11.0	310
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing T12 fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	36,936	12.1	0.0	$5,834.22	$31,503.70	$6,155.00	$25,348.70	4.3	37,194
Exterior	364	0.0	0.0	$57.42	$23.31	$5.00	$18.31	0.3	366

Measure Description

We recommend retrofitting existing incandescent, linear fluorescent, and circular fluorescent lighting technologies with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than 10 times longer than many incandescent lamps.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 24 below.

Figure 24 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**8,599**	**2.8**	**0.0**	**$1,358.33**	**$14,622.00**	**$1,835.00**	**$12,787.00**	**9.4**	**8,660**
ECM 4	Install Occupancy Sensor Lighting Controls	8,599	2.8	0.0	$1,358.33	$14,622.00	$1,835.00	$12,787.00	9.4	8,660

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
8,599	2.8	0.0	$1,358.33	$14,622.00	$1,835.00	$12,787.00	9.4	8,660

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in selected restrooms, classrooms, and office areas. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.1.3 Plug Load Equipment Control - Vending Machines

Our recommendations for plug load equipment control measures are summarized in Figure 25 below.

Figure 25 - Summary of Plug Load Equipment Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Plug Load Equipment Control - Vending Machine		**1,612**	**0.0**	**0.0**	**$254.60**	**$230.00**	**$0.00**	**$230.00**	**0.9**	**1,623**
ECM 5	Vending Machine Control	1,612	0.0	0.0	$254.60	$230.00	$0.00	$230.00	0.9	1,623

ECM 5: Vending Machine Control

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,612	0.0	0.0	$254.60	$230.00	$0.00	$230.00	0.9	1,623

Measure Description

Vending machines operate continuously, even during non-business hours. It is recommended to install occupancy sensor controls to reduce the energy use. These controls power down vending machines when the vending machine area has been vacant for some time, then power up at regular intervals, as needed, to turn machine lights on or keep the product cool. Energy savings are a dependent on vending machine and activity level in the area surrounding the machines.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional.

For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

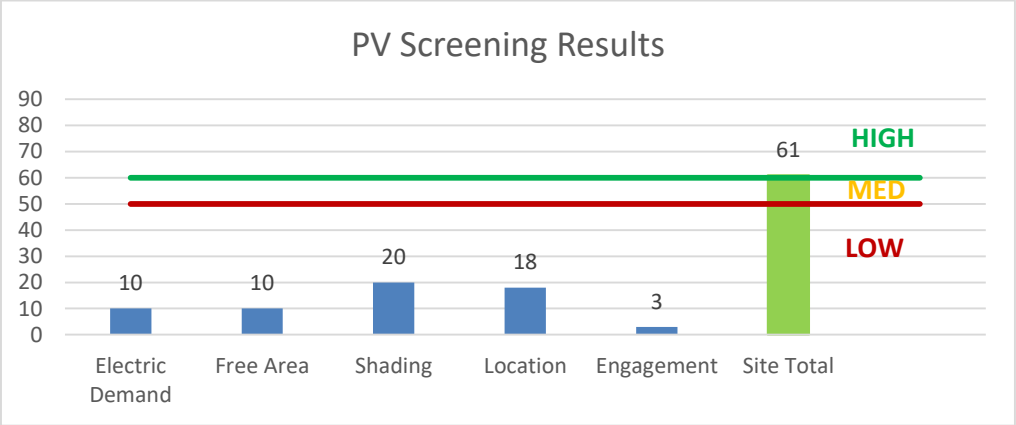
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **High** potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the building may be feasible. If Renaissance at Rand is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 26 - Photovoltaic Screening



Potential	High	
System Potential	54	kW DC STC
Electric Generation	64,334	kWh/yr
Displaced Cost	$10,160	/yr
Installed Cost	$140,400	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load is the most significant factor contributing to the potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR programs often find it to be a valuable source of revenue for their facility because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats, so that air conditioning units run less frequently, or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

In our opinion this building is not is a good candidate for DR.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 27 for a list of the eligible programs identified for each recommended ECM.

Figure 27 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X		X	
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	X		X	
ECM 3	Retrofit Fixtures with LED Lamps	X		X	
ECM 4	Install Occupancy Sensor Lighting Controls	X		X	
ECM 5	Vending Machine Control			X	

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. This facility does not meet all of the criteria for participating in the P4P program based on the measures identified in this study. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to medium-sized facilities with a peak electric demand that does not exceed 200 kW for any recent 12-month period. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor in the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Since Direct Install offers a free assessment of eligible measures, Direct Install is also available to small businesses and other commercial facilities too that may not be eligible for the more detailed facility audits provided by LGEA.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
General Office	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,000	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,400	0.36	1,251	0.0	$197.60	$1,022.00	$185.00	4.24
Principal's Office	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,000	Relamp	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,400	0.25	863	0.0	$136.35	$567.20	$110.00	3.35
Foyer	8	Incandescent: 100W Spotlight Bulbs BR30 (E26)	Wall Switch	100	2,150	Relamp	No	8	LED Screw-In Lamps: 17W Spotlight Bulbs	Wall Switch	17	2,150	0.44	1,642	0.0	$259.32	$254.00	$40.00	0.83
Foyer	3	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	3	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.30	1,150	0.0	$181.60	$1,254.50	$135.00	6.16
Foyer	2	Halogen Incandescent: 65W Spotlight Bulbs BR38 (Track Lighting)	Wall Switch	65	2,150	Relamp	No	2	LED Screw-In Lamps: 12W Spotlight Bulbs	Wall Switch	12	2,150	0.07	262	0.0	$41.40	$46.00	$0.00	1.11
Display Cases	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	720	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	720	0.05	58	0.0	$9.16	$143.60	$20.00	13.50
Multi-Purpose Room	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	None	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
MPR Office	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,760	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.09	274	0.0	$43.29	$350.00	$40.00	7.16
3 MPR Closets	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	600	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	600	0.13	137	0.0	$21.58	$351.00	$60.00	13.48
Room 120A	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	18	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.74	2,279	0.0	$359.95	$1,893.60	$340.00	4.32
Room 120A Closet	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	500	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.04	34	0.0	$5.36	$117.00	$10.00	19.97
Room 120A Restroom	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	600	Relamp & Reballast	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	600	0.08	81	0.0	$12.86	$234.00	$20.00	16.64
Room 120B	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.49	1,519	0.0	$239.97	$1,442.40	$250.00	4.97
Room 117	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.14	422	0.0	$66.66	$408.50	$70.00	5.08
Room 118	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.41	1,266	0.0	$199.97	$1,022.00	$185.00	4.19
Stairwell 2	3	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	3	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.30	1,150	0.0	$181.60	$1,254.50	$135.00	6.16
Stairwell 2	1	Circular Fluorescent - T9: Circline 30W T9 Fluorescent	Wall Switch	30	2,150	Relamp	No	1	LED - Linear Tubes: 12W LED Replacement for Circline Ring	Wall Switch	12	2,150	0.01	45	0.0	$7.03	$83.16	$0.00	11.83
Stairwell 3	3	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	3	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.30	1,150	0.0	$181.60	$1,254.50	$135.00	6.16
Stairwell 3	1	Incandescent: 100W Incandescent Bulbs	Wall Switch	100	2,150	Relamp	No	1	LED Screw-In Lamps: 17W Screw-In Bulbs	Wall Switch	17	2,150	0.05	205	0.0	$32.42	$23.31	$5.00	0.56
Food Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	880	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	616	0.03	42	0.0	$6.67	$174.50	$10.00	24.68
Ground Floor Hallway	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.26	979	0.0	$154.66	$702.00	$120.00	3.76
Boiler Room	11	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,250	Relamp	No	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,250	0.24	522	0.0	$82.42	$643.50	$110.00	6.47
Boiler Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,250	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	1,250	0.07	161	0.0	$25.43	$190.27	$40.00	5.91
Rm G10	20	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	20	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.82	2,532	0.0	$399.95	$2,044.00	$370.00	4.19
Rm G11	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.03	84	0.0	$13.33	$174.50	$10.00	12.34

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm G12	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.19	594	0.0	$93.86	$496.53	$100.00	4.22
Electrical Rm	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.04	30	0.0	$4.80	$117.00	$20.00	20.23
Mechanical Rm G14	2	Incandescent: 60W Incandescent Bulbs	Wall Switch	60	400	Relamp	No	2	LED Screw-In Lamps: 9W Screw-In Bulbs	Wall Switch	9	400	0.07	47	0.0	$7.41	$31.00	$10.00	2.83
Rm G4	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.05	149	0.0	$23.47	$211.13	$20.00	8.15
Music Rm G5	45	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	45	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	1.85	5,697	0.0	$899.88	$4,464.00	$815.00	4.05
Music Rm G5	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.05	169	0.0	$26.66	$387.00	$55.00	12.45
Rm G6	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	18	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.74	2,279	0.0	$359.95	$1,893.60	$340.00	4.32
Boys' Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.11	338	0.0	$53.33	$504.00	$75.00	8.04
Elevator	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,150	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,150	0.02	82	0.0	$12.89	$58.50	$10.00	3.76
Elevator Mech Rm	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	400	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	400	0.02	15	0.0	$2.40	$58.50	$10.00	20.23
Rm G16	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Rm G17	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.49	1,519	0.0	$239.97	$1,442.40	$250.00	4.97
Rm G17	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.11	338	0.0	$53.33	$504.00	$75.00	8.04
Sm. Restrooms	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	600	Relamp	No	4	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	600	0.05	48	0.0	$7.63	$143.60	$20.00	16.20
Girls' Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.11	338	0.0	$53.33	$504.00	$75.00	8.04
Mop Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	600	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	600	0.02	23	0.0	$3.60	$58.50	$10.00	13.48
Rm G2	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Computer Lab Rm 213	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Reading Rm 215	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.14	446	0.0	$70.40	$401.40	$80.00	4.57
Rm 216	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Rm 217	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Girls' Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.19	594	0.0	$93.86	$650.53	$115.00	5.71
2nd Flr Hallway	6	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	6	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.61	2,299	0.0	$363.21	$2,509.00	$270.00	6.16
Rm 210	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Rm 210	4	LED Screw-In Lamps: 10W LED Screw-In Bulbs	Wall Switch	10	1,760	None	No	4	LED Screw-In Lamps: 10W LED Screw-In Bulbs	Wall Switch	10	1,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Rm 202	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
2nd Flr Storage	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	880	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	616	0.16	253	0.0	$39.99	$416.80	$60.00	8.92
Rm 203	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Boys' Rm	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.19	594	0.0	$93.86	$650.53	$115.00	5.71
Mop Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	22	600	Relamp	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	600	0.01	9	0.0	$1.47	$31.90	$5.00	18.28
Rm 204	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.49	1,519	0.0	$239.97	$1,442.40	$250.00	4.97
Rm 205	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	1,760	Relamp	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,232	0.19	594	0.0	$93.86	$496.53	$100.00	4.22
Rm 206	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
Stairwell 1	2	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	2	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.20	766	0.0	$121.07	$836.33	$90.00	6.16
Stairwell 4	2	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	2	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.20	766	0.0	$121.07	$836.33	$90.00	6.16
Rm 110	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.38	1,182	0.0	$186.64	$1,359.00	$210.00	6.16
Rm 110	12	Incandescent: 60W Incandescent Bulbs	Wall Switch	60	1,760	Relamp	No	12	LED Screw-In Lamps: 9W Screw-In Bulbs	Wall Switch	9	1,760	0.40	1,239	0.0	$195.66	$186.00	$60.00	0.64
Rm 111	14	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.57	1,772	0.0	$279.96	$1,592.80	$280.00	4.69
1st Flr Hallway	7	Mercury Vapor: (1) 175W Lamp	Wall Switch	205	2,150	Fixture Replacement	No	7	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	50	2,150	0.71	2,683	0.0	$423.74	$2,927.16	$315.00	6.16
Teachers' Rm 107	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.41	1,266	0.0	$199.97	$1,022.00	$185.00	4.19
Staff Restroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	880	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	616	0.05	84	0.0	$13.33	$233.00	$20.00	15.98
Nurse's Rm 114	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	1,760	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,232	0.16	506	0.0	$79.99	$570.80	$95.00	5.95
Nurse's Rm 114	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	1,760	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,232	0.05	169	0.0	$26.66	$387.00	$55.00	12.45
Sm. Restroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	600	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	420	0.03	29	0.0	$4.54	$174.50	$10.00	36.19
LED EXIT Signs (Whole School)	15	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	15	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Exterior (Pole Lamps)	7	Mercury Vapor: (1) 175W Lamp	None	205	4,380	Fixture Replacement	No	7	LED - Fixtures: Outdoor Post-Mount	None	50	4,380	0.71	5,465	0.0	$863.25	$4,013.10	$35.00	4.61
Exterior Perimeter	8	Mercury Vapor: (1) 400W Lamp	None	455	4,380	Fixture Replacement	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	None	120	4,380	1.76	13,499	0.0	$2,132.27	$3,125.42	$800.00	1.09
Exterior Perimeter	2	Metal Halide: (1) 175W Lamp	None	215	4,380	Fixture Replacement	No	2	LED - Fixtures: Wall-Wash Lights	None	50	4,380	0.22	1,662	0.0	$262.56	$581.73	$60.00	1.99
Exterior Perimeter	1	Metal Halide: (1) 100W Lamp	None	128	4,380	Fixture Replacement	No	1	LED - Fixtures: Wall-Wash Lights	None	30	4,380	0.06	494	0.0	$77.97	$290.86	$30.00	3.35

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Back Door	1	Incandescent: 100W Incandescent Bulbs	None	100	4,380	Relamp	No	1	LED Screw-In Lamps: 17W Screw-In Bulbs	None	17	4,380	0.05	418	0.0	$66.04	$23.31	$5.00	0.28

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	Whole Building	1	Supply Fan	10.0	88.0%	No	1,980	No	88.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Classrooms	Classrooms	9	Ventilation Fan	0.3	69.5%	No	250	No	69.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Building	2	Heating Hot Water Pump	3.0	86.5%	No	500	No	86.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Principal's Office	Principal's Office	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teachers' Rm 107	Teachers' Rm 107	1	Window AC	0.58		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 110	Rm 110	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 111	Rm 111	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 117	Rm 117	1	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 118	Rm 118	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 120A	Rm 120A	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 120B	Rm 120B	1	Window AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 202	Rm 202	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 203	Rm 203	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 204	Rm 204	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 205	Rm 205	1	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 206	Rm 206	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 213	Rm 213	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 216	Rm 216	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm 217	Rm 217	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm G2	Rm G2	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm G10	Rm G10	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm G10	Rm G10	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
G16	G16	1	Window AC	1.13		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
G17	G17	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse's Rm 114	Nurse's Rm 114	1	Window AC	0.42		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm G6	Rm G6	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Rm G2	Rm G2	1	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Computer Lab	Computer Lab	1	Ductless Mini-Split AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Whole School	2	Natural Draft Steam Boiler	3,567.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Renaissance at Rand School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Cond	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Principal's Office	1	Stand-Up Refrigerator, Solid Door (≤15 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Nurse's Rm 114	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Teachers' Rm 107	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Food Storage Area	1	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Food Storage Area	1	Refrigerator Chest	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Renaissance @ Rand	50	Desktop Computer + Monitor	150.0	Yes
Renaissance @ Rand	3	TVs (med. CRT)	150.0	No
Renaissance @ Rand	6	Printers (sm.)	80.0	Yes
Renaissance @ Rand	2	Copy Machine (Lg.)	240.0	Yes
Renaissance @ Rand	1	Server Rack	360.0	No
Renaissance @ Rand	2	Microwave Ovens (med.)	900.0	No
Renaissance @ Rand	50	Laptop Computers	60.0	Yes

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teachers' Rm 107	1	Refrigerated	Yes	0.00	1,612	0.0	$254.60	$230.00	$0.00	0.90

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

Renaissance at Rand Middle School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 37,167
Built: 1924

For Year Ending: April 30, 2016
Date Generated: December 25, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Renaissance at Rand Middle School 176 North Fullerton Avenue Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5699716

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
66.5 kBtu/ft²

Source EUI
104.3 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	613,399 (25%)
Natural Gas (kBtu)	1,858,380 (75%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	76.5
National Median Source EUI (kBtu/ft²)	120
% Diff from National Median Source EUI	-13%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	167

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

___ _____
,
(___)___-_____
_____

Professional Engineer Stamp (if applicable)

Local Government Energy Audit:
Energy Audit Report



Watchung School

Montclair Board of Education

299 N. Fullerton Avenue

Montclair, New Jersey 07042

January 3, 2019

Final Report by:

TRC Energy Services

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Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate savings are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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Ensure Lighting Controls Are Operating Properly 24
Use Fans to Reduce Cooling Load 24
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1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for the Watchung School.

The goal of a LGEA is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and put you in a position to implement the ECMs. The LGEA also sets you on the path to receive financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing the ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey school districts in controlling energy costs and protecting our environment by offering a full spectrum of energy management options.

1.1 Facility Summary

The Watchung School is a three-story building totaling 52,109 square feet constructed in 1900. The building has a flat roof and exterior walls are finished with brick masonry. The windows throughout the facility are double paned and the exterior doors are constructed of metal. Interior lighting consists predominantly of linear T8 fluorescent lamps and fixtures with electronic ballasts. Lighting control is provided by manual wall switches. Heating is provided by two steam boilers and cooling is provided by a combination of window and split system air conditioners (ACs).

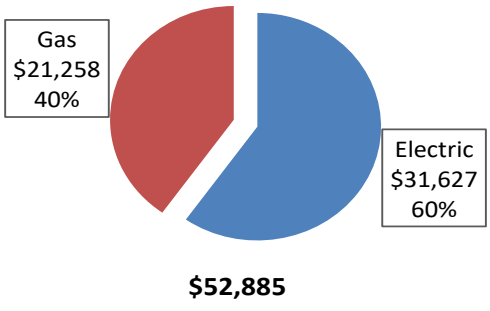
A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

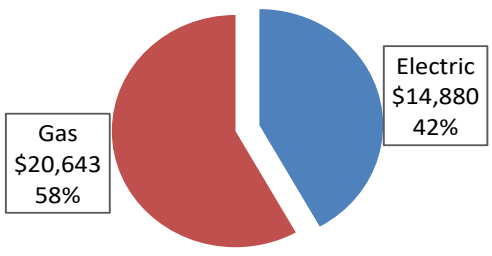
TRC evaluated nine measures. Six measures were recommended for implementation which together represent an opportunity for the Watchung School to reduce annual energy costs by roughly $12,641 and annual greenhouse gas emissions by 103,370 lbs CO_2e. The measures would pay for themselves in roughly 4 years. The breakdown of existing and potential utility costs is illustrated in Figure 1 and Figure 2, respectively. These projects represent an opportunity to reduce Watchung School's annual energy use by 12.2%.

Figure 1 – Previous 12 Month Utility Costs



$52,885

Figure 2 – Potential Post-Implementation Costs



$35,523

A detailed description of the Watchung School's existing energy use can be found in Section 3.

The evaluated measures have been listed and grouped into major categories as shown in Figure 3. Brief descriptions of the categories can be found below and descriptions of the individual opportunities can be found in Section 4. Measures without an "ECM #" in the table below have been evaluated, but are not recommended for implementation.

Figure 3 – Summary of Energy Reduction Opportunities

	Energy Conservation Measure	Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**87,875**	**21.3**	**0.0**	**$11,062.52**	**$54,625.36**	**$8,020.00**	**$46,605.36**	**4.21**	**88,489**
ECM 1	Install LED Fixtures	Yes	23,287	4.7	0.0	$2,931.59	$16,761.33	$2,310.00	$14,451.33	4.93	23,450
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	1,305	0.3	0.0	$164.33	$1,350.00	$85.00	$1,265.00	7.70	1,315
ECM 3	Retrofit Fixtures with LED Lamps	Yes	62,154	16.2	0.0	$7,824.55	$35,008.26	$5,625.00	$29,383.26	3.76	62,589
ECM 4	Install LED Exit Signs	Yes	1,128	0.1	0.0	$142.04	$1,505.77	$0.00	$1,505.77	10.60	1,136
Lighting Control Measures			**9,932**	**2.6**	**0.0**	**$1,250.38**	**$5,760.00**	**$770.00**	**$4,990.00**	**3.99**	**10,002**
ECM 5	Install Occupancy Sensor Lighting Controls	Yes	9,932	2.6	0.0	$1,250.38	$5,760.00	$770.00	$4,990.00	3.99	10,002
Motor Upgrades			**1,441**	**1.4**	**0.0**	**$181.37**	**$3,481.49**	**$0.00**	**$3,481.49**	**19.20**	**1,451**
	Premium Efficiency Motors	No	1,441	1.4	0.0	$181.37	$3,481.49	$0.00	$3,481.49	19.20	1,451
Electric Unitary HVAC Measures			**492**	**0.3**	**0.0**	**$61.99**	**$1,360.95**	**$0.00**	**$1,360.95**	**21.95**	**496**
	Install High Efficiency Electric AC	No	492	0.3	0.0	$61.99	$1,360.95	$0.00	$1,360.95	21.95	496
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**36.2**	**$285.90**	**$52,933.84**	**$2,848.00**	**$50,085.84**	**175.19**	**4,244**
	Install High Efficiency Steam Boilers	No	0	0.0	36.2	$285.90	$52,933.84	$2,848.00	$50,085.84	175.19	4,244
Domestic Water Heating Upgrade			**0**	**0.0**	**41.7**	**$328.66**	**$93.21**	**$0.00**	**$93.21**	**0.28**	**4,879**
ECM 6	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	41.7	$328.66	$93.21	$0.00	$93.21	0.28	4,879
TOTALS FOR ALL RECOMMENDED MEASURES			**97,807**	**23.92**	**41.7**	**$12,641.56**	**$60,478.57**	**$8,790.00**	**$51,688.57**	**4.09**	**103,370**
TOTALS FOR ALL MEASURES			**99,740**	**25.6**	**77.9**	**$13,170.82**	**$118,254.85**	**$11,638.00**	**$106,616.85**	**8.09**	**109,561**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when conditions allow. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing old standard efficiency motors with motors of the current efficiency standard (EISA 2007). Motors will be replaced with the same size motors. This measure saves energy by reducing the power used by the motors due to improved electrical efficiency.

Electric Unitary HVAC measures generally involve replacing old inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide cooling equivalent to older air condition systems, but use less energy. These measures save energy by reducing the power used by the air condition system due to improved electrical efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing old inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide heating equivalent to older systems, but use less energy. These measures save energy by reducing the fuel used by the heating due to improved combustion and heat transfer efficiency.

Domestic Water Heating upgrade measures generally involve replacing old inefficient domestic water heating systems with modern energy efficient systems. New domestic water heating systems can provide equivalent or greater capacity as older systems, but use less energy. These measures save energy by reducing the fuel used by the domestic water heating systems due to improved efficiency or the removal of standby losses.

Energy Efficient Practices

TRC also identified eight low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems. Through these practices equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. Opportunities identified at the Watchung School include:

- Close Doors and Windows
- Ensure Lighting Controls Are Operating Properly
- Use Fans to Reduce Cooling Load
- Clean and/or Replace HVAC Filters
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

Self-Generation Measures

TRC evaluated the potential for installing self-generation sources for the Watchung School. Based on the configuration of the site and its loads there is a low potential for installing any PV and combined heat and power self-generation measures.

For details on our evaluation and the self-generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, the equipment changes outlined for each ECM need to be selected and installed through project implementation. One of the first considerations is if there is capital available for project implementation. Another consideration is whether to pursue individual ECMs, a group of ECMs, or a comprehensive approach wherein all ECMs are pursued, potentially in conjunction with other facility projects or improvements.

Rebates, incentives, and financing are available from the NJBPU, NJCEP, as well as some of the state's investor-owned utilities, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any project, please review the appropriate incentive program guidelines before proceeding. This is important because in most cases you will need to submit an application for the incentives before purchasing materials and beginning installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- Energy Savings Improvement Program (ESIP)

For facilities with capital available for implementation of selected individual measures or phasing implementation of selected measures over multiple years, incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to design the ECM(s), select the equipment and apply for the incentive(s). Program pre-approval is required for some SmartStart incentives, so only after receiving approval may the ECM(s) be installed. The incentive values listed above in Figure 3 represent the SmartStart program and will be explained further in Section 8, as well as the other programs as mentioned below.

This facility also qualifies for the Direct Install program which, through an authorized network of participating contractors, can assist with the implementation of a group of measures versus installing individual measures or phasing implementation. This program is designed to be turnkey and will provide an incentive up to 70% of the cost of the project identified by the designated contractor.

For facilities without capital available to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with external project development, design, and implementation services as well as financing for implementing ECMs. This LGEA report is the first step for participating in ESIP and should help you determine next steps. Refer to Section 8.3 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a program (non-NJCEP) designed to reduce consumer electric load when wholesale electricity prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally. By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load. Refer to Section 7 for additional information on this program.

Additional descriptions of all relevant incentive programs are located in Section 8 or: www.njcleanenergy.com/ci.

To ensure projects are implemented such that maximum savings and incentives are achieved, bids and specifications should be reviewed by your procurement personnel and/or consultant(s) to ensure that selected equipment coincides with LGEA recommendations, as well as applicable incentive program guidelines and requirements.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 4 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Brian Fleischer	Business Administrator	bfleischer@montclair.k12.nj.us	(973) 509-4050
Designated Representative			
Clarren Vanperzee	Custodian		(973) 509-4044
TRC Energy Services			
Moussa Traore	Auditor	mtraore@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 14, 2016, TRC performed an energy audit at the Watchung School located in Montclair, New Jersey. TRC's auditor met with Clarren Vanperzee to review the facility operations and focus the investigation on specific energy-using systems.

The 52,109 square feet school facility is a three-story building comprised of classrooms, gymnasium, administration offices, auditorium, nurse's room, kitchen, mechanical room, and storage areas within two buildings connected by a hallway. The building was originally constructed in 1900 and expanded to accommodate additional classrooms and other spaces in 1908, 1917, 1924, and the greenhouse was added in 2002.

2.3 Building Occupancy

The school operates on a 10-month schedule and is open Monday through Friday. The typical schedule is presented in the table below. During a typical day, the school is occupied by approximately 440 students and 39 staff.

Figure 5 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Watchung School	Weekday	7:00 AM - 4:30 PM
Watchung School	Weekend	Closed

2.4 Building Envelope

The three-story buildings have a reinforced concrete foundation. They have flat roof areas covered with a white synthetic rubber: EPDM roofing (ethylene propylene diene monomer). They are in good condition with no signs of leakage. Exterior walls are finished with brick masonry, and the windows throughout the facility are double paned glass with aluminum frames and are in acceptable condition showing little sign of outside air infiltration. Exterior doors are constructed of metal.



Image 1 – Building Envelope

2.5 On-site Generation

The Watchung School does not have any on-site electric generation capacity.

2.6 Energy-Using Systems

Please refer to Appendix A: Equipment Inventory & Recommendations for an inventory of your equipment.

Lighting System

Lighting at the facility is provided predominately by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as compact fluorescent lamps (CFL) and incandescent lamps. Most of the building spaces use 1-lamp or 2-lamp, 4-foot long fixtures. The auditorium is illuminated with 100-Watt wall mounted incandescent lamps while the gymnasium is lit with 52-Watt CFL lamps. Several storage rooms and closets are illuminated with a mix of incandescent and compact fluorescent lamps. Exit signs throughout the facility are incandescent. Lighting control is provided mainly by manual wall switches. The school has minimal exterior lighting, consisting of 150-Watt metal halide and 175-Watt mercury vapor lamps. Exterior fixtures are controlled with photocells.

Steam System

The steam system consists of two Weil McLain 2,848 kBtu/hr output boilers. The boilers are two and 28 years old. The new unit has a combustion efficiency of 84% while the older unit is at 75%. The 28-year-old boiler has passed its useful service life. The two boilers operate in lead/lag operation with only one boiler operating at one time. Each boiler has a 3 hp forced draft fan with discharge dampers to control the volume of combustion air, and a 0.8 hp constant speed feed water pump. The boiler water levels are controlled by valves. Steam is supplied to radiators and fan coil units at 15 psi, and roughly 75% of the condensate is returned to the feed water system via the two 3 hp condenser water pumps. Space temperatures are controlled by local thermostats.



Image 2 – Steam System

Air Conditioning (DX)



Image 3 – Air Conditioning

The cooling system consists of 20 window units and eight split ACs. The split ACs range from 1.5 to 3 tons and are all two years old. The window units are four years old and appeared in good condition. Only the unit serving room 19 appears to be in poor condition. The split AC systems are controlled with programmable thermostats.

Domestic Hot Water

Domestic hot water for the school consists of one A.O. Smith gas fired non-condensing hot water heater with an input rating of 75,000 KBtu/hr and a nominal efficiency of 80%. The water heater is one year old and has a 74-gallon storage tank.

Food Service & Refrigeration

The school houses a small non-commercial kitchen for light cooking. The kitchen appliances include a gas cooking range, gas warmers, a stand-up refrigerator and freezer. The kitchen is well maintained.

Plug load & Vending Machines

There are approximately 52 computer work stations throughout the facility and they are mostly desktop units with LCD monitors. There is no centralized PC power management software installed. The facility has one refrigerated beverage vending machine located in the teacher room.

2.7 Water-Using Systems

There are several restrooms at this facility. A sampling of restrooms found that all of the faucets are rated for 2.0 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf) and the urinals are rated at 2 gpf. The kitchen has faucets that rated for 2.5 gpm or higher. There is no restroom with showers.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost/ft^2 and energy use/ft^2. These energy use indices are indicative of the relative energy effectiveness of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy use for other facilities identified as: School (K-12). Specific local climate conditions, daily occupancy hours of the facility, seasonal fluctuations in occupancy, daily operating hours of energy use systems, and the behavior of the occupants with regard to operating systems that impact energy use such as turning off appliances and leaving windows open. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

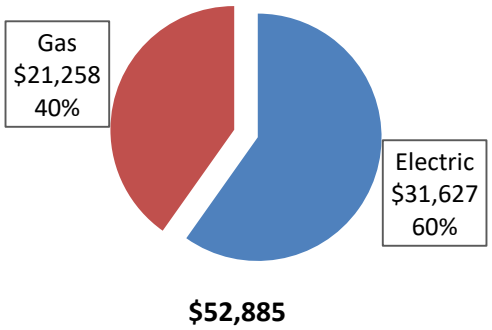
The following energy consumption and cost data is based on the last 12 month period of utility usage data that was provided for each utility. The annual consumption and cost was developed from this information.

Figure 6 - Utility Summary

Utility Summary for Watchung School		
Fuel	**Usage**	**Cost**
Electricity	215,729 kWh	$31,627
Natural Gas	26,953 Therms	$21,258
Total		**$52,885**

The current utility cost for this site is $52,885 as shown in the chart below.

Figure 7 - Energy Cost Breakdown



$52,885

3.2 Electricity Usage

Electricity is provided by PSE&G. The average electric cost (combined for commodity, transmission and distribution) for the past 12 months is $0.126/kWh, which is the blended rate used throughout the analyses in this report. The monthly electricity consumption and peak demand is represented graphically in the chart below. The electricity use profile reflects low occupancy in the summer months.

Figure 8 - Electric Usage & Demand

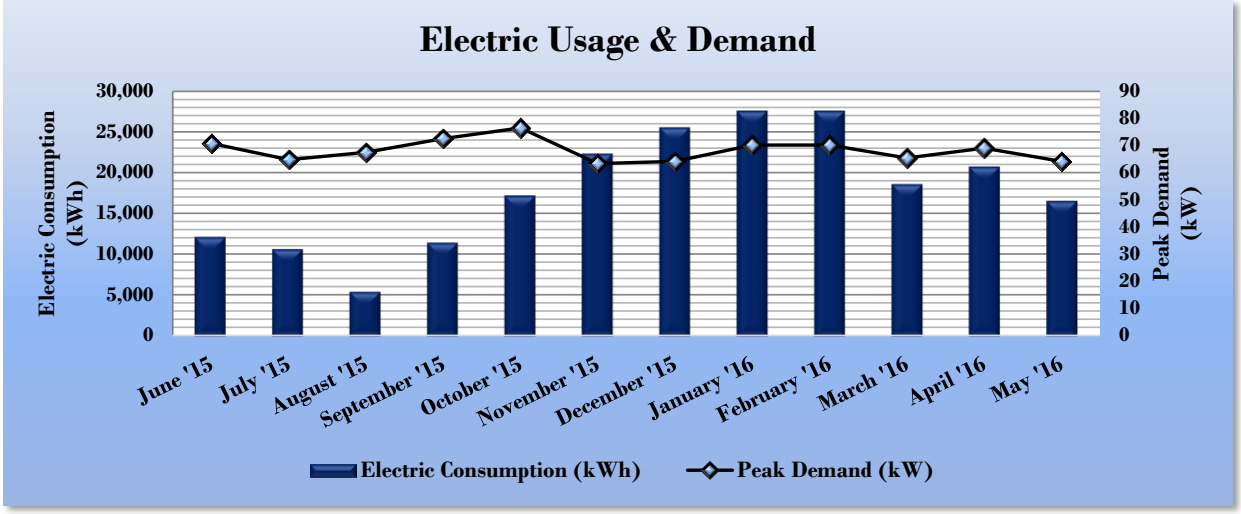


Figure 9 - Electric Usage & Demand

Electric Billing Data for Watchung School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
6/16/15	30	12,120	71	$316	$2,522
7/17/15	31	10,650	65	$599	$2,244
8/17/15	30	5,430	68	$307	$1,561
9/16/15	30	11,430	73	$281	$2,404
10/16/15	31	17,220	77	$293	$2,472
11/16/15	30	22,325	63	$316	$3,032
12/16/15	30	25,535	64	$334	$3,362
1/17/16	31	27,565	70	$276	$3,384
2/17/16	31	27,564	70	$280	$3,384
3/16/16	31	18,600	65	$873	$2,413
4/16/16	29	20,730	69	$306	$2,673
5/17/16	31	16,560	64	$287	$2,176
Totals	**365**	**215,729**	**76.5**	**$4,469**	**$31,627**
Annual	**365**	**215,729**	**76.5**	**$4,469**	**$31,627**

3.3 Natural Gas Usage

Natural gas is provided by PSE&G. The average gas cost for the past 12 months is $0.789/therm, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is represented graphically in the chart below. The gas use profile is typical for a facility with a significant heating load relative to other end uses.

Figure 10 - Natural Gas Usage

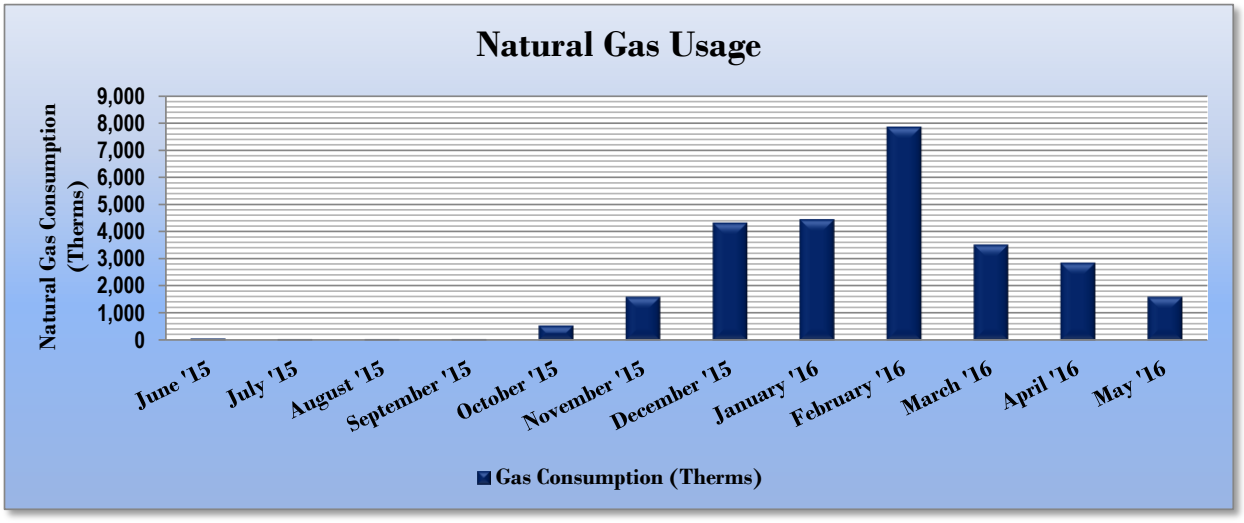


Figure 11 - Natural Gas Usage

Gas Billing Data for Watchung School				
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost	TRC Estimated Usage?
6/16/15	30	70	$150	Yes
7/17/15	31	50	$131	Yes
8/17/15	30	49	$131	No
9/16/15	30	43	$120	No
10/16/15	31	548	$403	No
11/16/15	30	1,598	$1,816	No
12/16/15	30	4,326	$3,472	No
1/17/16	31	4,447	$3,546	No
2/17/16	31	7,847	$5,747	No
3/16/16	31	3,516	$3,119	Yes
4/16/16	29	2,858	$1,650	No
5/17/16	31	1,601	$973	No
Totals	**365**	**26,953**	**$21,258**	3
Annual	**365**	**26,953**	**$21,258**	

3.4 Benchmarking

This facility was benchmarked through Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and compares its performance against a yearly baseline, national medians, or similar buildings in your portfolio. Metrics used in this comparison are the Energy Use Intensity (EUI) and ENERGY STAR® score.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more energy than similar buildings on a square foot basis or if that building performs better than the median. EUI is presented in both site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy is the raw fuel consumed to generate the energy consumed at the site, factoring in energy production and distribution losses.

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Watchung School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	98.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	65.8	58.2

By implementing all recommended measures covered in this reporting, the project's estimated post-implementation EUI improves as shown in the table below:

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Watchung School	National Median Building Type: School (K-12)
Source Energy Use Intensity (kBtu/ft^2)	77.7	141.4
Site Energy Use Intensity (kBtu/ft^2)	58.6	58.2

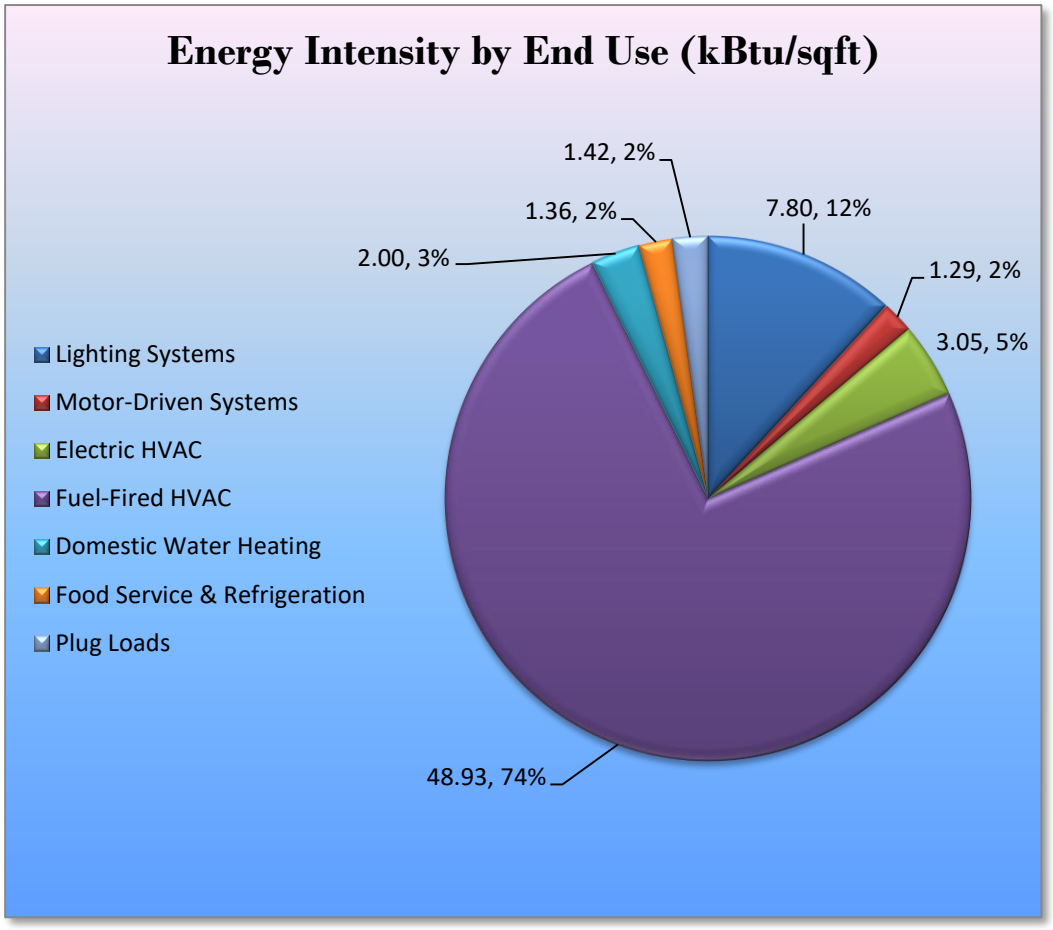
Many buildings can also receive a 1 – 100 ENERGY STAR® score. This score compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide — and may be eligible for ENERGY STAR® certification. This facility has a current score of 52.

The Portfolio Manager®, Statement of Energy Performance can be found in Appendix B: ENERGY STAR® Statement of Energy Performance.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building and determine their proportional contribution to overall building energy usage. This visual representation of energy end uses highlights systems that may benefit most from energy efficiency projects.

Figure 14 - Energy Balance (% and kBtu/SF)



4 ENERGY CONSERVATION MEASURES

Level of Analysis

The goal of this audit report is to identify potential energy projects, help prioritize specific measures for implementation, and set the Watchung School on the path to receive financial incentives. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is considered sufficient to make "Go/No-Go" decisions and to prioritize energy projects. Savings are based on the New Jersey Board of Public Utilities New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016. Further analysis or investigation may be required to calculate more accurate savings to support any custom SmartStart, Pay for Performance, or Large Energy Users incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Depending on your implementation strategy, the project may be eligible for more lucrative incentives through other programs as identified in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 15 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**87,875**	**21.3**	**0.0**	**$11,062.52**	**$54,625.36**	**$8,020.00**	**$46,605.36**	**4.21**	**88,489**
ECM 1	Install LED Fixtures	23,287	4.7	0.0	$2,931.59	$16,761.33	$2,310.00	$14,451.33	4.93	23,450
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,305	0.3	0.0	$164.33	$1,350.00	$85.00	$1,265.00	7.70	1,315
ECM 3	Retrofit Fixtures with LED Lamps	62,154	16.2	0.0	$7,824.55	$35,008.26	$5,625.00	$29,383.26	3.76	62,589
ECM 4	Install LED Exit Signs	1,128	0.1	0.0	$142.04	$1,505.77	$0.00	$1,505.77	10.60	1,136
Lighting Control Measures		**9,932**	**2.6**	**0.0**	**$1,250.38**	**$5,760.00**	**$770.00**	**$4,990.00**	**3.99**	**10,002**
ECM 5	Install Occupancy Sensor Lighting Controls	9,932	2.6	0.0	$1,250.38	$5,760.00	$770.00	$4,990.00	3.99	10,002
Domestic Water Heating Upgrade		**0**	**0.0**	**41.7**	**$328.66**	**$93.21**	**$0.00**	**$93.21**	**0.28**	**4,879**
ECM 6	Install Low-Flow Domestic Hot Water Devices	0	0.0	41.7	$328.66	$93.21	$0.00	$93.21	0.28	4,879
TOTALS		**97,807**	**23.9**	**41.7**	**$12,641.56**	**$60,478.57**	**$8,790.00**	**$51,688.57**	**4.09**	**103,370**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for lighting upgrades are summarized Figure 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**87,875**	**21.3**	**0.0**	**$11,062.52**	**$54,625.36**	**$8,020.00**	**$46,605.36**	**4.21**	**88,489**
ECM 1	Install LED Fixtures	23,287	4.7	0.0	$2,931.59	$16,761.33	$2,310.00	$14,451.33	4.93	23,450
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	1,305	0.3	0.0	$164.33	$1,350.00	$85.00	$1,265.00	7.70	1,315
ECM 3	Retrofit Fixtures with LED Lamps	62,154	16.2	0.0	$7,824.55	$35,008.26	$5,625.00	$29,383.26	3.76	62,589
ECM 4	Install LED Exit Signs	1,128	0.1	0.0	$142.04	$1,505.77	$0.00	$1,505.77	10.60	1,136

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	12,785	3.3	0.0	$1,609.48	$10,901.18	$810.00	$10,091.18	6.27	12,874
Exterior	10,502	1.4	0.0	$1,322.11	$5,860.16	$1,500.00	$4,360.16	3.30	10,576

Measure Description

This measure evaluates replacing existing fixtures with new high-performance LED light fixtures at interior and exterior locations. In the auditorium, consider removing and replacing halogen and LED sources. The Green House is illuminated with HID fixtures which should be considered for LED. High Intensity Discharge (HID) lighting along the building perimeter should also be looked at for replacement at LED source lighting. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are generally more than twice that of a fluorescent source and more than 10 times incandescent sources. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During planning and design for the installation of new fixtures, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,305	0.3	0.0	$164.33	$1,350.00	$85.00	$1,265.00	7.70	1,315
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T12 lamps, ballasts, and reflectors with LED tube lamps, reflectors, and drivers specifically designed for existing linear fluorescent fixtures. The retrofit uses the existing fixture housing but replaces the rest of the components with an efficient source and reflectors designed for LEDs. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output and efficiently projects the light into the space.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	62,154	16.2	0.0	$7,824.55	$35,008.26	$5,625.00	$29,383.26	3.76	62,589
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing linear fluorescent T8 lamps with LED tube lamps and replacing incandescent and compact fluorescent screw-in based lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed although there is a fluorescent fixture ballast in place. Other tube lamps require that fluorescent fixture ballasts be removed or replaced with LED drivers. Screw-in LED lamps can be used as a direct replacement for most other screw-in lamps. This measure saves energy by installing LED sources which use less power than other technologies with a comparable light output.

Maintenance savings are anticipated since LED sources have burn hours which are more than twice that of a fluorescent source and more than 10 times incandescent sources. LED lamps that use the existing fluorescent fixture ballast will be constrained by the remaining hours of the ballast. Maintenance savings may be partially offset by the higher material costs associated with LED sources.

During retrofit planning and design, we recommend a holistic approach that considers both the technology of the lighting sources and how they are controlled.

ECM 4: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	1,128	0.1	0.0	$142.04	$1,505.77	$0.00	$1,505.77	10.60	1,136
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.00	0

Measure Description

This measure evaluates replacing incandescent lighting in exit signs with LEDs. LED sources require virtually no maintenance and LED exit signs have a life expectancy of at least 20 years. Many manufacturers can provide retrofit kits that meet fire and safety code requirements. Retrofit kits are less expensive and simpler to install than replacement signs, however, new fixtures would have a longer useful life and are therefore recommended.

A reduction in maintenance costs will be realized with the proposed retrofit because lamps will not have to be replaced as frequently.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures summarized in Figure 17 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**9,932**	**2.6**	**0.0**	**$1,250.38**	**$5,760.00**	**$770.00**	**$4,990.00**	**3.99**	**10,002**
ECM 5	Install Occupancy Sensor Lighting Controls	9,932	2.6	0.0	$1,250.38	$5,760.00	$770.00	$4,990.00	3.99	10,002

ECM 5: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
9,932	2.6	0.0	$1,250.38	$5,760.00	$770.00	$4,990.00	3.99	10,002

Measure Description

This measure evaluates installing occupancy sensors to control light fixtures that are currently manually controlled in many restrooms, classrooms, storage rooms, and offices. Sensors detect occupancy using ultrasonic and/or infrared wave technologies. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Occupants will also be able to manually turn off fixtures. Energy savings result from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. Ceiling-mounted or remote-mounted sensors require the use of low voltage switching relays or a wireless signal to the switch. In general, use wall switch replacement sensors for single occupant offices and other small rooms. Install ceiling-mounted or remote mounted sensors in locations without local switching, in situations where the existing wall switches are not in the line-of-sight of the main work area, and in large spaces. We recommend a holistic design approach that considers both the technology of the lighting sources and how they are controlled.

Maintenance savings are anticipated due to reduced lamp operation, however, additional maintenance costs may be incurred because the occupancy sensors may require periodic adjustment; it is anticipated that the net effect on maintenance costs will be negligible.

4.1.3 Domestic Water Heating Upgrade

Our recommendations for domestic water heating improvements are summarized in Figure 18 below.

Figure 18 - Summary of Domestic Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**41.7**	**$328.66**	**$93.21**	**$0.00**	**$93.21**	**0.28**	**4,879**
ECM 6	Install Low-Flow Domestic Hot Water Devices	0	0.0	41.7	$328.66	$93.21	$0.00	$93.21	0.28	4,879

ECM 6: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	41.7	$328.66	$93.21	$0.00	$93.21	0.28	4,879

Measure Description

This measure evaluates the savings from installing low flow domestic water devices to reduce overall water flow in general and hot water flow in particular. Low flow faucet aerators reduce the water flow, relative to standard aerators, from the fixture.

All of the low flow devices reduce the overall water flow from the fixture which generally reduces the amount of hot water used resulting in energy and water savings.

4.2 ECMs Evaluated but Not Recommended

The measures below have been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in each measure description section.

Figure 19 – Summary of Evaluated but Not Recommended ECMs

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades	**1,441**	**1.4**	**0.0**	**$181.37**	**$3,481.49**	**$0.00**	**$3,481.49**	**19.20**	**1,451**
Premium Efficiency Motors	1,441	1.4	0.0	$181.37	$3,481.49	$0.00	$3,481.49	19.20	1,451
Electric Unitary HVAC Measures	**492**	**0.3**	**0.0**	**$61.99**	**$1,360.95**	**$0.00**	**$1,360.95**	**21.95**	**496**
Install High Efficiency Electric AC	492	0.3	0.0	$61.99	$1,360.95	$0.00	$1,360.95	21.95	496
Gas Heating (HVAC/Process) Replacement	**0**	**0.0**	**36.2**	**$285.90**	**$52,933.84**	**$2,848.00**	**$50,085.84**	**175.19**	**4,244**
Install High Efficiency Steam Boilers	0	0.0	36.2	$285.90	$52,933.84	$2,848.00	$50,085.84	175.19	4,244
TOTALS	**1,933**	**1.7**	**36.2**	**$529.26**	**$57,776.28**	**$2,848.00**	**$54,928.28**	**103.78**	**6,191**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,441	1.4	0.0	$181.37	$3,481.49	$0.00	$3,481.49	19.20	1,451

Measure Description

This measure evaluates replacing the two 0.8 hp boiler feed water and the two 3 hp condensate water pumps standard efficiency motors with EISA 2007 efficiency motors. The evaluation assumes existing motors will be replaced with the same size motors. It is important that the speed of each new motor match the speed of the motor it replaces as closely as possible. The base case motor efficiencies are obtained from nameplate information. Proposed case premium motor efficiencies are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016*). Savings are based on the difference between baseline and proposed efficiencies and the annual operating hours.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone.

Install High Efficiency Electric AC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
492	0.3	0.0	$61.99	$1,360.95	$0.00	$1,360.95	21.95	496

Measure Description

This measure evaluates replacing window air conditioner serving room 19 with high efficiency window air conditioner. There have been significant improvements in both compressor and fan motor efficiencies in the past several years. Therefore, electricity savings can be achieved by replacing old units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the old and new unit, the cooling load, and the annual operating hours.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone. Replace this unit with a high efficiency unit when funds are available to do so, or upon failure.

Install High Efficiency Steam Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	36.2	$285.90	$52,933.84	$2,848.00	$50,085.84	175.19	4,244

Measure Description

This measure evaluates replacing the older inefficient steam boiler with a high efficiency steam boiler. Significant improvements have been made in combustion technology resulting in increases in overall boiler efficiency. Savings result from improved combustion efficiency and reduced standby losses at low loads.

Reasons for not Recommending

The simple payback of this measure exceeds the expected useful life of the equipment and is therefore not recommended on the basis of energy savings alone. However, replacement of this boiler now would modernize the core of the heating system and help minimize deferred maintenance on the system.

5 ENERGY EFFICIENT PRACTICES

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of low or no-cost efficiency strategies. By employing certain behavioral and operational adjustments as well as performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and annual energy, operation, and maintenance costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming setpoints and sensitivity are appropriately configured.

Use Fans to Reduce Cooling Load

Utilizing ceiling fans to supplement cooling is a low cost strategy to reduce cooling load considerably. Thermostat settings can be increased by 4°F with no change in overall occupant comfort when the wind chill effect of moving air is employed for cooling.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low flow faucets or faucet aerators, low flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low flow toilets and low flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gpf and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.3 for any low-flow ECM recommendations.

6 SELF-GENERATION MEASURES

Self-generation measures include both renewable (e.g., solar, wind) and non-renewable (e.g., microturbines) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

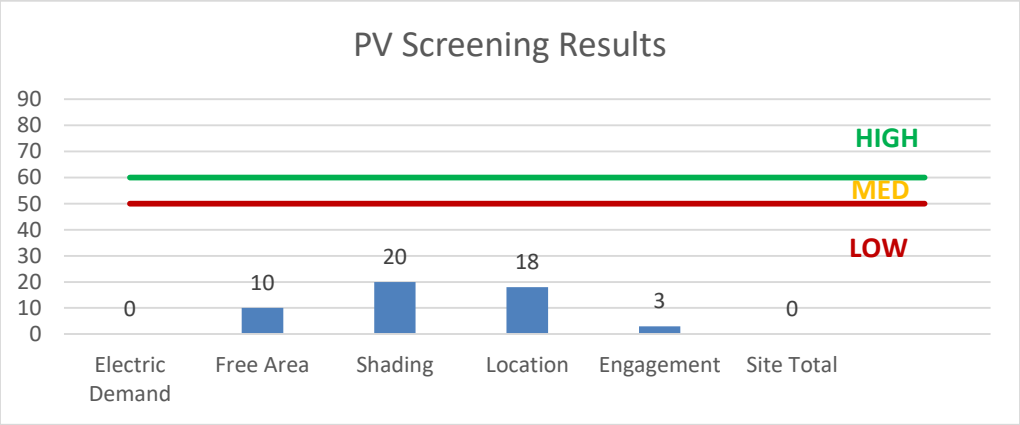
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a **Low** potential for installing a PV array.

In order to be cost-effective, a solar PV array generally needs a minimum of 4,000 square feet of flat or south-facing rooftop, or other unshaded space, on which to place the PV panels. In our opinion, the facility does appear not meet these minimum criteria for cost-effective PV installation.

Figure 20 - Photovoltaic Screening



For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

6.2 Combined Heat and Power

In non-industrial settings, combined heat and power (CHP) is the on-site generation of electricity and recovery of heat which is put to beneficial use. Common prime movers in CHP applications include reciprocating engines, microturbines, fuel cells, and (at large facilities) gas turbines. Electricity is typically interconnected to the sites local distribution system. Heat is recovered from the exhaust stream and the ancillary cooling system and interconnected to the existing hot water (or steam) distribution system.

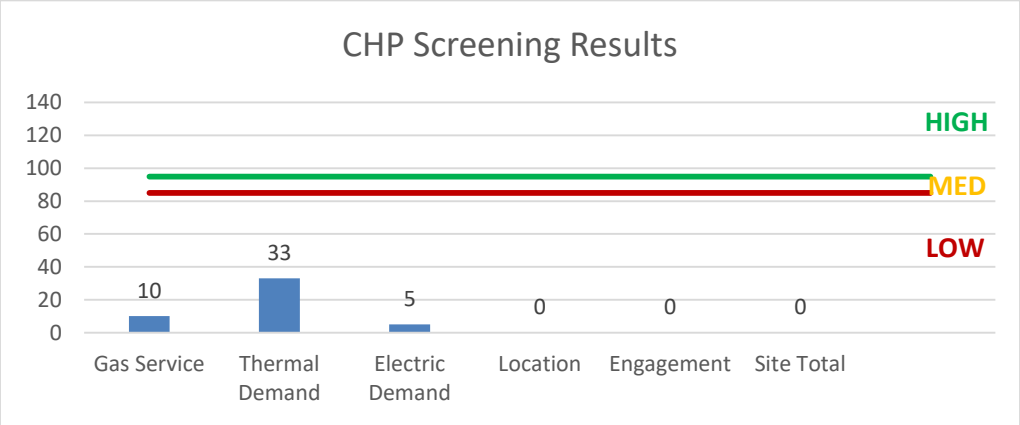
CHP systems are typically used to produce a portion of the electricity needed by a facility, with the balance of electric needs satisfied by purchase from the grid. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use for large quantities of waste heat are the best candidates for CHP.

A preliminary screening based on heating and electrical demand, siting, and interconnection shows that the facility has a **Low** potential for installing a cost-effective CHP system.

Low or infrequent thermal load, and lack of space near the existing thermal generation are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in NJ specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

Figure 21 - Combined Heat and Power Screening



7 DEMAND RESPONSE

Demand Response (DR) is a program designed to reduce consumer electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. DR service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability locally.

By enabling grid operators to call upon Curtailment Service Providers and energy consumers to reduce electric usage during times of peak demand, the grid is made more reliable and overall transmission costs are reduced for all ratepayers. Curtailment Service Providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants will receive payments whether or not their facility is called upon to curtail their load.

Typically an electric customer needs to be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with a greater capability to quickly curtail their demand during peak hours will receive higher payments. Customers with back-up generators onsite may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in a DR program often find it to be a valuable source of revenue for their facility(ies) because the payments can significantly offset annual utility costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature set points on thermostats so that air conditioning units run less frequently or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR event cycle. DR program participants often have to install smart meters and may need to also sub-meter larger energy-using equipment, such as chillers, in order to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a demand response activity in most situations.

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding the program rules and requirements for metering and controls, a facility's ability to temporarily reduce electric load, as well as the payments involved in participating in the program. Also, these providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment to help ensure compliance of all terms and conditions of a DR contract.

A preliminary screening based on the facility's electric demand and equipment configuration, shows that the facility has a low potential for participation in a DR program.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and others, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's 1999 Electricity Restructuring Law which requires all customers of investor-owned electric and gas utilities to pay this charge on their monthly energy bills. As a contributor to the fund you were able to participate in the LGEA program and are also eligible to utilize the equipment incentive programs. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 22 for a list of the eligible programs identified for each recommended ECM.

Figure 22 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install
ECM 1	Install LED Fixtures	x		x
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	x		x
ECM 3	Retrofit Fixtures with LED Lamps	x		x
ECM 4	Install LED Exit Signs			x
ECM 5	Install Occupancy Sensor Lighting Controls	x		x
ECM 6	Install Low-Flow Domestic Hot Water Devices			x

SmartStart is generally well suited for implementation of individual or small sets of measures, with the flexibility to install projects at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities to bundle measures and simplify participation, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities and requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption; applicants can use in-house staff or preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent comparison of available incentives.

Brief descriptions of all relevant alternative financing and incentive programs are located in the sections below. You may also check the following website for further information, including most current program availability, requirements, and incentive levels: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Prescriptive Equipment Incentives Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The prescriptive path provides fixed incentives for specific energy efficiency measures whereas the custom measure path provides incentives for unique or specialized technologies that are not addressed through prescriptive offerings.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at the lesser of 50% of the total installed incremental project cost, or a buy down to a one year payback. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

8.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to mid-sized facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and install those measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor assigned to the county where your facility is located; a complete list is provided on the Direct Install website identified below. The contractor will be paid the program incentive directly which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps mentioned above, and the remaining 30% of the cost is your responsibility to the contractor.

Since Direct Install offers a free assessment, LGEA applicants that do not meet the audit program eligibility requirements, but do meet the Direct Install requirements, may be moved directly into this program.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

8.3 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize the incentive programs to help further reduce costs when compiling the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Sub-basement Boiler Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Sub-basement Boiler Room	9	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,185	Relamp & Reballast	No	9	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.19	712	0.0	$89.68	$882.00	$45.00	9.33
Basement Hallway	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.01	44	0.0	$5.54	$35.90	$5.00	5.58
Basement Hallway	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.28	1,078	0.0	$135.71	$760.50	$130.00	4.65
Basement Hallway	2	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$20.29	$215.11	$0.00	10.60
Basement Hallway	1	Incandescent: 60W A Lamp	Wall Switch	60	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.03	128	0.0	$16.13	$53.75	$10.00	2.71
Room 31	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.33	1,257	0.0	$158.29	$818.00	$140.00	4.28
Bathroom	1	Incandescent: 60W A Lamp	Wall Switch	60	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.03	128	0.0	$16.13	$53.75	$10.00	2.71
CTS Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.05	210	0.0	$26.38	$233.00	$40.00	7.32
Women Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.11	419	0.0	$52.76	$504.00	$75.00	8.13
Women Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.01	44	0.0	$5.54	$35.90	$5.00	5.58
Teacher Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.29	1,107	0.0	$139.31	$686.80	$140.00	3.93
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.02	83	0.0	$10.44	$58.50	$10.00	4.65
Room 33	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.11	419	0.0	$52.76	$350.00	$60.00	5.50
Room 21	5	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.24	922	0.0	$116.09	$591.67	$120.00	4.06
Room 21	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.06	239	0.0	$30.05	$71.80	$10.00	2.06
Speech Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.05	184	0.0	$23.22	$211.13	$20.00	8.23
Speech Room	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.02	80	0.0	$10.12	$96.40	$20.00	7.55
Custodian Closet	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.04	166	0.0	$20.88	$117.00	$20.00	4.65
Storage	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.02	80	0.0	$10.12	$96.40	$20.00	7.55
Cafeteria	31	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	31	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,530	1.05	4,039	0.0	$508.45	$1,460.90	$215.00	2.45
Kitchen	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.06	239	0.0	$30.05	$71.80	$10.00	2.06
Electrical Room	1	Incandescent: 60W A Lamp	Wall Switch	60	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.03	128	0.0	$16.13	$53.75	$10.00	2.71
Boys Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,530	0.14	521	0.0	$65.61	$413.60	$55.00	5.47
Storage	2	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.12	447	0.0	$56.31	$107.51	$20.00	1.55

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 22	6	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.29	1,107	0.0	$139.31	$686.80	$140.00	3.93
Stairwell	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.17	663	0.0	$83.51	$468.00	$80.00	4.65
2nd Floor Room 6	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Room 5	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Room 4	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Room 7	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Main Hallway	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	13	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.28	1,078	0.0	$135.71	$760.50	$130.00	4.65
Main Hallway	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Main Hallway	4	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	322	0.0	$40.58	$430.22	$0.00	10.60
Mian Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.05	210	0.0	$26.38	$233.00	$40.00	7.32
Principal Office	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.14	553	0.0	$69.66	$401.40	$80.00	4.61
Data Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.05	210	0.0	$26.38	$233.00	$40.00	7.32
Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.01	40	0.0	$5.06	$48.20	$10.00	7.55
Custodian Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.01	40	0.0	$5.06	$48.20	$10.00	7.55
Room 3	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Room 1	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,185	Relamp	Yes	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,530	0.62	2,358	0.0	$296.80	$1,244.00	$245.00	3.37
Room 2	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	22	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.60	2,305	0.0	$290.20	$1,403.00	$240.00	4.01
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
Library	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	2,185	Relamp	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,530	0.49	1,886	0.0	$237.44	$1,018.40	$200.00	3.45
Library	3	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.03	121	0.0	$15.18	$144.60	$30.00	7.55

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Bathroom	1	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,530	0.03	98	0.0	$12.31	$179.20	$0.00	14.56
3rd Floor Main Hallway	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	7	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.08	308	0.0	$38.75	$251.30	$35.00	5.58
3rd Floor Main Hallway	1	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	81	0.0	$10.15	$107.56	$0.00	10.60
Room 10	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 10	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Room 11	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 11	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Room 12	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 12	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Room 13	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 13	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Girls Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.05	210	0.0	$26.38	$233.00	$20.00	8.07
Room14	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room14	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.01	40	0.0	$5.06	$48.20	$10.00	7.55
Room14	1	Halogen Incandescent: PAR38 90W	Wall Switch	90	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.05	204	0.0	$25.62	$53.75	$10.00	1.71
Nurse Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	Yes	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,530	0.06	220	0.0	$27.65	$259.60	$40.00	7.94
Bathroom	1	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.01	44	0.0	$5.54	$35.90	$5.00	5.58
Closet	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.02	80	0.0	$10.12	$96.40	$20.00	7.55
Men Bathroom	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.05	210	0.0	$26.38	$233.00	$20.00	8.07
Room 15	10	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	2,185	Relamp	Yes	10	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,530	0.48	1,844	0.0	$232.19	$1,067.33	$220.00	3.65
Room 15	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Room 9	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 9	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Room 8	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 8	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 16	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.38	1,467	0.0	$184.67	$935.00	$160.00	4.20
Room 16	2	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.02	88	0.0	$11.07	$71.80	$10.00	5.58
Annex hallway	7	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	32	2,185	Relamp	No	7	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,185	0.08	308	0.0	$38.75	$251.30	$35.00	5.58
Annex hallway	2	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$20.29	$215.11	$0.00	10.60
Room 18	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.36	1,362	0.0	$171.48	$876.50	$150.00	4.24
Room 18	1	Incandescent: 60W A Lamp	Wall Switch	60	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.03	128	0.0	$16.13	$53.75	$10.00	2.71
Room 17	13	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.36	1,362	0.0	$171.48	$876.50	$150.00	4.24
Auditorium	3	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	3	LED Exit Signs: 2 W Lamp	None	6	8,760	0.02	242	0.0	$30.44	$322.67	$0.00	10.60
Auditorium	10	Incandescent: 100 W A Lamp (Wall Sconce)	Wall Switch	100	2,185	Relamp	No	10	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.58	2,236	0.0	$281.53	$537.53	$100.00	1.55
Auditorium	12	Incandescent: 100W Hanging Pendant	Wall Switch	100	2,185	Fixture Replacement	No	12	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.70	2,684	0.0	$337.84	$763.81	$60.00	2.08
Auditorium	7	Halogen Incandescent: 575W Flood Light	Wall Switch	575	2,185	Fixture Replacement	No	7	LED - Fixtures: Architectural Flood/Spot Luminaire	Wall Switch	125	2,185	2.06	7,915	0.0	$996.44	$8,574.66	$350.00	8.25
Stage	31	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	31	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	11	2,185	1.81	6,933	0.0	$872.75	$1,973.15	$0.00	2.26
Stage	10	Halogen Incandescent: PAR38 90W	Wall Switch	90	2,185	Relamp	No	10	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.52	1,985	0.0	$249.90	$537.53	$100.00	1.75
Office	1	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	Yes	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Occupancy Sensor	11	1,530	0.06	232	0.0	$29.20	$169.75	$30.00	4.79
Closet	1	Incandescent: 100W	Wall Switch	100	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.06	224	0.0	$28.15	$53.75	$10.00	1.55
Custodian Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	33	2,185	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,185	0.01	40	0.0	$5.06	$48.20	$10.00	7.55
Room 20	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.33	1,257	0.0	$158.29	$818.00	$140.00	4.28
Room 20	1	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.06	224	0.0	$28.15	$53.75	$10.00	1.55
Room 19	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,530	0.33	1,257	0.0	$158.29	$818.00	$140.00	4.28
Room 19	1	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	1	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.06	224	0.0	$28.15	$53.75	$10.00	1.55
Mid level Basement	10	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	10	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.58	2,236	0.0	$281.53	$537.53	$100.00	1.55
Attic Floor	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,185	Relamp & Reballast	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.15	593	0.0	$74.65	$468.00	$40.00	5.73
Attic Floor	2	Incandescent: 100W A Lamp	Wall Switch	100	2,185	Relamp	No	2	LED Screw-In Lamps: Downlight Solid State Retrofit	Wall Switch	11	2,185	0.12	447	0.0	$56.31	$107.51	$20.00	1.55
Gymnasium	8	Compact Fluorescent: 52W CFL	Wall Switch	52	2,185	Relamp	No	8	LED - Fixtures: Downlight Solid State Retrofit	Wall Switch	9	2,185	0.23	864	0.0	$108.82	$509.20	$0.00	4.68
Gymnasium	2	Exit Signs: Incandescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$20.29	$215.11	$0.00	10.60

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Green House	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,185	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,185	0.06	249	0.0	$31.32	$175.50	$30.00	4.65
Green House	2	Metal Halide: (1) 250W Lamp	Wall Switch	295	2,185	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	75	2,185	0.29	1,106	0.0	$139.18	$781.35	$200.00	4.18
Green House	2	Mercury Vapor: (1) 250W Lamp	Wall Switch	290	2,185	Fixture Replacement	No	2	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Wall Switch	75	2,185	0.28	1,080	0.0	$136.02	$781.35	$200.00	4.27
Exterior Perimeter Light	4	Mercury Vapor: (1) 175W Lamp	Daylight Dimming	205	4,380	Fixture Replacement	No	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	55	4,380	0.39	3,022	0.0	$380.46	$1,562.71	$400.00	3.06
Exterior Perimeter Light	11	Metal Halide: (1) 150W Lamp	Daylight Dimming	190	4,380	Fixture Replacement	No	11	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	55	4,380	0.97	7,480	0.0	$941.65	$4,297.45	$1,100.00	3.40

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Boilers	2	Combustion Air Fan	3.0	78.0%	No	910	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Boilers	2	Boiler Feed Water Pump	0.8	68.0%	No	1,040	Yes	81.1%	No		0.20	207	0.0	$26.10	$1,728.77	$0.00	66.23
Boiler Room	Boilers	1	Air Compressor	2.0	82.0%	No	1,040	No	82.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Root Top	Hallway	1	Exhaust Fan	0.3	76.0%	No	1,040	No	76.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Root Top	Kitchen	1	Exhaust Fan	0.3	78.0%	No	1,040	No	78.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Root Top	Bathroom	1	Exhaust Fan	0.3	75.0%	No	1,040	No	75.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Root Top	Bathroom	2	Exhaust Fan	2.0	75.0%	No	1,040	No	75.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Mid Level Basement	School Building	2	Condenser Water Pump	3.0	68.0%	No	1,040	Yes	89.5%	No		1.17	1,233	0.0	$155.27	$1,752.72	$0.00	11.29
School	School Building	17	Supply Fan	0.3	71.0%	No	1,040	No	71.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Electric HVAC Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 22	Room 22	4	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 6	Room 6	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 7	Room 7	1	Window AC	1.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 5	Room 5	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 4	Room 4	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Main Office	Main Office	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Principal Office	Principal Office	1	Window AC	0.83		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 3	Room 3	1	Window AC	0.67		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 11	Room 11	1	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 10	Room 10	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 9	Room 9	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 8	Room 8	1	Window AC	1.26		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 16	Room 16	1	Window AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 18,17	Room 18,17	2	Window AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Ground Floor	Teacher Room, Room 33, Room 35	3	Split-System AC	1.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 20	Room 20	1	Window AC	1.96		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 19	Room 19	1	Window AC	1.25		Yes	1	Window AC	1.25		12.00		No	0.29	492	0.0	$61.99	$1,360.95	$0.00	21.95
Ground Floor	Room 22, Room 21, Room 31	3	Split-System AC	3.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Ground Floor	Cafeteria	1	Split-System AC	3.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Ground Floor	Speech Room	1	Split-System AC	2.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Forced Draft Steam Boiler	2,848.00	Yes	1	Forced Draft Steam Boiler	2,848.00	82.40%	Et	0.00	0	36.2	$285.90	$52,933.84	$2,848.00	175.19
Boiler Room	School	1	Forced Draft Steam Boiler	2,848.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	2	Faucet Aerator (Kitchen)	2.50	2.20	0.00	0	2.2	$17.00	$14.34	$0.00	0.84
School	11	Faucet Aerator (Lavatory)	2.00	1.00	0.00	0	39.5	$311.66	$78.87	$0.00	0.25

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions			Proposed Condi	Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	ENERGY STAR Qualified?	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Yes	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Cooking Equipment Inventory & Recommendations

	Existing Conditions			Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	High Efficiency Equipement?	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Gas Convection Oven (Half Size)	Yes	No	0.00	0	0.0	$0.00	$7,118.81	$500.00	0.00
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Yes	No	0.00	0	0.0	$0.00	$2,878.43	$300.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
School	4	Microwave	900.0	No
School	52	Desktop Computer	191.0	Yes
School	3	Copy Machine	850.0	Yes
School	5	Printer	460.0	Yes
Teacher Room	1	Refrigerator	250.0	No
Custodian Closet	1	Refrigerator	250.0	No

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions	Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Teacher Room	1	Refrigerated	No	0.00	0	0.0	$0.00	$718.80	$0.00	0.00

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

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ENERGY STAR® Score[1]

Watchung Elementary School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 52,109
Built: 1900

For Year Ending: April 30, 2016
Date Generated: December 21, 2017

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Watchung Elementary School 14 Garden Street Montclair, New Jersey 07042	Montclair Board of Education 22 Valley Road Montclair, NJ 07042 (973) 509-4050	Steve DiGeronimo 22 Valley Road Montclair, NJ 07042 (973) 509-4050 bfleischer@montclair.k12.nj.us

Property ID: 5724944

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
64.5 kBtu/ft²

Source EUI
97.2 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	734,085 (22%)
Natural Gas (kBtu)	2,629,231 (78%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	65.9
National Median Source EUI (kBtu/ft²)	99.2
% Diff from National Median Source EUI	-2%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	221

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

APPENDIX 2 ECM CALCULATIONS

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Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

ECM DESCRIPTION

Retrofit existing lighting fixtures with new energy efficient lighting fixtures, install motion sensors and implement daylight harvesting in selected areas

DATA / ASSUMPTIONS

* Heating Season	20	Weeks
** Fraction of heat to be made-up	40.0%	
Heating Hours (Weather Data)	3,948	Hours

** Fraction of the Year Representing the Cooling Season Liberal estimate of the heating season, as there are times during the year when the building is neither heated nor cooled.
*** Fraction of the Lighting Reduction that Has to Be Made Up by Heating a portion of the lighting heat is released at night plus interior zones will have limited heating loads

MEASUREMENT AND VERIFICATION

Option A - The Engineering Calculations are based on 5% of the retrofitted lighting fixtures direct kW measurements and operating hours. The kW Measurements are taken for existing lighting fixtures before removal and for new installed lighting fixtures. Lighting operating hours are agreed by client basis from the audit, logging data, and operating personal input. The occupancy sensors savings are calculated as % of operating hours basebd on logging data and historical statistical data

COMMISSIONING

Confirm lighting operation and occupancy sensors functions

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Relatively high safety factor is used for this ECM because of direct measurements are proven over the time and savings are stipulated

Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty
CALCULATIONS

Detailed energy savings calculations are in the line-by-line calculation sheet

*Inputs are blue

Building	Lighting Savings (kWh)	Lighting Savings (kW)	Lighting Hours Check (hrs)
Bradford Elementary School	95,312	24.1	3,955
Bullock Elementary School	147,621	74.2	1,990
Buzz Aldrin Middle School	244,098	61.6	3,963
Edgemont Elementary School	77,431	18.7	4,141
Glenfield Middle School	114,782	58.4	1,966
Valley Road Complex	210,583	134.7	1,564
Montclair High School	243,460	109.4	2,224
George Inness Annex (HS-9th), Athletics	126,735	23.7	5,347
Nishuane K-2	134,023	33.8	3,965
Northeast Elementary School	98,410	24.8	3,968
Renaissance Middle School	100,209	24.6	4,074
Watchung Elementary School	64,905	15.8	4,108
Woodman Field	36,312	6.5	5,586
Totals	1,693,881	610	

Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Lighting Derate	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lighting Savings	68,263	210,087	174,482	52,968	165,390	381,453	310,017	67,130	95,739	70,246	69,680	44,754	18,411
kW Savings	24	74	62	19	58	135	109	24	34	25	25	16	7
Heating Season	20	20	20	20	20	20	20	20	20	20	20	20	20
** % of Heating Season	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
***Fraction of Heat to be Made-up	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
****Annual Equivalent of Lighting kWh Saved in Therms	2,329	7,168	5,953	1,807	5,643	13,015	10,578	2,290	3,267	2,397	2,377	1,527	628
Current Boiler Efficiency	72.5%	82.0%	69.4%	72.5%	91.0%	69.6%	69.6%	64.8%	64.8%	64.8%	72.5%	73.5%	70.6%
Heating Penalty (Therms)	(667)	(2,053)	(1,705)	(518)	(1,616)	(3,728)	(3,030)	(656)	(936)	(686)	(681)	(437)	(180)
NJ BPU Protocol Calculations													
Delta kW	24.10	74.17	61.60	18.70	58.39	134.67	109.45	23.70	33.80	24.80	24.60	15.80	6.50
# of Fixtures	**910**	**1,111**	**1,792**	**444**	**1,513**	**2,915**	**2,640**	**1,003**	**1,212**	**794**	**519**	**499**	**219**
Baseline Fixture Wattage (from table)	**0.063209**	**0.106679**	**0.082249**	**0.088018**	**0.068824**	**0.071009**	**0.074246**	**0.088205**	**0.059472**	**0.067733**	**0.095607**	**0.070361**	**0.068676**
Number of Fixtures Installed	**910**	**1,111**	**1,792**	**444**	**1,513**	**2,915**	**2,640**	**1,003**	**1,212**	**794**	**519**	**499**	**219**
Watttage of New Fixtures	**0.036725**	**0.039919**	**0.047874**	**0.045901**	**0.030231**	**0.024810**	**0.032788**	**0.064576**	**0.031584**	**0.036499**	**0.048208**	**0.038697**	**0.038995**
Energy Savings (kWh/yr)	**68,263**	**210,087**	**174,482**	**52,968**	**165,390**	**381,453**	**310,017**	**67,130**	**95,739**	**70,246**	**69,680**	**44,754**	**18,411**
Hours	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**	**2,575**
HVACd	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440
HVACe	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
HVACg	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)	(0.001075)
CF	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Peak Demand Savings	**17**	**53**	**44**	**13**	**42**	**97**	**79**	**17**	**24**	**18**	**18**	**11**	**5**
Fuel Savings	**(667)**	**(2,053)**	**(1,705)**	**(518)**	**(1,616)**	**(3,728)**	**(3,030)**	**(656)**	**(936)**	**(686)**	**(681)**	**(437)**	**(180)**

Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

Prescriptive Lighting

This is a fixture replacement program for existing commercial customers targeted for facilities performing efficiency upgrades to their lighting systems. New fixtures and technologies available after publication will be periodically updated. Baselines will be established based on the guidelines noted below.

Algorithms

$$\Delta kW = (\#\ of\ replaced\ fixtures) * (baseline\ fixture\ wattage\ from\ table) - (\#\ of\ fixtures\ installed) * (wattage\ of\ new\ fixture)$$

$$\text{Energy Savings } \left(\frac{\text{kWh}}{\text{yr}}\right) = (\Delta\text{kW}) * (Hrs) * (1 + HVAC_e)$$

$$\text{Peak Demand Savings (kW)} = (\Delta\text{kW}) * (CF) * (1 + HVAC_d)$$

$$\text{Fuel Savings } \left(\frac{\text{MMBtu}}{\text{yr}}\right) = (\Delta\text{kW}) * (\text{Hrs}) * (\text{HVAC}_g)$$

Definition of Variables

ΔkW	= Change in connected load from baseline to efficient lighting level.
CF	= Coincidence factor
Hrs	= Annual hours of operation
$HVAC_d$	= HVAC interactive factor for peak demand savings
$HVAC_e$	= HVAC interactive factor for annual energy savings
$HVAC_g$	= HVAC interactive factor for annual fuel savings

Summary of Inputs

Prescriptive Lighting for Commercial Customers

Component	Type	Value	Source
ΔkW	Variable	See NGrid Fixture Wattage Table https://www1.nationalgridus.com/files/AddedPDF/POA/RILightingRetrofit1.pdf And formula above	1 Fixture counts and types, space type, floor area from customer application.
CF	Fixed	Table by Building in Performance Lighting Section Above	3
Hrs	Fixed	See Table by Building in Performance Lighting Section Above	3
$HVAC_d$	Fixed	See Table by Building Type in Performance Lighting Section Above	2
$HVAC_e$	Fixed	See Table by Building Type in Performance Lighting Section Above	2
$HVAC_g$	Fixed	See Table by Building Type in Performance Lighting Section Above	4

Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

Building Type	Sector	CF	Hours
Medical - Clinic	Large Commercial/Industrial & Small Commercial	0.8	3,909
Medical - Hospital	Large Commercial/Industrial & Small Commercial	0.8	8,760[33]
Office	Large Commercial/Industrial	0.7	2,969
	Small Commercial	0.67	2,950
Other	Large Commercial/Industrial & Small Commercial	0.66	4,573
Retail	Large Commercial/Industrial	0.96	4,920
	Small Commercial	0.86	4,926
School	Large Commercial/Industrial & Small Commercial	0.50	2,575
Warehouse/ Industrial	Large Commercial/Industrial	0.7	4,116
	Small Commercial	0.68	3,799
Unknown[34]	Large Commercial/Industrial	0.50	2,575
Multifamily – Common Areas[35]	Multifamily	0.86	5,950
Multifamily – In-Unit[36]	Multifamily	0.59	679
Multifamily – Exterior[36]	Multifamily	0.00	3,338

Montclair Board of Education
Exhibit D
ECM 1A LED Lighting
Lighting Upgrade and Heating Penalty

HVAC Interactive Effects

Building Type	Demand Waste Heat Factor ($HVAC_d$)		Annual Energy Waste Heat Factor by Cooling/Heating Type ($HVAC_e$)			
	AC (Utility)	AC (PJM)	AC/ NonElec	AC/ ElecRes	Heat Pump	NoAC/ ElecRes
Office	0.35	0.32	0.10	-0.15	-0.06	-0.25
Retail	0.27	0.26	0.06	-0.17	-0.05	-0.23
Education	0.44	0.44	0.10	-0.19	-0.04	-0.29
Warehouse	0.22	0.23	0.02	-0.25	-0.11	-0.27
Other[36]	0.34	0.32	0.08	-0.18	-0.07	-0.26

Interactive Factor (HVACg) for Annual Fuel Savings

Project Type	Fuel Type	Impact (MMBtu/ΔkWh)
Large Retrofit (> 200 kW)	C&I Gas Heat	-0.00023
Large Retrofit (> 200 kW)	Oil	-0.00046
Small Retrofit (≤ 200 kW)	Gas Heat	-0.001075
Small Retrofit (> 200 kW)	Oil Heat	-0.000120

Montclair Board of Education
Exhibit D
ECM 1B Lighting Controls
Lighting Controls and Heating Penalty

ECM DESCRIPTION

Install motion and photo sensors in selected areas

DATA / ASSUMPTIONS

* Heating Season	20	Weeks
** Fraction of heat to be made-up	40.0%	
Heating Hours (Weather Data)	3,948	Hours

** Fraction of the Year Representing the Cooling Season Liberal estimate of the heating season, as there are times during the year when the building is neither heated nor cooled.
*** Fraction of the Lighting Reduction that Has to Be Made Up by Heating a portion of the lighting heat is released at night plus interior zones will have limited heating loads

MEASUREMENT AND VERIFICATION

Option A - The Engineering Calculations are based on 5% of the retrofitted lighting fixtures direct kW measurements and operating hours. The kW Measurements are taken for existing lighting fixtures before removal and for new installed lighting fixtures. Lighting operating hours are agreed by client basis from the audit, logging data, and operating personal input. The occupancy sensors savings are calculated as % of operating hours basebd on logging data and historical statistical data

COMMISSIONING

Confirm lighting operation and occupancy sensors functions

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Relatively high safety factor is used for this ECM because of direct measurements are proven over the time and savings are stipulated

Montclair Board of Education
Exhibit D
ECM 1B Lighting Controls
Lighting Controls and Heating Penalty

CALCULATIONS

Detailed energy savings calculations are in the line-by-line calculation sheet

*Inputs are blue

Building	Lighting Controls Savings (kWh)
Bullock Elementary School	3,456
Valley Road Complex	1,320
Montclair High School	154
Totals	**4,930**

CALCULATIONS

	Bullock Elementary School	Valley Road Complex	Montclair High School
Lighting Safety Factor	0%	0%	0%
Lighting Savings	2,385	745	593
Heating Season	20	20	20
** % of Heating Season	38%	38%	38%
***Fraction of Heat to be Made-up	40%	40%	40%
****Annual Equivalent of Lighting kWh Saved in Therms	81	25	20
Current Boiler Efficiency	82.0%	69.6%	69.6%
Heating Penalty	(15)	(6)	(4)
NJ BPU Protocol Calculations			
kWc	4.80	1.50	0.70
SVG	30%	30%	30%
CF	0.57	0.57	0.57
EFLH	1,440	1,440	2,456
IF	0.15	0.15	0.15
Energy Savings (kWh)	**2,385**	**745**	**593**
Demand Savings (kW)	**0.94**	**0.29**	**0.14**

Montclair Board of Education
Exhibit D
ECM 1B Lighting Controls
Lighting Controls and Heating Penalty

Lighting Controls

Component	Type	Value	Source
kW_c	Variable	Load connected to control	Application
SVG	Fixed	Occupancy Sensor, Controlled Hi-Low Fluorescent Control, LED and controlled HID = 30% Daylight Dimmer System=50%	See sources below
CF	Fixed	See Lighting Table by Building in Performance Lighting Section Above	1
EFLH	Fixed	See Lighting Table by Building in Performance Lighting Section Above	2, 3
IF	Fixed	See Lighting Table by Building in Performance Lighting Section Above	2

Lighting by Building Type

Building Type	EFLH	CF	IF
Education – Primary School	1,440	0.57	0.15
Education – Secondary School	*2,456*	0.57	0.15
Education – Community College	*3,416*	0.64	0.15
Education – University	*3,416*	0.64	0.15
Grocery	*6,019*	0.88	0.13
Medical – Hospital	8,736	0.72	0.18
Medical – Clinic	*4,007*	0.72	0.18
Lodging Hotel (Guest Rooms)	1,145	0.67	0.14
Lodging Motel	8,736	1.00	0.14
Manufacturing – Light Industrial	*4,781*	0.63	0.04
Office- Large	*3,642*	0.68	0.17
Office-Small	*3,642*	0.68	0.17
Restaurant – Sit-Down	*4,089*	0.76	0.15
Restaurant – Fast-Food	6,188	0.76	0.15

Montclair Board of Education
Exhibit D
ECM 1B Lighting Controls
Lighting Controls and Heating Penalty

Retail – 3-Story Large	*4,103*	0.78	0.11
Retail – Single-Story Large	*4,103*	0.78	0.11
Retail – Small	*4,103*	0.78	0.11
Storage Conditioned	4,290	0.69	0.06
Storage Heated or Unconditioned	4,290	0.69	0.00
Warehouse	*4,009*	0.69	0.06
Average = Miscellaneous	*4,268*	0.72	0.13

*Note: Figures in italics are derived from NEEP Report – July 2011 (source #5)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Bradford Elementary School	Elec. Room - RM 1	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Custodian - RM 2	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	BR - RM 3	1	0.1200	0.0090	Incandescent, (1) 120W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Boiler - RM 4	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Boiler - RM 4	10	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage / Elec. - RM 5	5	0.0600	0.0125	Fluorescent, (1) 48", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage / Elec. - RM 5	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage 2 - RM 6	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Storage 3 - RM 7	4	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage 3 - RM 7	1	0.0600	0.0125	Fluorescent, (1) 48", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Tunnel - RM 8	5	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	BF Office - RM 9	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	BF Office - RM 9	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	BF Storage - RM 10	1	0.2000	0.0120	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	Bradford Elementary School	BF Storage - RM 10	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Class 2 - RM 11	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Small BR - RM 12	1	0.2000	0.0120	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	Bradford Elementary School	Class 1 - RM 13	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 1 - RM 13	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 1 - RM 13	1	0.2000	0.0120	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	Bradford Elementary School	Corridor 4 - RM 14	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Paper Storage - RM 15	1	0.2000	0.0120	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	Bradford Elementary School	Copy Room - RM 16	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Copy Room - RM 16	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Mechanical - RM 17	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Music Room - rM 18	20	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Music Room - rM 18	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Instrument Storage - RM 19	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Teacher's Lounge - RM 20	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Teacher's Lounge - RM 20	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Teacher's Lounge - RM 20	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Main Office - RM 21	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Main Office - RM 21	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Speech Room 5A - RM 22	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 5 - RM 23	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Nurse - RM 24	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Nurse - RM 24	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Girls RR - RM 25	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 4 - RM 26	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 4 - RM 26	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 3 - RM 27	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Custodian - RM 28	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Bradford Elementary School	Boys RR - RM 29	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 3 - RM 30	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 3 - RM 30	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 3 - RM 30	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 3 - RM 30	3	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Corridor 3 - RM 30	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Class 6 - RM 31	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 7 - RM 32	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Food Service - RM 33	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Back Storage - RM 34	6	0.0260	0.0140	CFL: 26W	Relamp/Reballast: LED 1-Lamp PL 4-Pin
Montclair BOE	Bradford Elementary School	Gym Lobby - RM 35	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Gym Lobby / Gym - RM 35	3	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Gym - RM 36	6	0.2950	0.1001	Metal Halide, (1) 250W lamp	Relamp: LED - Replacement for High-Bay Luminaires: 100W
Montclair BOE	Bradford Elementary School	Gym - RM 36	6	0.2950	0.1001	Metal Halide, (1) 250W lamp	Relamp: LED - Replacement for High-Bay Luminaires: 100W
Montclair BOE	Bradford Elementary School	Corridor 1 & 2 - RM 37	9	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 1 & 2 - RM 37	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Courtyard Hall - RM 38	9	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Elev. Mech / Hall - RM 39	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Meter Room -RM 40	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Guidance - RM 41	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Guidance - RM 41	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Bradford Elementary School	Class 8 - RM 42	1	0.0550	0.0280	CFL: 55W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 9 - RM 43	1	0.0550	0.0280	CFL: 55W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Bradford Elementary School	Faculty BR - RM 44	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Library Work Room - RM 45	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Media Center / Library - RM 46	32	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Media Center / Library - RM 46	24	0.0260	0.0140	CFL: 26W	Relamp/Reballast: LED 1-Lamp PL 4-Pin
Montclair BOE	Bradford Elementary School	Media Center / Library - RM 46	8	0.1280	0.1120	Fluorescent, (4) 48", T5 lamp	Relamp/Reballast: Plug & Play LED - 4-Lamp - 4-Foot T5HO
Montclair BOE	Bradford Elementary School	Media Center / Library - RM 46	2	0.0640	0.0560	Fluorescent, (2) 48", T5 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - 4-Foot T5HO
Montclair BOE	Bradford Elementary School	Class 11 - RM 47	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 11 - RM 47	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 11 - RM 47	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 11 - RM 47	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 10 - RM 48	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 10 - RM 48	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 10 - RM 48	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 10 - RM 48	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Girls BR - RM 49	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Girls BR - RM 49	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Custodian - RM 50	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Boys RR - RM 51	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Boys RR - RM 51	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor Hall - RM 52	11	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor Hall - RM 52	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 25 - RM 53	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 25 - RM 53	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 25 - RM 53	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 25 - RM 53	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 26 - RM 54	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 26 - RM 54	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 26 - RM 54	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 26 - RM 54	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 21 - RM 55	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 21 - RM 55	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 21 - RM 55	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 21 - RM 55	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 22 Tech. Lab - RM 56	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 22 Tech. Lab - RM 56	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 22 Tech. Lab - RM 56	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 22 Tech. Lab - RM 56	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 23 Art - RM 57	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	SAC. Office - RM 58	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	SAC. Office - RM 58	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	SAC. Office - RM 58	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	SAC. Office - RM 58	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Girls BR - RM 59	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Girls BR - RM 59	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Custodian 2 - RM 60	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Boys BR - RM 61	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Boys BR - RM 61	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	2F Corridor - RM 62	16	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage 1 - RM 63	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage 2 - RM 64	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Courtyard Hall 2 - RM 65	7	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Storage 3 - RM 66	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Elec. Closet 3 - RM 67	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Fan Room - RM 68	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Class 17 - RM 69	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 18 - RM 70	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Bradford Elementary School	Corridor 5 - RM 71	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 5 - RM 71	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Corridor 6 - RM 72	4	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 6 - RM 72	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Girls RR - RM 73	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 15 - RM 74	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 15 - RM 74	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 13 - RM 75	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 13 - RM 75	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Janitor Closet - RM 76	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Bradford Elementary School	Boys BR - RM 77	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Attic - RM 78	2	0.1500	0.0120	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	Bradford Elementary School	Class 12 - RM 79	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 12 - RM 79	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 14A Child Study - RM 80	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 14A Child Study - RM 80	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 14 - RM 81	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 16 - RM 82	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 7 - RM 83	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Corridor 7 - RM 83	2	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Class 19 - RM 84	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 19 - RM 84	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 20 - RM 85	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 20 - RM 85	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Class 19A Office - RM 86	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Janitor Closet - RM 87	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Bradford Elementary School	Stair 1 Hall 2F - RM 88	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 1 Hall 2F - RM 88	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 6 - RM 89	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 5 - RM 90	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 5 - RM 90	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 5 - RM 90	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 5 - RM 90	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 4 - RM 91	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 4 - RM 91	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 4 - RM 91	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 3 - RM 92	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 3 - RM 92	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 2 - RM 93	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 2 - RM 93	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 2 - RM 93	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 1 - RM 94	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Stair 1 - RM 94	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Bradford Elementary School	Exterior A	23	0.0660	0.0170	High Pressure Sodium, (1) 50W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 17 W
Montclair BOE	Bradford Elementary School	Exterior B	1	0.2950	0.0760	High Pressure Sodium, (1) 250W lamp	Fixture Replacement: LED Architectural Flood/Spot (25 - 150W): 76 W
Montclair BOE	Bradford Elementary School	Exterior C	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Bradford Elementary School	Exterior D	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	CR 101 - RM 1	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 102 - RM 2	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Print Room - RM 3	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Server - RM 4	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	General Office - RM 5	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	General Office - RM 5	7	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	General Office - RM 5	5	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Nurses Office - RM 6	6	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Nurses Office - RM 6	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Nurses Office - RM 6	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Nurses Office - RM 6	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls - RM 7	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls - RM 7	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Janitor - RM 8	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys - RM 9	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys - RM 9	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Buzz Aldrin Middle School	CR 105 - RM 10	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 106 - RM 11	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 107 - RM 12	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 107B - RM 13	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 108 - RM 14	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 5 / Lobby - RM 15	18	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Buzz Aldrin Middle School	Corridor 5 / Lobby - RM 15	30	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 5 / Lobby - RM 15	12	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Auditorium - RM 16	10	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Auditorium - RM 16	8	0.1000	0.1000	Incandescent, (1) 100W lamp	**No Upgrade (Controls Only)**
Montclair BOE	Buzz Aldrin Middle School	Auditorium - RM 16	5	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Stage - RM 17	3	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Stage - RM 17	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Elevator Lobby - RM 18	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 109 - RM 19	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 110 - RM 20	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 111 - RM 21	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 111 - RM 21	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Buzz Aldrin Middle School	CR 112 - RM 22	19	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 113 - RM 23	19	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 114 - RM 24	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 114 - RM 24	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Buzz Aldrin Middle School	Custodian - RM 25	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Faculty RR - RM 26	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Girls RR - RM 27	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls RR - RM 27	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 28	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 28	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Corridor 7 - RM 29	25	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 7 - RM 29	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 7 - RM 29	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 7 - RM 29	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 115 - RM 30	20	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 115A - RM 31	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 116 - RM 32	20	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 117 - RM 33	20	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Supplies - RM 34	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 8 - RM 35	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Large Gym - RM 36	16	0.2950	0.2950	Metal Halide, (1) 250W lamp	**No Upgrade (Controls Only)**
Montclair BOE	Buzz Aldrin Middle School	Large Gym - RM 36	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Gym Connect. - RM 37	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Small Gym - RM 38	14	0.2950	0.2950	Metal Halide, (1) 250W lamp	**No Upgrade (Controls Only)**
Montclair BOE	Buzz Aldrin Middle School	Small Gym - RM 38	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Small Gym - RM 38	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Small Gym - RM 38	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Supplies - RM 39	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 6 - RM 40	46	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 17 - RM 41	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 17 - RM 41	6	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	Buzz Aldrin Middle School	Work Area - RM 42	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Work Area - RM 42	2	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	Buzz Aldrin Middle School	CR 16 - RM 43	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 16 - RM 43	6	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	Buzz Aldrin Middle School	Cust. / Plennum - RM 44	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Cust. / Plennum - RM 44	10	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Mech. - RM 45	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Cafeteria - RM 46	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Cafeteria - RM 46	10	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Cafeteria - RM 46	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Serving - RM 47	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Teachers RR - RM 48	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Teachers RR - RM 48	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Teachers Café - RM 49	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Electrical - RM 50	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Electrical - RM 50	4	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Teachers Lounge - RM 51	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Teachers Lounge - RM 51	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Office - RM 52	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Buzz Aldrin Middle School	Office - RM 52	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 3 - RM 53	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 3 - RM 53	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 2 - RM 54	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 2 - RM 54	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 1A/1B - RM 55	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 1A/1B - RM 55	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	SGI 1A/1B - RM 55	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 1 & 2 - RM 56	28	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 1 & 2 - RM 56	20	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boiler Full - RM 57	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boiler Full - RM 57	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boiler Full - RM 57	29	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boiler Full - RM 57	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Custodians - RM 58	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Elev. Lobby - RM 59	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Supply - RM 60	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Supply - RM 60	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Music / Instr. - RM 61	27	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls Locker - RM 62	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls Locker - RM 62	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls Locker - RM 62	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 20A/B - RM 63	25	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 20A/B - RM 63	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 20A/B - RM 63	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 22 - RM 64	25	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 23 - RM 65	36	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 23 - RM 65	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 23 - RM 65	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 24 - RM 66	21	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 24 - RM 66	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 25 - RM 67	21	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys Locker - RM 68	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys Locker - RM 68	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys Locker - RM 68	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 69	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 69	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 69	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Custodian - RM 70	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Buzz Aldrin Middle School	Mens RR - RM 71	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Mens RR - RM 71	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Dark Room - RM 72	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	All Gender RR - RM 73	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Women RR - RM 74	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Women RR - RM 74	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Women RR - RM 74	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 4 - RM 75	23	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 3 - RM 76	45	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 201 - RM 77	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 202 - RM 78	19	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 202 - RM 78	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Custodian - RM 79	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 80	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 80	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls RR - RM 81	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls RR - RM 81	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 203 - RM 82	17	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 203A - RM 83	16	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 203A - RM 83	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 204 - RM 84	20	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 205 - RM 85	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 206 - RM 86	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 207 - RM 87	20	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 207B - RM 88	10	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 208 - RM 89	18	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 9 - RM 90	30	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 9 - RM 90	7	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 9 - RM 90	4	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Buzz Aldrin Middle School	Elev. Lobby - RM 91	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 209A - RM 92	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 209B - RM 93	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 209C - RM 94	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Mech. - RM 95	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Mech. - RM 95	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Costumes - RM 96	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 210 - RM 97	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 211 - RM 98	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 211 - RM 98	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Buzz Aldrin Middle School	CR 212 - RM 99	19	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 213A - RM 100	10	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 213A - RM 100	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Buzz Aldrin Middle School	CR 214/213 - RM 101	18	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 214/213 - RM 101	20	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 214/213 - RM 101	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Buzz Aldrin Middle School	CR 215 - RM 102	15	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 216 - RM 103	20	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 217 - RM 104	25	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	CR 217 - RM 104	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 12 - RM 105	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Custodian - RM 106	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 107	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Boys RR - RM 107	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Teachers LAV - RM 108	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Girls - RM 109	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Girls - RM 109	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 11 - RM 110	25	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Corridor 10 - RM 111	45	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 1 - RM 112	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 2 - RM 113	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 3 - RM 114	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 3 - RM 114	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Buzz Aldrin Middle School	Stair 4 - RM 115	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 5 - RM 116	9	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Stair 6 - RM 117	7	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Buzz Aldrin Middle School	Exterior A	2	0.0950	0.0420	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Fuel Pump Canopy (40 - 125W): 43 W
Montclair BOE	Buzz Aldrin Middle School	Exterior B	8	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Buzz Aldrin Middle School	Exterior C	2	0.0950	0.0150	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 15 W
Montclair BOE	Buzz Aldrin Middle School	Exterior D	5	0.0950	0.0150	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 15 W
Montclair BOE	Edgemont Elementary School	Gym/Mutil Purpose - RM 1	20	0.4550	0.1133	Mercury Vapor, (1) 400W lamp	Relamp: LED - Replacement for High-Bay Luminaires: 113W
Montclair BOE	Edgemont Elementary School	Gym Closet - RM 2	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Art Office - RM 3	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	All Gender BR - RM 4	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boys RR - RM 5	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 8 - RM 6	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 8 - RM 6	1	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	Edgemont Elementary School	Class 7 - RM 7	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Custodian Closet - RM 8	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Edgemont Elementary School	Class 5 - RM 9	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Girls RR - RM 10	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Library - RM 11	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Library - RM 11	16	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 2 - RM 12	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Office/Principal - RM 13	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Office/Principal - RM 13	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Nurse - RM 14	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Nurse - RM 14	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Nurse - RM 14	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Supplies - RM 15	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Supplies - RM 15	1	0.2000	0.0150	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 15 W
Montclair BOE	Edgemont Elementary School	Class 21 - RM 16	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 14 - RM 17	19	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 14 - RM 17	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 13 - RM 18	19	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 13 - RM 18	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Kitchen - RM 19	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Kitchen - RM 19	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Edgemont Elementary School	Janitor Closet - RM 20	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Janitor Office - RM 21	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Janitor Office - RM 21	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 2 & 3 - RM 22	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 2 & 3 - RM 22	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 2 & 3 - RM 22	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	10	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	4	0.0190	0.0190	Fluorescent, (1) 18" T8 lamp	**No Upgrade (Controls Only)**
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 1 - RM 23	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 115 - RM 24	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 115 - RM 24	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 114 - RM 25	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 114 - RM 25	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Closet 113 - RM 26	1	0.2000	0.0150	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 15 W
Montclair BOE	Edgemont Elementary School	Corridor 5 - RM 27	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Storage - RM 28	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Attic - RM 29	3	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Attic - RM 29	1	0.0750	0.0090	Incandescent, (1) 75W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Attic - RM 29	1	0.0180	0.0090	CFL: 18W	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Attic - RM 29	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 110 - RM 30	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 109 - RM 31	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 107 - RM 32	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 106 - RM 33	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 105 - RM 34	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Teacher's Lounge - RM 35	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Teacher's Lounge - RM 35	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Class 103 - RM 36	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Corridor 4 - RM 37	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Attic - RM 38	4	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Stairs 1 - RM 39	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Stairs 1 - RM 39	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Stairs 2 - RM 40	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Stairs 2 - RM 40	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Vestibule - RM 41	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	5	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Boiler - RM 42	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Red Door 1 - RM 43	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Red Door 1 - RM 43	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Red Door 2 - RM 44	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Red Door 2 - RM 44	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Red Door 2 - RM 44	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	BF Hall - RM 45	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	BF Hall - RM 45	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	BF Hall - RM 45	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Janitor Closet - RM 46	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Edgemont Elementary School	Exterior A	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Edgemont Elementary School	Exterior B	3	0.4580	0.0600	Metal Halide, (1) 400W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 59 W
Montclair BOE	Edgemont Elementary School	Exterior C	4	0.0950	0.0150	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 15 W
Montclair BOE	Edgemont Elementary School	Exterior D	4	0.1900	0.0270	Metal Halide, (1) 150W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 27 W
Montclair BOE	Edgemont Elementary School	Exterior E	1	0.4650	0.1482	High Pressure Sodium, (1) 400W lamp	Fixture Replacement: LED Architectural Flood/Spot (25 - 150W): 148 W
Montclair BOE	Edgemont Elementary School	Exterior F	2	0.0900	0.0900	Incandescent, (1) 90W lamp	**No Upgrade (Controls Only)**
Montclair BOE	Edgemont Elementary School	Stairs 3 - RM 47	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Edgemont Elementary School	Stairs 3 - RM 47	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Cafeteria - RM 1	41	0.0850	0.0850	CFL: 85W	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Cafeteria - RM 1	8	0.0850	0.0850	CFL: 85W	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Cafeteria - RM 1	15	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Café Exit - RM 2	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Food Service - RM 3	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Food Service - RM 3	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Food Service - RM 3	2	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	George Inness School	Food Service - RM 3	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Walk-In - RM 4	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Food Sto - RM 5	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Table/Chair - RM 6	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Elevator Machine - RM 7	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Sprinkler/Electrical/Water - RM 8	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Men's RR - RM 9	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Men's RR - RM 9	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Custodian - RM 10	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Women's RR - RM 11	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Women's RR - RM 11	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Elev/Café Lobby - RM 12	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Elev/Café Lobby - RM 12	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-400A - RM 13	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-400A - RM 13	2	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	George Inness School	CR-400A - RM 13	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	George Inness School	CR-400B - RM 14	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Health Hall - RM 15	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Health Hall - RM 15	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-402 - RM 16	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-402 - RM 16	1	0.0720	0.0090	Incandescent, (1) 72W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	CR-402 - RM 16	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Janitor - RM 17	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	George Inness School	Girls Locker - RM 18	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Girls Locker - RM 18	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	STO - RM 18A	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Stair 2 - RM 19	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 2 - RM 19	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-403B - RM 20	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-403B - RM 20	5	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	CR-403A - RM 21	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-403A - RM 21	2	0.0540	0.0300	Fluorescent, (2) 48", T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - 4-Foot T8 (Stand. - 12W)
Montclair BOE	George Inness School	CR-403A - RM 21	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Scenery Storage - RM 22	5	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Scenery Storage - RM 22	4	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Scenery Storage - RM 22	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Scenery Storage - RM 22	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Back Boiler - RM 23	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Jan Loft - RM 24	4	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Boiler Main - RM 25	7	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boiler Main - RM 25	7	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boiler Main - RM 25	5	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Custodian - RM 26	1	0.0940	0.0940	Fluorescent, (2) 48", T12 lamp	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Custodian - RM 26	1	0.0400	0.0090	Incandescent, (1) 40W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Air Compressor - RM 27	2	0.3000	0.0090	Incandescent, (1) 300W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Computer STO - RM 28	1	0.3000	0.0090	Incandescent, (1) 300W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Computer STO - RM 28	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boiler Hall - RM 29	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boiler Hall - RM 29	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boiler Hall - RM 29	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Dance - RM 30	17	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Electrical/Alarm - RM 31	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Boys Lockers - RM 32	15	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boys Lockers - RM 32	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 7 - RM 33	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 7 - RM 33	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 7 - RM 33	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Jan - RM 34	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	George Inness School	CR-415 - RM 35	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Paints + Whips - RM 36	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Paints + Whips - RM 36	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Cleansers - RM 37	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Cloths + Disinfectant - RM 38	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Mops + Brooms - RM 39	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Corridor 1 - RM 40	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-501A - RM 41	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-501A - RM 41	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-501B - RM 42	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	George Inness School	CR-501B - RM 42	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Teacher's Room - RM 43	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Chemical STO - RM 44	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Custodian Break - RM 45	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	RR - RM 46	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Custodian - RM 47	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Men's RR - RM 48	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Men's RR - RM 48	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-500B - RM 49	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-500B - RM 49	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-500A - RM 50	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-500A - RM 50	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Math Hall - RM 51	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Math Hall - RM 51	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-502 - RM 52	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-504 - RM 53	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-504 - RM 53	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	George Inness School	All Gender RR - RM 54	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 2 - RM 55	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 2 - RM 55	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Girls Gym - RM 56	12	0.4550	0.4550	Mercury Vapor, (1) 400W lamp	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Gym Office - RM 57	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Jan - RM 58	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-508 - RM 59	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-510 - RM 60	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Teacher's Lounge - RM 61	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-509 - RM 62	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-507 - RM 63	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 3A - RM 64	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Auditorium - RM 65	10	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Auditorium - RM 65	8	0.0600	0.0065	Incandescent, (1) 60W lamp	Relamp: LED - Candle (2 - 7W): 6.5 W
Montclair BOE	George Inness School	Auditorium - RM 65	9	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Booth - RM 66	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Stage Left - RM 67	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stage Left - RM 67	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stage Left - RM 67	15	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	George Inness School	Stage Right - RM 68	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stage Right - RM 68	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stage Right - RM 68	15	0.0330	0.0180	Fluorescent, (2) 24", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 2-Foot T8
Montclair BOE	George Inness School	Passage - RM 69	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Passage - RM 69	1	0.0600	0.0125	Fluorescent, (1) 48", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Main Entry - RM 70	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Main Entry - RM 70	8	0.0400	0.0060	Incandescent, (1) 40W lamp	Relamp: LED - Globe (0.5 - 8W): 6 W
Montclair BOE	George Inness School	Main Office Full - RM 71	14	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Main Office Full - RM 71	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	CR-525 - RM 72	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Lockers - RM 73	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-527 - RM 74	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-531 - RM 75	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boys RR - RM 76	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Boys Gym - RM 77	12	0.4550	0.4550	Mercury Vapor, (1) 400W lamp	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Gym Office - RM 78	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Jan - RM 79	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	George Inness School	Corridor 3B - RM 80	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-602A - RM 81	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-602A - RM 81	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-602B - RM 82	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-602B - RM 82	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Teacher's Lounge - RM 83	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Teacher's Lounge - RM 83	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	602-C - RM 84	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	602-C - RM 84	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Art Supplies - RM 85	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	RR - RM 86	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Custodian - RM 87	1	0.0550	0.0280	CFL: 55W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	George Inness School	Girls RR - RM 88	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Girls RR - RM 88	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-600B - RM 89	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	George Inness School	CR-600B - RM 89	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-600A - RM 90	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-600A - RM 90	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Hallway - RM 91	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Hallway - RM 91	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-601 - RM 92	18	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Men's RR - RM 93	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 4 - RM 94	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 4 - RM 94	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	O-602 - RM 95	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Jan - RM 96	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	George Inness School	CR-604 - RM 97	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-604 - RM 97	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	CR-608 - RM 98	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-608 - RM 98	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	O-607 - RM 99	6	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-605 - RM 100	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-605A - RM 101	9	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-603 - RM 102	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 5 - RM 103	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-610 - RM 104	4	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-610 - RM 104	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-612 - RM 105	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-614 - RM 106	9	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Jan - RM 107	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	George Inness School	O-616 - RM 108	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Girls RR - RM 109	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	O-617 - RM 110	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-615 - RM 111	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-613 - RM 112	15	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	CR-611 - RM 113	6	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 6 - RM 114	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Corridor 6 - RM 114	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 10 - RM 115	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 10 - RM 115	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 10 - RM 115	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 10 - RM 115	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 10 - RM 115	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 9 - RM 116	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 9 - RM 116	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 9 - RM 116	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 9 - RM 116	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 9 - RM 116	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 8 - RM 117	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 8 - RM 117	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 8 - RM 117	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 8 - RM 117	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 6 - RM 118	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 6 - RM 118	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 6 - RM 118	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 6 - RM 118	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 6 - RM 118	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 3 - RM 119	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 3 - RM 119	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 3 - RM 119	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 3 - RM 119	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 1 - RM 120	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 1 - RM 120	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 1 - RM 120	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 1 - RM 120	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Stair 1 - RM 120	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	George Inness School	Exterior A	2	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Exterior B	1	0.0950	0.0270	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 27 W
Montclair BOE	George Inness School	Exterior C	5	0.1000	0.0120	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 12 W
Montclair BOE	George Inness School	Exterior D	6	0.2950	0.0423	Metal Halide, (1) 250W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 42 W
Montclair BOE	George Inness School	Exterior E	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	George Inness School	Exterior F	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	George Inness School	Exterior G	1	0.4580	0.0600	Metal Halide, (1) 400W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 59 W

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Nishuane School	CR 201 - RM 1	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 202 - RM 2	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	202 Storage - RM 3	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 203A - RM 4	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 203A - RM 4	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 203 - RM 5	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	203 Storage - RM 6	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 204 - RM 7	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 204 - RM 7	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	204 Storage - RM 8	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 205 - RM 9	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	205 Storage - RM 10	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 206 - RM 11	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	206 Storage - RM 12	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 207 - RM 13	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	207 Storage - RM 14	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 208 - RM 15	15	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	208 Storage - RM 16	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 209 - RM 17	15	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	209 Storage - RM 18	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 210 - RM 19	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	210 Storage - RM 20	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 211 - RM 21	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 211A - RM 22	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 212 - RM 23	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 10 - RM 24	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 213 - RM 25	16	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 214 - RM 26	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 215 - RM 27	16	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	215/216 Storage - RM 28	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 216 - RM 29	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Boys BR 2A - RM 30	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Boys BR 2A - RM 30	1	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	CR 217 - RM 31	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 11 - RM 32	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 11 - RM 32	4	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Balcony - RM 33	32	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Balcony - RM 33	6	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Balcony - RM 33	6	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Balcony - RM 33	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Girls BR 2A - RM 34	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Janitor - RM 35	1	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Corridor 9 - RM 36	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 101 - RM 37	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 102 - RM 38	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 102 - RM 38	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	CR 102 - RM 38	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	SW 1 - RM 39	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	SW 1 - RM 39	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Closet - RM 40	1	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Gen. Off. 1 - RM 41	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Gen. Off. 1 - RM 41	1	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Gen. Off. 1 - RM 41	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Gen. Off. 2 - RM 42	9	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Principal - RM 43	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Principal - RM 43	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	PTA/Server - RM 44	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Nurse Main - RM 45	11	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Nurse Main - RM 45	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Nurse Private - RM 46	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Printer - RM 47	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Files - RM 48	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 103 - RM 49	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	104 Storage - RM 50	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 105 - RM 51	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	105 Storage - RM 52	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 106 - RM 53	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 107 / Library - RM 54	42	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Nishuane School	CR 108 - RM 55	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	108 Storage - RM 56	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 104 - RM 57	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Girls RR - RM 58	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Boys RR - RM 59	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 8 & 6 - RM 60	14	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Teachers Room - RM 61	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 110 - RM 62	16	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 111 - RM 63	16	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	111/112 Storage - RM 64	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR 112 - RM 65	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Gym - RM 66	8	0.4580	0.1133	Metal Halide, (1) 400W lamp	Relamp: LED - Replacement for High-Bay Luminaires: 113W
Montclair BOE	Nishuane School	Gym Office - RM 67	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Auditorium - RM 68	30	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Auditorium - RM 68	12	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Auditorium - RM 68	64	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Corridor 7 - RM 69	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 5 - RM 70	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B1 - RM 71	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	BR B2 - RM 72	19	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Elec. / Storage - RM 73	3	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Elec. / Storage - RM 73	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Elec. / Storage - RM 73	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Custodial - RM 74	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Custodial - RM 74	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Custodial - RM 74	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Custodial - RM 74	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Custodial - RM 74	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Custodial - RM 74	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Spec. Principal - RM 75	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B5 - RM 76	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B6 - RM 77	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B6 - RM 77	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Boys RR GA - RM 78	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Girls RR GA - RM 79	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Cafeteria - RM 80	23	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Cafeteria - RM 80	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B12 - RM 81	19	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B13 - RM 82	14	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Kitchen - RM 83	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Kitchen - RM 83	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Kitchen - RM 83	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 4/2 - RM 84	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 4/2 - RM 84	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 4/2 - RM 84	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	CR B11A - RM 85	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	CR B11 - RM 86	18	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Janitor - RM 87	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Boiler - RM 88	13	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Boiler - RM 88	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Music/Computer - RM 89	33	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Music/Computer - RM 89	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Compressor - RM 90	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Compressor - RM 90	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Storage - RM 91	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Storage - RM 91	5	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Storage - RM 91	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Storage - RM 91	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Corridor 3 - RM 92	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 3 - RM 92	4	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 3 - RM 92	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Storage - RM 93	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Storage - RM 93	2	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Storage - RM 94	1	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Nishuane School	Storage - RM 95	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Resource & Vocal - RM 96	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Dance Studio - RM 97	25	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 1 - RM 98	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Nishuane School	Corridor 1 - RM 98	4	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Corridor 1 - RM 98	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 2 - RM 99	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 2 - RM 99	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 3 - RM 100	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 3 - RM 100	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 3 - RM 100	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 4 - RM 101	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 4 - RM 101	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 6 - RM 102	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 6 - RM 102	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 6 - RM 102	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 6 - RM 102	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Stairwell 7 - RM 103	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Nishuane School	Exterior A	7	0.0950	0.0150	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 15 W
Montclair BOE	Nishuane School	Exterior B	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Nishuane School	Exterior C	1	0.0950	0.0170	Metal Halide, (1) 70W lamp	Relamp: LED - A-Lamp (3 - 25W): 17 W
Montclair BOE	North East Elementary School	Media Center / Library - RM 1	39	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Media Center / Library - RM 1	3	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Media Center / Library - RM 1	18	0.0260	0.0140	CFL: 26W	Relamp/Reballast: LED 1-Lamp PL 4-Pin
Montclair BOE	North East Elementary School	Library Office - RM 2	3	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Computer Lab - RM 3	12	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Computer Lab - RM 3	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	BR / Hall - RM 4	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	BR / Hall - RM 4	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	North East Elementary School	16 Speech - RM 5	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	15 Resource - RM 6	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Elec. - RM 7	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Sprinkler - RM 8	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Elevator Room - RM 9	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor Library - RM 10	2	0.0460	0.0460	Fluorescent, (1) 36", T12 lamp	**No Upgrade (Controls Only)**
Montclair BOE	North East Elementary School	Corridor Library - RM 10	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor Library - RM 10	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	SAC Office - RM 11	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	SAC Office - RM 11	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	SAC Office - RM 11	1	0.0650	0.0100	Incandescent, (1) 65W lamp	Relamp: LED - BR30 (6 - 17W): 10 W
Montclair BOE	North East Elementary School	Class 14 - RM 12	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 13 - RM 13	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 12 ESL - RM 14	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Boys BR - RM 15	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Janitor Closet - RM 16	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Girls BR - RM 17	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	ESL Room - RM - RM 18	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Multi Purpose / Gym - RM 19	20	0.2950	0.0800	Metal Halide, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	North East Elementary School	Back Stage - RM 20	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Back Stage - RM 20	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Copy Room BR - RM 21	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Copy Room Hall - RM 22	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Men BR - RM 23	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Back Vestibule - RM 24	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	BF Corridor 1 & 2 - RM 25	14	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	BF Corridor 1 & 2 - RM 25	3	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	BF Corridor 1 & 2 - RM 25	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Boiler Room - RM 26	14	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Food Service - RM 27	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Food Service - RM 27	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 11 - RM 28	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 11 - RM 28	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 11 - RM 28	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Corr. 4 / Storage / BR - RM 29	5	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corr. 4 / Storage / BR - RM 29	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Corr. 4 / Storage / BR - RM 29	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Class 8 - RM 30	24	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 8 - RM 30	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Class 8 - RM 30	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Class 10 Art - RM 31	17	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Art / Supply Storage - RM 32	8	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Art / Supply Storage - RM 32	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	North East Elementary School	Art / Supply Storage - RM 32	1	0.3000	0.0170	Incandescent, (1) 300W lamp	Relamp: LED - A-Lamp (3 - 25W): 17 W
Montclair BOE	North East Elementary School	Janitor Closet - RM 33	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 3 Hall - RM 34	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 3 Hall - RM 34	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 3 Hall - RM 34	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Class 19 - RM 35	27	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 19 - RM 35	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Corridor 8 - RM 36	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Teachers Room -RM 37	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 20 - RM 38	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Small Closet - RM 39	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Janitor Closet - RM 40	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	North East Elementary School	Girls BR - RM 41	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 23 - RM 42	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 24 - RM 43	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Boys Br - RM 44	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 22 - RM 45	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 21 - RM 46	22	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Music - RM 47	9	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Music - RM 47	9	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Music - RM 47	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Main Office Area - RM 48	15	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Main Office Area - RM 48	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Main Office Area - RM 48	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	12	0.0150	0.0040	Incandescent, (1) 15W lamp	Relamp: LED - Candle (2 - 7W): 4 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	6	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	4	0.0150	0.0040	Incandescent, (1) 15W lamp	Relamp: LED - Candle (2 - 7W): 4 W
Montclair BOE	North East Elementary School	Corridor 7 - RM 49	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Class 25 - RM 50	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 26 - RM 51	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 27 - RM 52	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 28 - RM 53	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Fan Room - RM 54	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Class 29 - RM 55	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 29 - RM 55	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 30 ESL - RM 56	11	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 30 ESL - RM 56	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	31 Conference - RM 57	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	31 Conference - RM 57	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 32 - RM 58	11	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 32 - RM 58	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 33 - RM 59	11	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 33 - RM 59	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 34 - RM 60	11	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Class 34 - RM 60	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	35 Staff - RM 61	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	35 Staff - RM 61	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Boys BR - RM 62	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Girls BR - RM 63	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Custodian - RM 64	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Elec. Closet - RM 65	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor Hall - RM 66	9	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 5 - RM 67	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 5 - RM 67	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Corridor 6 - RM 68	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Corridor 6 - RM 68	2	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Corridor 6 - RM 68	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	North East Elementary School	Stair 1 - RM 69	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 1 - RM 69	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 2 - RM 70	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 2 - RM 70	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 3 - RM 71	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 3 - RM 71	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 3 - RM 71	1	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	North East Elementary School	Stair 4 - RM 72	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Stair 4 - RM 72	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Library Stairs - RM 73	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Library Stairs - RM 73	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Library Stairs - RM 73	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Library Stairs - RM 73	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	North East Elementary School	Und. Grd. Tunnel Stair 2 - RM 74	7	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Exterior A	5	0.0900	0.0170	Incandescent, (1) 90W lamp	Relamp: LED - PAR38 (13 - 23W): 17 W
Montclair BOE	North East Elementary School	Exterior B	3	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	North East Elementary School	Exterior C	1	0.0750	0.0140	Incandescent, (1) 75W lamp	Relamp: LED - BR40 (9 - 30W): 12 W
Montclair BOE	North East Elementary School	Exterior D	3	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	North East Elementary School	Exterior E	1	0.0650	0.0105	Incandescent, (1) 65W lamp	Relamp: LED - BR30 (6 - 17W): 12 W
Montclair BOE	Renaissance Middle School	G2 - RM 1	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G2 - RM 1	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G2 BR - RM 2	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G17 - RM 3	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G17 - RM 3	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G17 Closet - RM 4	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Girls RR - RM 5	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G18 Custodian - RM 6	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G16 - RM 7	15	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G16 BR - RM 8	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G4 & G4A - RM 9	1	0.1080	0.0125	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G4 & G4A - RM 9	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G5 Media Center - RM 10	45	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G5 Media Center - RM 10	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Boys RR - RM 11	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G14 Mech. - RM 12	2	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	G14 Mech. - RM 12	1	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	G6 - RM 13	17	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G6 BR - RM 14	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G13 Mech. - RM 15	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G12 - RM 16	4	0.1080	0.0125	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G10 - RM 17	10	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G10 Closet - RM 18	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G10 BR - RM 19	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G7 Custodian - RM 20	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G7 Closet - RM 21	1	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	G9 Storage - RM 22	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G8 Boiler - RM 23	12	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G8 Boiler - RM 23	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	G8 Storage - RM 24	2	0.1080	0.0125	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Corridor G1 Hall - RM 25	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Nurse Office - RM 26	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Nurse Office - RM 26	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Nurse BR - RM 27	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 110 - RM 28	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 110 - RM 28	6	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 110 - RM 28	12	0.0650	0.0090	Incandescent, (1) 65W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	Class 110 RR - RM 29	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 111 - RM 30	13	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 111 BR - RM 31	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Janitor - RM 32	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Renaissance Middle School	Teacher's Lounge - RM 33	10	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Teacher's Lounge - RM 33	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Teachers RR - RM 34	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	105 Main Office - RM 35	10	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	103 Principal's - RM 36	6	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Principal's BR - RM 37	1	0.0750	0.0090	Incandescent, (1) 75W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	105 Main Office Closet - RM 38	1	0.0750	0.0090	Incandescent, (1) 75W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	150 Multi/Gym - RM 39	8	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Renaissance Middle School	150 Multi/Gym - RM 39	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	150 Multi/Gym - RM 39	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Kitchen - RM 40	2	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Gym Sto. 1 - RM 41	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Gym Sto. 2 - RM 42	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Gym Sto. 3 - RM 43	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Gym Office - RM 44	2	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Renaissance Middle School	Class 120B - RM 45	18	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 120B Closet - RM 46	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 120B BR - RM 47	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 120A - RM 48	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 118 - RM 49	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 118 Sto./BR - RM 50	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	117 Resource - RM 51	5	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Corridor 2 Hall - RM 52	6	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Corridor 2 Hall - RM 52	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Renaissance Middle School	Corridor 2 Hall - RM 52	2	0.0650	0.0100	Incandescent, (1) 65W lamp	Relamp: LED - BR30 (6 - 17W): 10 W
Montclair BOE	Renaissance Middle School	Corridor 2 Hall - RM 52	8	0.0750	0.0100	Incandescent, (1) 75W lamp	Relamp: LED - BR30 (6 - 17W): 10 W
Montclair BOE	Renaissance Middle School	Corridor 2 Hall - RM 52	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 206 - RM 53	13	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 206 BR - RM 53	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	205 Guidance - RM 54	4	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 204 - RM 56	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Custodian - RM 57	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Renaissance Middle School	Boys RR - RM 58	4	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 203 - RM 59	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 202 - RM 60	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 217 - RM 61	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 216 - RM 62	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 215 - RM 63	3	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 213 - RM 64	13	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Class 213 BR - RM 65	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Girls BR - RM 66	4	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	210 Teachers - RM 67	14	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	211 Storage - RM 68	1	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	210A Storage - RM 69	4	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Renaissance Middle School	Corridor 201 Hall - RM 70	6	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Corridor 201 Hall - RM 70	12	0.0750	0.0100	Incandescent, (1) 75W lamp	Relamp: LED - BR30 (6 - 17W): 10 W
Montclair BOE	Renaissance Middle School	Stair 2 - RM 71	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 2 - RM 71	2	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 2 - RM 71	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Renaissance Middle School	Stair 2 - RM 71	1	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	Stair 3 - RM 72	2	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Renaissance Middle School	Stair 3 - RM 72	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 3 - RM 72	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 3 - RM 72	1	0.1500	0.0090	Incandescent, (1) 150W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Renaissance Middle School	Stair 4 - RM 73	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 4 - RM 73	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 1 - RM 74	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Stair 1 - RM 74	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Vestibule - RM 75	1	0.2900	0.0800	Mercury Vapor, (1) 250W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Renaissance Middle School	Exterior A	2	0.1900	0.0432	Metal Halide, (1) 150W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Renaissance Middle School	Exterior B	6	0.2950	0.0432	Metal Halide, (1) 250W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Renaissance Middle School	Exterior C	2	0.2950	0.0432	Metal Halide, (1) 250W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Renaissance Middle School	Exterior D	3	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Class 2 - RM 1	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Class 2 - RM 1	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 2 - RM 1	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 3 - RM 2	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Class 3 - RM 2	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 3 - RM 2	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Janitor Closet - RM 3	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Principal Office - RM 4	3	0.1880	0.0500	Fluorescent, (4) 48", T12 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Principal Office - RM 4	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Main Office - RM 5	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 4 - RM 6	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 4 - RM 6	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 4 - RM 6	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Class 5 - RM 7	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 5 - RM 7	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 5 - RM 7	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Class 6 - RM 8	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 6 - RM 8	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 6 - RM 8	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Class 7 - RM 9	21	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Watchung Elementary School	Class 7 - RM 9	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 7 - RM 9	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Mimeograph - RM 10	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Audiovisual - RM 11	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Library Office - RM 12	1	0.0590	0.0280	Fluorescent, (2) U-Tube, T8 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 12W
Montclair BOE	Watchung Elementary School	Library Office - RM 12	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Library - RM 13	3	0.0470	0.0270	Fluorescent, (3) 24", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Library - RM 13	12	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Library - RM 13	1	0.2000	0.0090	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Media Center - RM 14	15	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 2 - RM 15	13	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 2 - RM 15	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 2 - RM 15	4	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Watchung Elementary School	Class 17 - RM 16	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 17 - RM 16	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Upstairs Storage - RM 17	2	0.1730	0.0890	Fluorescent, (2) 96", T12 lamp	Fixture Replacement: Linear Ambient Luminaire - 8' (60 - 100W): 89 W
Montclair BOE	Watchung Elementary School	Upstairs Storage - RM 17	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Upstairs Storage - RM 17	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Gym - RM 18	8	0.0850	0.0800	CFL: 85W	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Watchung Elementary School	Janitor Closet - RM 19	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Class 19 - RM 20	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 19 - RM 20	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Class 20 Special Ed. - RM 21	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 20 Special Ed. - RM 21	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Class 18 - RM 22	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 18 - RM 22	1	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Corridor 3 - RM 23	7	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Custodian Office - RM 24	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Paper Storage - RM 25	2	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Boys BR - RM 26	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Storage - RM 27	2	0.2000	0.0090	Incandescent, (1) 200W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Storage - RM 27	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Small Hall/Stor. - RM 28	3	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Class 2 - RM 29	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 2 - RM 29	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Lunch - RM 30	29	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Lunch - RM 30	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Mech - RM 31	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Class 21 Spanish - RM 32	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 21 Spanish - RM 32	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Teacher's Lounge - RM 33	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Teacher's Lounge - RM 33	2	0.0610	0.0360	Fluorescent, (4) 24", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Boiler - RM 34	7	0.0600	0.0125	Fluorescent, (1) 48", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Boiler - RM 34	2	0.0600	0.0125	Fluorescent, (1) 48", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Boiler - RM 34	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Art - RM 35	7	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Art - RM 35	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Art - RM 35	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Girls BR - RM 36	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Girls BR - RM 36	1	0.0310	0.0310	Fluorescent, (1) 12" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Watchung Elementary School	Class 35 CFT Office - RM 37	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Girls BR Hall - RM 38	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 33 SAC - RM 39	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Miss Polizano - RM 40	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Miss Polizano - RM 40	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 1 - RM 41	5	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 1 - RM 41	1	0.1000	0.0090	Incandescent, (1) 100W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Corridor 1 - RM 41	2	0.0300	0.0023	EXIT Incandescent, (2) 15W lamp	Fixture Replacement: LED Exit Sign: 2.3 W
Montclair BOE	Watchung Elementary School	Class 16 - RM 42	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 16 - RM 42	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 16 - RM 42	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 15 - RM 43	8	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 15 - RM 43	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 14 - RM 44	8	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 14 - RM 44	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 14 - RM 44	1	0.1200	0.0140	Incandescent, (1) 120W lamp	Relamp: LED - BR40 (9 - 30W): 12 W
Montclair BOE	Watchung Elementary School	Class 14 - RM 44	1	0.0750	0.0090	Incandescent, (1) 75W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Class 13 - RM 45	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Watchung Elementary School	Class 13 - RM 45	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 13 - RM 45	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 12 - RM 46	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 12 - RM 46	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 12 - RM 46	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 11 - RM 47	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 11 - RM 47	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 11 - RM 47	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 10 - RM 48	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 10 - RM 48	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 10 - RM 48	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Girls BR - RM 49	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Janitor Closet - RM 50	1	0.0200	0.0090	Fluorescent, (1) 24", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Nurse's Office - RM 51	2	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Custodian - RM 52	1	0.0280	0.0090	Fluorescent, (1) 24", T12 lamp	Relamp: Direct Line LED - 1-Lamp - 2-Foot T8
Montclair BOE	Watchung Elementary School	Boys RR - RM 53	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 9 - RM 54	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 9 - RM 54	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 9 - RM 54	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 8 - RM 55	6	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 8 - RM 55	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Class 8 - RM 55	2	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Corridor 4 - RM 56	7	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 1 - RM 57	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 1 - RM 57	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 1 - RM 57	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 1 - RM 57	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 2 - RM 58	1	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 2 - RM 58	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Stair 2 - RM 58	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Watchung Elementary School	Exterior A	2	0.0260	0.0090	CFL: 26W	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Exterior B	6	0.1900	0.0432	Metal Halide, (1) 150W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Watchung Elementary School	Exterior C	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Watchung Elementary School	Exterior D	4	0.0950	0.0432	Metal Halide, (1) 70W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Watchung Elementary School	Exterior E	4	0.1280	0.0432	Metal Halide, (1) 100W lamp	Fixture Replacement: LED Outdoor Wall Mount (14 - 60W): 43 W
Montclair BOE	Watchung Elementary School	Exterior F	4	0.0900	0.0170	Incandescent, (1) 90W lamp	Relamp: LED - PAR38 (13 - 23W): 17 W
Montclair BOE	Woodman Field House	Vestibule - RM 1	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Sprinkler - RM 2	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Girls Locker 1 & 2 - RM 3	11	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Girls Locker 1 & 2 - RM 3	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Girls Locker 1 & 2 - RM 3	12	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boiler Room - RM 4	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Coach & Elev. - RM 5	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Coach & Elev. - RM 5	8	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Training Room - RM 6	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Training Room - RM 6	8	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Hallway 1 - RM 7	6	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Hallway 1 - RM 7	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Laundry - RM 8	1	0.1080	0.0500	Fluorescent, (4) 48", T8 lamp	Relamp: Direct Line LED - 4-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Backside Hallway - RM 9	4	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Mens RR - RM 10	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Girls RR - RM 11	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Locker Room 1 - RM 12	8	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Boys Locker Room 1 - RM 12	3	0.0130	0.0130	CFL: 13W	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Office - RM 13	1	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Open Space - RM 14	5	0.0650	0.0280	CFL: 65W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Woodman Field House	Gym - RM 15	5	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Gym - RM 15	17	0.1900	0.0800	Metal Halide, (1) 150W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Office - RM 16	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Electric Room - RM 16	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Locker Room 4 - RM 18	5	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Boys Locker Room 4 - RM 18	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Stairs 1 - RM 19	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Stairs 2 - RM 20	3	0.0280	0.0125	Fluorescent, (1) 48", T8 lamp	Relamp: Direct Line LED - 1-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Storage - RM 21	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Girls Locker 3 - RM 22	2	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Girls Locker 3 - RM 22	5	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Girls Locker 3 - RM 22	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)

Site Name	Building Name	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair BOE	Woodman Field House	Storage - RM 23	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	2nd Floor Gym - RM 24	3	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	2nd Floor Gym - RM 24	17	0.1280	0.0800	Metal Halide, (1) 100W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Head Coach - RM 25	2	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Storage - RM 26	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Open Space - RM 27	3	0.1280	0.0800	Metal Halide, (1) 100W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Boys Locker 3 - RM 28	1	0.0830	0.0375	Fluorescent, (3) 48", T8 lamp	Relamp: Direct Line LED - 3-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Locker 3 - RM 28	2	0.0640	0.0250	Fluorescent, (2) 48", T5 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Locker 3 - RM 28	8	0.0960	0.0320	Fluorescent, (2) U-Tube, T12 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 15W
Montclair BOE	Woodman Field House	Boys Locker 3 - RM 28	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Boys Locker 2 - RM 29	10	0.0960	0.0320	Fluorescent, (2) U-Tube, T12 lamp	Relamp/Reballast: Plug & Play LED - 2-Lamp - U-Bend (U6): 15W
Montclair BOE	Woodman Field House	Boys Locker 2 - RM 29	1	0.0940	0.0250	Fluorescent, (2) 48", T12 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Womens RR - RM 30	4	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Mens RR - RM 31	4	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Custodian Closet - RM 32	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	3	0.0650	0.0280	CFL: 65W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	4	0.0650	0.0280	CFL: 65W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	2	0.0650	0.0280	CFL: 65W	Relamp/Reballast: LED 2-Lamp PL 4-Pin
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	3	0.1280	0.0800	Metal Halide, (1) 100W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	4	0.1280	0.0800	Metal Halide, (1) 100W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	2	0.1280	0.0800	Metal Halide, (1) 100W lamp	Relamp: LED - Replacement for Low-Bay Luminaires: 80W
Montclair BOE	Woodman Field House	Furlong Field House - RM 33	1	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Exterior A	3	0.0540	0.0250	Fluorescent, (2) 48", T8 lamp	Relamp: Direct Line LED - 2-Lamp - 4-Foot T8 (Stand. - 12.5W)
Montclair BOE	Woodman Field House	Exterior B	2	0.0600	0.0090	Incandescent, (1) 60W lamp	Relamp: LED - A-Lamp (3 - 25W): 9 W
Montclair BOE	Woodman Field House	Exterior C	6	-	-	**LED (Controls Only)**	**No Upgrade (Controls Only)**
Montclair BOE	Woodman Field House	Exterior D	3	0.0260	0.0260	Fluorescent, (1) 8" circular lamp	**No Upgrade (Controls Only)**

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Board of Education Offices	Ext	Wall Pack 15' Rear Wall	1	0.2900	0.0759	HPS 250w	LED Wallpack, Full Cutoff, 10,000lm, Photocell
Board of Education Offices	Ext	L E D Coach At Public Entry	1	0.0140	0.0140	LED 14w	Will not be retrofit
Board of Education Offices	Ext	L E D Wall Pack	1	0.0200	0.0200	LED 20w	Will not be retrofit
Board of Education Offices	Ext	Wall Pack With Bottom Conduit	1	0.2900	0.0759	MH 250w, Bottom Conduit Entrance	LED Wallpack, Full Cutoff, 10,000lm, Photocell, BF Conduit
Board of Education Offices	ATC	Attic Level Landing	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	ATC	Attic Level Landing	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Board of Education Offices	ATC	Attic Level Storage Small	1	0.1057	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	ATC	Attic Level Storage Large	1	0.1057	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	ATC	Attic Level Storage Large	5	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	ATC	Attic Level Office	3	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	ATC	Attic Level Office	2	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	ATC	Attic Level Office	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Level 2 Copy Landing	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Office Fox	6	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Dir. Curr.	4	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Office Cubicles	7	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Spec Asst	2	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Par. Coord.	2	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Asst. Sup.	3	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Level 2 Fountain Landing	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Closet Custodial	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Board of Education Offices	2	Lounge	3	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Bathroom, Women's	1	0.1057	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	2	Business Office	15	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Business Office Sink	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Board of Education Offices	2	Accounts Payable	3	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Payroll Front	2	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Payroll Rear	2	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Bus Admin	3	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Acc	3	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	2	Copy Room	1	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	2	Break Room	11	0.1057	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	2	Vestibule	1	0.0150	0.0085	CF PL 13w	LED Retrofit Can Kit, 6 Inch, Low Outpu
Board of Education Offices	2	Conference Room	12	0.1057	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	SW	Stairwell Mezzanine	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	SW	Stairwell Mezzanine	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Board of Education Offices	1	Reception Office	12	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Personnel	18	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Personnel Private Office	4	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Corridor	3	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Safe	1	0.0700	0.0220	1x8, 1-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps, 8' Kit
Board of Education Offices	1	Sec	4	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	1	Vestibule	1	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Bathroom	1	0.1057	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	1	Closet	1	0.0165	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Board of Education Offices	1	Inclu. Spec.	4	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Pupil Services	4	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Pupil Services Sec	4	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Director Of Operations (estimated)	6	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Registration	4	0.0532	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Corridor	3	0.0532	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Board of Education Offices	1	Corridor	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Board of Education Offices	1	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Board of Education Offices	1	Work Room Superintendent	3	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	1	Work Room Superintendent	1	0.0150	0.0085	CF PL 13w	LED Retrofit Can Kit, 6 Inch, Low Outpu
Board of Education Offices	1	Superintendent	6	0.0798	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Board of Education Offices	1	Superintendent	3	0.0150	0.0085	CF PL 13w	LED Retrofit Can Kit, 6 Inch, Low Outpu
Board of Education Offices	1	Conference Room	12	0.1057	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Board of Education Offices	1	Closet Conference Room	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Board of Education Offices	B	Basement Steps	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Board of Education Offices	B	Basement Storage	1	0.0670	0.0220	1x8, 1-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 8' Kit
Board of Education Offices	B	Basement Storage	4	0.0700	0.0220	1x8, 1-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps, 8' Kit
Board of Education Offices	B	Basement Storage	5	0.0700	0.0220	1x8, 1-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps, 8' Kit
Board of Education Offices	B	Basement Crawl Space (estimated)	10	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Bullock Elementary Schoo	2	Classroom 200	7	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 200	8	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 200	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	2	Classroom 200	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Outpu
Bullock Elementary Schoo	2	Classroom 200 Storage	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Classroom 200 Rear	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 200 Rear	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 202	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 202	4	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 202	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Classroom 202	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Classroom 202 Kiln	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Classroom 202 Storage	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Classroom 204	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 204	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 204	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 204	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Outpu
Bullock Elementary Schoo	2	Classroom 206	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 206	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 206	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Bullock Elementary Schoo	2	Classroom 206	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 208	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 208	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 208	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 208	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 210	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 210	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 210	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 210	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Library	17	0.3520	0.1500	1x12, 6-Lamp T5 HO	LED Int. Driver Lamp, (6) 4' T5 HO Lamps
Bullock Elementary Schoo	2	Library	4	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	2	Library	20	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Library	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Library	3	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Library Exit Stairwel	2	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	SW	Library Exit Stairwel	2	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	SW	Library Exit Stairwel	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	2	Library Break Room	3	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Library Break Room	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	Library Office	3	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Library Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	Mechanical Vestibule	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Library Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Mechanical Room 201	10	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room 201	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room 201	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	2	Mechanical Room 201	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	A V Storage 205 B	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Classroom 203	5	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 203	2	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 203	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Hub Room (estimated)	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Tech Office	2	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Tech Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	Office 207	2	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	2	Closet Electrical (estimated)	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Elevator Machine Room	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Elevator Machine Room	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	Bathroom, Boys	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Bathroom, Boys	2	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Bathroom, Boys	2	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	2	Bathroom, Boys	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Bathroom, Girls	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Bathroom, Girls	2	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Bathroom, Girls	2	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	2	Bathroom, Girls	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Closet Custodial	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Closet Data	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room	6	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	Storage Room	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Storage Room	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Storage Room	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	Faculty Room Front	3	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Faculty Room Front	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	Faculty Room Vestibule	1	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Faculty Room Front	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Bullock Elementary Schoo	2	Faculty Room Toilet Women	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Faculty Room Toilet Men	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	2	Faculty Room Rear	5	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Faculty Room Rear	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	Faculty Room Rear	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Bullock Elementary Schoo	2	Classroom 223 A	3	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 223 A	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	2	Classroom 223 A	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 223 B	3	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 223 B	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	2	Classroom 223 B	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 225	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 225	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 225	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Reading Area 227	2	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	2	Reading Area 227	1	0.3520	0.1500	1x12, 6-Lamp T5 HO	LED Int. Driver Lamp, (6) 4' T5 HO Lamps
Bullock Elementary Schoo	2	Reading Area 227	6	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 230	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 230	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 230	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 230	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 228	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 228	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 228	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 228	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 226	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 226	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 226	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Bullock Elementary Schoo	2	Classroom 226	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 224	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 224	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 224	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 224	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 222	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 222	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 222	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 222	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Mechanical Room 220	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room 220	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	2	Mechanical Room 220	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	Classroom 218	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 218	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 218	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 218	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 216	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 216	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 216	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 216	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Classroom 214	2	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	2	Classroom 214	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	2	Classroom 214	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Classroom 214	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	2	Classroom 214	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	2	Classroom 214 Awareness Cove	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	2	Child Study	2	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	2	Child Study	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	2	C S T Office	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	2	C S T Office	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	2	Speech Therapy	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	2	Speech Therapy	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	2	Testing Room	1	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	2	Testing Room	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	2	C S T Conference Room	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	2	C S T Conference Room	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	2	Hallway Library To 200	11	0.2350	0.0580	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HE Lamps
Bullock Elementary Schoo	2	Hallway Library To 200	5	0.2350	0.0580	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HE Lamps, Battery Backup
Bullock Elementary School	2	Hallway Library To 200	2	0.0300	0.0160	CF PL (2) 13w	LED Drum, 2,000 Lumens, PM, Metalic Bronze
Bullock Elementary Schoo	2	Hallway Library To 200	7	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Hallway Library To 200	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	2	Hallway Library To 200	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	2	Hallway Library To 200 Display	2	0.0300	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Bullock Elementary Schoo	2	Hallway Lockers	5	0.1170	0.0290	1x4, 2-Lamp T5 HO	LED Int. Driver Lamp, (2) 4' T5 HE Lamps
Bullock Elementary Schoo	2	Hallway 200 To 230	17	0.2350	0.0580	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HE Lamps
Bullock Elementary Schoo	2	Hallway 200 To 230	8	0.2350	0.0580	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HE Lamps, Battery Backup
Bullock Elementary School	2	Hallway 200 To 230	7	0.0300	0.0160	CF PL (2) 13w	LED Drum, 2,000 Lumens, PM, Metalic Bronze
Bullock Elementary Schoo	2	Hallway 200 To 230	18	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	2	Hallway 200 To 230	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Main Lobby Stairs	11	0.0835	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Bullock Elementary Schoo	SW	Main Lobby Stairs	11	0.0600	0.0130	Inc 60w	LED Lamp, R/PAR30, NLO
Bullock Elementary Schoo	SW	Main Lobby Stairs	4	0.0360	0.0360	CF PL 32w	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 4	2	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Extra Labor
Bullock Elementary Schoo	SW	Stairwell 4	1	0.2350	0.1000	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Battery Backup
Bullock Elementary Schoo	SW	Stairwell 4	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	SW	Stairwell 4	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 4	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 4	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 4	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 1	3	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Extra Labor
Bullock Elementary Schoo	SW	Stairwell 1	1	0.2350	0.1000	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Battery Backup
Bullock Elementary Schoo	SW	Stairwell 1	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 1	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 1	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 1	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	SW	Stairwell 1	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	SW	Stairwell 1	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 2	2	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Extra Labor
Bullock Elementary Schoo	SW	Stairwell 2	1	0.2350	0.1000	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Battery Backup
Bullock Elementary Schoo	SW	Stairwell 2	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	SW	Stairwell 2	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 2	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Stairwell 2	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	SW	Stairwell 2	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Main Office	4	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	1	Main Office	2	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	1	Main Office Corridor	4	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Main Office Corridor	2	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Main Office Corridor	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Main Office Break Room	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Main Office Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Main Office Conference	3	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	1	Main Office Conference	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	1	Main Office Principa	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Bullock Elementary Schoo	1	Main Office Principa	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	1	Main Office Principa	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Main Office Work Room	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	1	Main Office Work Room	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	1	Main Office Copy Room	2	0.0835	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Bullock Elementary Schoo	1	Main Office Copy Room	1	0.0835	0.0330	2x4, 3-Lamp T8, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Main Office Storage (estimated)	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Nurse Office	4	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Nurse Office	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Nurse Cots	2	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Nurse Cots	2	0.0185	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Bullock Elementary Schoo	1	Nurse Office Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Nurse Office	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Nurse Office	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Office Counselor	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, DS
Bullock Elementary Schoo	1	Office Counselor	1	0.1790	0.0750	2x4, 3-Lamp T5H, Double Switched, Battery Backup	LED Int. Driver Lamp, (3) 4' T5 HO Lamps, Battery Backup, Do
Bullock Elementary Schoo	1	Classroom 106	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 106	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 106	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 106	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 108	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 108	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 108	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 108	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 110	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 110	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 110	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 110	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 112	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 112	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 112	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 112	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Cafeteria	22	0.2350	0.1000	4x4, 4-Lamp T5 HO	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	1	Cafeteria	2	0.2350	0.1000	4x4, 4-Lamp T5 HO	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	1	Cafeteria	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Cafeteria	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Cafeteria Storage	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Kitchen	19	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Kitchen	7	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Kitchen Hood	3	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Kitchen	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Kitchen Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	1	Kitchen Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Kitchen Refrigerator	1	0.0100	0.0100	LED 10w	Will not be retrofit
Bullock Elementary Schoo	1	Kitchen Refrigerator	1	0.1170	0.0500	1x4, 2-Lamp T5 HO	LED Int. Driver Lamp, (2) 4' T5 HO Lamps, Extra Labor
Bullock Elementary Schoo	1	Kitchen Freezer	1	0.0100	0.0100	LED 10w	Will not be retrofit
Bullock Elementary Schoo	1	Kitchen Freezer	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Kitchen Dry Storage (estimated)	2	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Kitchen Trash Room	2	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Kitchen	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Bathroom, Boys	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Bathroom, Boys	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Bathroom, Boys	1	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	1	Bathroom Vestibule	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	1	Corridor 100 A	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Corridor 100 A	2	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Corridor 100 A	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Corridor 100 A	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Custodian Office	2	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	1	Custodian Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	1	All Gender Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Mechanical Room	6	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Mechanical Room	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Corridor Stage Ramp	4	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Corridor Stage Ramp	2	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Corridor Stage Ramp	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Stage Storage	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Stage	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, High Location, Extra La
Bullock Elementary Schoo	1	Mechanical Room	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	SW	Corridor Stage Steps	2	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	SW	Corridor Stage Steps	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	SW	Corridor Stage Steps	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Stage Steps To Gym	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary School	1	Gymnasium	32	0.3680	0.1000	(8) CF PL 42w, High Bay	LED High Bay, 11K Lumens, WG, OSF, Pendant Mount
Bullock Elementary Schoo	1	Gymnasium	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Gymnasium	8	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Gym Storage	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Gym Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS	LED Int. Driver Lamps, (3) 4' Lamps, DS
Bullock Elementary Schoo	1	Gym Office	1	0.0865	0.0330	2x4, 3-Lamp T8, DS, Battery Backup	LED Int. Driver Lamps, (3) 4' Lamps, Battery Backup, Double
Bullock Elementary Schoo	1	Tech Room 113 (estimated)	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Bullock Elementary Schoo	1	Electrical Room 117	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Electrical Room 117	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Bathroom, Boys	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Bathroom, Boys	2	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Bathroom, Boys	2	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	1	Bathroom, Boys	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Bathroom, Girls	2	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Bathroom, Girls	2	0.0490	0.0240	1x3, 2-Lamp T5E	LED Int. Driver Lamp, (2) 3' T5 HE Lamps
Bullock Elementary Schoo	1	Bathroom, Girls	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Closet Custodial	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room 127	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room 127	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room 127	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Boiler Room 129	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Boiler Room 129	1	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Boiler Room 129	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Faculty Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Classroom 131	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 131	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 131	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 133 A	3	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 133 A	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 133 A	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 133 B	3	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 133 B	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 133 B	1	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 135	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 135	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 135	2	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Reading Area 227	3	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	1	Reading Area 227	1	0.1170	0.0500	1x4, 2-Lamp T5 HO	LED Int. Driver Lamp, (2) 4' T5 HO Lamps
Bullock Elementary Schoo	1	Reading Area 227	6	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Reading Area 227	1	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Classroom 130	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 130	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 130	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 130	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 130 Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Classroom 128	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 128	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 128	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 128	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 128 Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Classroom 126	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 126	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 126	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 126	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 126 Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Classroom 124	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 124	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 124	1	0.1105	0.0440	1x8, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Bullock Elementary Schoo	1	Classroom 124	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 124 Toilet	1	0.0565	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Mechanical Room 122	2	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room 122	1	0.0565	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Bullock Elementary Schoo	1	Mechanical Room 122	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Bullock Elementary Schoo	1	Classroom 120	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 120	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 120	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 120	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 118	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 118	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 118	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 118	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 116	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 116	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 116	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 116	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Classroom 114	3	0.1670	0.0660	1x12, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Bullock Elementary Schoo	1	Classroom 114	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Bullock Elementary Schoo	1	Classroom 114	1	0.1670	0.0660	1x12, 6-Lamp T8, Battery Backup	LED Int. Driver Lamps, (6) 4' Lamps, Battery Backup
Bullock Elementary Schoo	1	Classroom 114	3	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Hallway Café To Lobby	10	0.2350	0.0580	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HE Lamps
Bullock Elementary Schoo	1	Hallway Café To Lobby	5	0.2350	0.0580	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HE Lamps, Battery Backup
Bullock Elementary School	1	Hallway Café To Lobby	5	0.0300	0.0160	CF PL (2) 13w	LED Drum, 2,000 Lumens, PM, Metalic Bronze
Bullock Elementary Schoo	1	Hallway Café To Lobby	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Hallway Café To Lobby	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Hallway Nurse To 104	1	0.0565	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Bullock Elementary Schoo	1	Hallway Nurse To 104	1	0.0565	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Bullock Elementary Schoo	1	Hallway Café To Lobby	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Lobby Seating Area	4	0.2350	0.1000	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HO Lamps
Bullock Elementary Schoo	1	Lobby Seating Area	2	0.2350	0.1000	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HO Lamps, Battery Backup
Bullock Elementary School	1	Lobby Seating Area	5	0.0300	0.0160	CF PL (2) 13w	LED Drum, 2,000 Lumens, PM, Metalic Bronze

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Bullock Elementary Schoo	1	Lobby Seating Area Display	12	0.0500	0.0060	Inc 50w	LED Lamp NLO MR16
Bullock Elementary Schoo	1	Lobby Seating Area	3	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Hallway Lobby To 130	15	0.2350	0.0580	1x8, 4-Lamp T5H 4'	LED Int. Driver Lamp, (4) 4' T5 HE Lamps
Bullock Elementary Schoo	1	Hallway Lobby To 130	7	0.2350	0.0580	1x8, 4-Lamp T5 HO, Battery Backup	LED Int. Driver Lamp, (4) 4' T5 HE Lamps, Battery Backup
Bullock Elementary School	1	Hallway Lobby To 130	4	0.0300	0.0160	CF PL (2) 13w	LED Drum, 2,000 Lumens, PM, Metalic Bronze
Bullock Elementary Schoo	1	Hallway Lobby To 130	18	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	1	Hallway Lobby To 130	2	-	-	Exit Sign - LED	Will not be retrofit
Bullock Elementary Schoo	1	Lobby Vestibule	4	0.0360	0.0125	CF PL 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary Schoo	Ext	Exterior B & G Storage (estimated)	4	0.1105	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Bullock Elementary School	Ext	Wall Pack With Battery	12	0.0560	0.0291	CF PL (2) 26w, Battery Backup	LED Wallpack, Medium Full Cutoff, 3000LM, Battery Backup
Bullock Elementary School	Ext	Wall Pack Without Battery	25	0.0560	0.0291	CF PL (2) 26w	LED Wallpack, Medium Full Cutoff, 3000LM
Bullock Elementary School	Ext	Decorative Biax Sconce 2' Length	8	0.0700	0.0150	1x2, 2-Lamp 36 Biax	LED Retrofit Board and Driver Kit, 2000lm, 2 Lamp, 2'
Bullock Elementary School	Ext	Decorative Biax Sconce 4' Length	8	0.1400	0.0300	1x4, 4-Lamp 36 Biax	LED Retrofit Board and Driver Kit, 4,000LM , 4 Lamp, 3', Hig
Bullock Elementary Schoo	Ext	Overhead Cans With Battery At Entries	3	0.0720	0.0125	CF PL (2) 32w, Battery Backup	LED Retrofit Can Kit, 6 Inch, Normal Output, Battery Backup
Bullock Elementary Schoo	Ext	Decorative Wall Jar Houses 20'	26	0.0460	0.0460	CF PL 42w	No Retrofit
Bullock Elementary Schoo	Ext	Decorative Wall Jar Houses 8'	4	0.0460	0.0460	CF PL 42w	No Retrofit
Bullock Elementary Schoo	Ext	Overhead Cans At Main Entry	2	0.0720	0.0125	CF PL (2) 32w	LED Retrofit Can Kit, 6 Inch, Normal Output
Bullock Elementary School	Ext	Parking Poles M175 20'	12	0.2100	0.0644	MH 175w	LED Shoebox, 7,000 Lumens, Type III, Photocell, Arm Mount, Bronze
Bullock Elementary School	Ext	Parking Poles Led Corn Cob 20'	15	0.0650	0.0644	LED 65w	LED Shoebox, 7,000 Lumens, Type III, Photocell, Arm Mount, Bronze
Central Heating Plant	1	Boiler Room	10	0.0550	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Central Heating Plant	1	Boiler Room	3	0.1500	0.0135	Inc 150w	LED Lamp, R/PAR38, HLO
Central Heating Plant	1	Tank	1	0.0550	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Central Heating Plant	1	Electrical	2	0.2180	0.0660	1x8, 8-Lamp T8	(2) LED Vapor Resistant, NLO, 1x4
Central Heating Plant	1	Electrical	3	0.0230	0.0090	CFL SI 23w	LED Lamp, A-Line, NLO
Central Heating Plant	1	Well	1	0.1500	0.0135	Inc 150w	LED Lamp, R/PAR38, HLO
Central Heating Plant	Ext	Entry Door	1	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Central Heating Plant	Ext	Wall Corner	1	0.0190	0.0190	LED 19w	Will not be retrofit
Glenfield Middle Schoo	G	Mechanical M1	4	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Boiler Room M2	7	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Boiler Room M2	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 1x4 Special Wrap Lens
Glenfield Middle Schoo	G	Boiler Room M2	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Mechanical M3	8	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Mechanical M3	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Custodial Office G-1	6	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Storage 121	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Boys Locker 119	6	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Boys Locker 119	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Boys Locker 119	5	-	-	CF PL 26w, De-Lamped	Will not be retrofit
Glenfield Middle Schoo	G	Boys Locker 119	2	0.0560	0.0200	CF PL (2) 26w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Boys Locker 119	2	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp, Extra Labor
Glenfield Middle Schoo	G	Bath 119a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	G	Boys Locker 119	2	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp, Extra Labor
Glenfield Middle Schoo	G	Office 119b	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Boys Locker 119	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp, Extra Labor
Glenfield Middle Schoo	G	Gym 124	15	0.1600	0.1600	LED 160w	Will not be retrofit
Glenfield Middle Schoo	G	Gym 124	5	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Exitway 15	2	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Aux Gym 123	6	0.1600	0.1600	LED 160w	Will not be retrofit
Glenfield Middle Schoo	G	Aux Gym 123	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Aux Gym 123	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	G	Electrical G-2	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	G	Girls Locker Room 120	13	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Girls Locker Room 120	3	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 1x4 Special Wrap Lens
Glenfield Middle Schoo	G	Girls Locker Room 120	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Girls Locker Room 120	4	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Girls Locker Room 120	2	0.0300	0.0090	1x2, 1-Lamp T12	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	G	Bath 10a	2	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Office 120b	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Office 120b	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 1x4 Special Wrap Lens
Glenfield Middle Schoo	G	Planetarium G-3	2	0.1600	0.1600	LED 160w	Will not be retrofit
Glenfield Middle Schoo	G	Planetarium G-3	4	0.0250	0.0075	Inc 25w	LED Lamp, R/PAR20, LLO, Dimming
Glenfield Middle Schoo	G	Planetarium G-3	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Planetarium G-3	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Electrical G-4	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Hall To G-3	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	G	Vestibule V1	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Lobby L1	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Lobby L1	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 1x4 Special Wrap Lens
Glenfield Middle Schoo	G	Lobby L1	1	0.1200	0.0135	Inc 120w	LED Lamp, R/PAR38, HLO
Glenfield Middle Schoo	G	Lobby L1	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Lobby L1	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Classroom 125	4	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Hall H2	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Hall H2	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Hall H3	2	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Hall H3	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Hall H3	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 4	7	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	G	Corridor 4	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Glenfield Middle Schoo	G	Corridor 5	2	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	G	Corridor 5	1	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit, 2x2 Lens
Glenfield Middle Schoo	G	Corridor 5	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 5	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 5	4	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Corridor 5	1	0.0960	0.0330	1x4, 4-Lamp T8	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	G	Classroom 127	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Classroom 127	4	0.0480	0.0220	1x4, 2-Lamp T8	LED ext. Driver Lamps, (2) 4' Lamps. Dimming
Glenfield Middle Schoo	G	Classroom 127	36	0.0480	0.0220	1x4, 2-Lamp T8	LED ext. Driver Lamps, (2) 4' Lamps. Dimming
Glenfield Middle Schoo	G	Classroom 127	1	-	-	Existing Flourescent Dimming Switch	Wall Dimmer Switch
Glenfield Middle Schoo	G	Classroom 127	2	0.0290	0.0180	1x2, 2-Lamp T8	LED Int. Driver Lamps, (2) 2' Lamps
Glenfield Middle Schoo	G	Classroom 127	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Ext. Driver Lamp, (1) 4' Lamp. Dimming.
Glenfield Middle Schoo	G	Classroom 127	1	-	-	Existing Flourescent Dimming Switch	Wall Dimmer Switch
Glenfield Middle Schoo	G	Storage 127a	4	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Storage 127b	2	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Office 127c	4	0.0730	0.0330	2x4, 3-Lamp T8	LED ext. Driver Lamps, (3) 4' Lamps, Dimming
Glenfield Middle Schoo	G	Office 127c	1	-	-	Existing Flourescent Dimming Switch	Wall Dimmer Switch
Glenfield Middle Schoo	G	Storage 128	8	0.0480	0.0220	1x4, 2-Lamp T8	LED ext. Driver Lamps, (2) 4' Lamps. Dimming
Glenfield Middle Schoo	G	Storage 128	1	-	-	Existing Flourescent Dimming Switch	Wall Dimmer Switch
Glenfield Middle Schoo	G	Storage 128a	4	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Storage 132	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Storage 132a	3	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Storage 132b	1	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Storage 132c	1	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Storage 131	3	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Storage 133a	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Classroom 116	8	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Classroom 115	5	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Classroom 115	3	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Bath 115a	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp, 1x4 Special Vanity Lens
Glenfield Middle Schoo	G	Bath 115ab	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp, 1x4 Special Vanity Lens
Glenfield Middle Schoo	G	Weight Room 114	12	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Classroom 113	21	0.0730	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Glenfield Middle Schoo	G	Dance 126	14	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Bath B1	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Bath B1	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	G	Bath B1	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Jc1	1	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Bath B2	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Bath B2	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	G	Bath B2	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Corridor 3	6	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	G	Corridor 3	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 3	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 2	9	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	G	Corridor 2	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 2	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Classroom 112	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Classroom 111	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Elec Mains 109	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	G	Elec Mains 109	4	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Electrical 109a	1	0.0400	0.0110	1x4, 1-Lamp T12	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Classroom 105	10	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Storage 105a	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Tank Room 105d	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Storage 105b	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Storage 105c	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Classroom 104	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Hall 104a	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps, 2x4 Special Box Lens
Glenfield Middle Schoo	G	Classroom 102	10	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Storage 102a	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Storage 102a	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	G	Storage 102b	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps, 2x4 Special Box Lens
Glenfield Middle Schoo	G	Storage 134	1	0.2000	0.0150	Inc 200w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	G	Corridor 1	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Corridor 1	3	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 1	5	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Corridor 1	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Corridor 1	1	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Classroom 233	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 233a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	1	Classroom 232b	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 232a	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 234	6	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	1	Classroom 235/236	8	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 235a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	1	Conference 237	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Conference 237	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Glenfield Middle Schoo	1	Conference 237	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Glenfield Middle Schoo	1	Bath 237a	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Bath 237a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	1	Bath 237a	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Bath 237a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	1	Bath B3	8	0.0140	0.0140	LED 14w	Will not be retrofit
Glenfield Middle Schoo	1	Bath B3	1	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Bath B3	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Glenfield Middle Schoo	1	Bath B4	8	0.0140	0.0140	LED 14w	Will not be retrofit
Glenfield Middle Schoo	1	Bath B4	3	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Jc 4	1	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Jc 4	1	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Food Service 238	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Food Service 238	6	0.1200	0.0135	Inc 120w	LED Lamp, R/PAR38, HLO
Glenfield Middle Schoo	1	Music 239	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Corridor 8	5	0.0960	0.0440	2x4, 4-Lamp T8	LED Ext. Driver Lamps, (4) 4' Lamps, Dimming
Glenfield Middle Schoo	1	Corridor 8	1	-	-	Existing Flouresent Dimming Switch	Wall Dimmer Switch
Glenfield Middle Schoo	1	Corridor 8	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 9	8	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Corridor 9	1	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	1	Corridor 9	3	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 9	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Classroom 242	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 242	3	0.0150	0.0150	CF PL 13w	Will not be retrofit
Glenfield Middle Schoo	1	Classroom 231	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 230	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 241	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 241	4	0.0150	0.0150	CF PL 13w	Will not be retrofit
Glenfield Middle Schoo	1	Classroom 229	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 229a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	1	Cafeteria 240	20	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Cafeteria 240	20	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Cafeteria 240	4	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	1	Cafeteria 240	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Cafeteria 240	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Cafeteria 240	6	0.0150	0.0150	CF PL 13w	Will not be retrofit
Glenfield Middle Schoo	1	Cafeteria 240	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Glenfield Middle Schoo	1	Electrical	1	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	1	Corridor 7	4	0.0960	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Corridor 7	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 7	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Office 227	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 226	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	General Office 225	2	0.0960	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	General Office 225	4	0.1400	0.0381	1x8, 2-Lamp T12 HO	LED Strip w/ Lens, NLO, 1x8, Pendant Mountec
Glenfield Middle Schoo	1	General Office 225	1	0.0800	0.0203	1x4, 1-Lamp T12 HO	LED Strip w/ Lens, NLO, 1x4, Pendant Mountec
Glenfield Middle Schoo	1	General Office 221	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	General Office 221	2	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	1	Office 222	2	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Office 223	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 224	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Library 243	25	0.1400	0.0360	1x8, 2-Lamp T12 HO	LED Int. Driver Lamp, (2) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	3	0.0800	0.0180	1x4, 1-Lamp T12 HO	LED Int. Driver Lamp, (1) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	25	0.1400	0.0360	1x8, 2-Lamp T12 HO	LED Int. Driver Lamp, (2) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	3	0.0800	0.0180	1x4, 1-Lamp T12 HO	LED Int. Driver Lamp, (1) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	7	0.1400	0.0360	1x8, 2-Lamp T12 HO	LED Int. Driver Lamp, (2) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	4	0.0800	0.0180	1x4, 1-Lamp T12 HO	LED Int. Driver Lamp, (1) 4' Lamp, High Output
Glenfield Middle Schoo	1	Library 243	8	0.1920	0.0880	4x4, 8-Lamp T8	LED Int. Driver Lamps, (8) 4' Lamps
Glenfield Middle Schoo	1	Library 243	2	0.1920	0.0880	4x4, 8-Lamp T8	LED Int. Driver Lamps, (8) 4' Lamps, Special 4x4 Lens
Glenfield Middle Schoo	1	Library 243	5	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	1	Library 243	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Library 243	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Library 243	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Office 244	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 245/246	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Vestibule 2	4	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Nurse 220	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Bath 220a	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Bath 220ab	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Nurse 220	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 209a	4	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	1	Storage 201	1	0.0700	0.0220	1x8, 2-Lamp T12 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Storage 202	4	0.0400	0.0110	1x4, 1-Lamp T12	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Stage 209	10	0.2000	0.0170	Inc 200w	LED Lamp, R/PAR38, VHLO
Glenfield Middle Schoo	1	Stage 209	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Stage 209	5	0.0500	0.0500	LED 50w	Will not be retrofit
Glenfield Middle Schoo	1	Auditorium 209	19	0.0500	0.0500	LED 50w	Will not be retrofit
Glenfield Middle Schoo	1	Auditorium 209	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Auditorium 209	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Auditorium 209	14	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	1	Storage 210	3	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	1	Hall T0 Aud 209e	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Practice Room 203	12	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 204	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 205	3	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Practice 207	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Bath 207a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	1	Office 208	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Hall 99	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Hall 99	1	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	1	Hall 99	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Hall 98	5	0.0100	0.0100	LED 10w	Will not be retrofit
Glenfield Middle Schoo	1	Bath 209f	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Jc 209h	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Glenfield Middle Schoo	1	Bath 209g	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Lobby L2	9	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	1	Lobby L2	3	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Lobby L2	5	0.0480	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Glenfield Middle Schoo	1	Lobby L2	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Lobby L2	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Lobby L2	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Lobby L2	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Office 219	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 218	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 217	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 216	2	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Office 215	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	1	Office 214	1	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Classroom 213	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Bath 213a	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Classroom 212	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Bath 212a	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Storage 212b	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Vestibule V3	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	1	Storage 211	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	1	Corridor 6	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 6	11	0.0100	0.0100	LED 10w	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 6	9	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 6	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	1	Corridor 6	3	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	1	Corridor 6	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	1	Vestibule V4	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	Storage M1	3	0.2000	0.0440	1x8, 2-Lamp T12 HO, Wire Guard	LED Int. Driver Lamps, (4) 4' Lamps, 1x8 Bracket Kit, Extra Labor
Glenfield Middle Schoo	1	Storage M2	3	0.2000	0.0440	1x8, 2-Lamp T12 HO, Wire Guard	LED Int. Driver Lamps, (4) 4' Lamps, 1x8 Bracket Kit, Extra Labor
Glenfield Middle Schoo	1	Storage M3	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	1	Power Company Storage M3	2	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Glenfield Middle Schoo	2	Math Office 3-1	1	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Classroom 328	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 328a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 327	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 327a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 326	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 326a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 325	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 325a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 324	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 324a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 336	9	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	2	Storage 336a	1	0.0140	0.0140	LED 14w	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 337	9	0.0240	0.0240	LED 24w	Will not be retrofit
Glenfield Middle Schoo	2	Storage 337a	1	0.0140	0.0140	LED 14w	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 329	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 330	8	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 330a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 331	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 332	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 332	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 332	3	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 334	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 334a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Classroom 335	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 335a	1	0.0800	0.0330	1x4, 1-Lamp T12 HO	LED Standard Wrap, NLO, 1x4
Glenfield Middle Schoo	2	Bath 335b	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Bath 335b	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	2	Bath 335b	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	2	Electrical 335d	1	-	0.0090	Inc 60w, De-Lamped	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	2	Bath 335c	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	2	Bath 335c	5	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Bath 335c	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	2	Jc 335f	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Bath 324b	1	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Bath 324b	1	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Bath 324b	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	2	Bath 324c	1	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Corridor 10	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 10	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 10	4	0.0960	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 10	1	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 13	1	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 13	4	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 13	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 13	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 12	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 12	4	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 12	3	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 12	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 11	6	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Corridor 11	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Corridor 11	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	2	Hall 97	1	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Glenfield Middle Schoo	2	Hall 97	6	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Hall 97	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Hall 97	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Hall 97	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 322	12	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 321	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 321	14	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 323	14	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 319	5	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Storage 307	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Electrical 306	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Hall 96	1	0.0480	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Hall 96	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Hall 95	4	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Hall 95	1	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps, 4x4 Lens
Glenfield Middle Schoo	2	Hall 95	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 312	10	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 311	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 310	14	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 313	14	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Electrical 310a	1	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Bath 311a	4	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Bath 311a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	2	Bath 311a	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	2	Jc 311b	1	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, 2x4 Box Special Lens
Glenfield Middle Schoo	2	Bath 302a	4	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	2	Bath 302a	1	0.0150	0.0090	1x2, 1-Lamp T8	LED Int. Driver Lamp, (1) 2' Lamp
Glenfield Middle Schoo	2	Bath 302a	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	2	Hall 94	4	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Hall 94	2	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	2	Classroom 302	9	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 301	12	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 300	12	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	2	Classroom 300	4	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	2	Classroom 300	3	0.0650	0.0130	Inc 65w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	2	Classroom 300	13	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	3	Stairs To Attic	1	0.0260	0.0260	Circline 22w	Will not be retrofit
Glenfield Middle Schoo	4	Attic A4	2	0.0600	0.0600	Inc 60w	Will not be retrofit
Glenfield Middle Schoo	4	Attic A4	6	-	-	Inc 60w, De-Lamped	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 1	4	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 1	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	3	Stairs 1	4	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 1	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 2	4	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 2	2	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 2	4	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 2	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 3	4	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 3	1	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 3	1	0.0960	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	3	Stairs 3	1	-	-	Exit Sign - LED	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 4	2	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	3	Stairs 4	1	0.0960	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	3	Stairs 4	2	0.0600	0.0200	Circline 32w and 22w	LED 14" Drum, 2,000 Lumens
Glenfield Middle Schoo	3	Stairs 4	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Stairs 5	3	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	G	Stairs 5	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	G	Stairs 5	2	0.0250	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Glenfield Middle Schoo	3	Stairs 6	4	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	3	Stairs 6	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Glenfield Middle Schoo	3	Stairs 6	1	0.0960	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	3	Stairs 6	1	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	1	General Office 225	1	0.0800	0.0203	1x4, 1-Lamp T12 HO	LED Strip w/ Lens, NLO, 1x4, Pendant Mountec
Glenfield Middle Schoo	G	Catching Ownes Comm Ctr Entry	1	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	G	Catching Ownes Comm Ctr Main Room 1	8	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Catching Ownes Comm Ctr Main Room 2	13	0.0480	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Glenfield Middle Schoo	G	Catching Ownes Comm Ctr Track Heads	4	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Glenfield Middle Schoo	G	Catching Ownes Comm Ctr Elec Room	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Catchin Owens Comm Ctr Bath	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Catchin Owens Comm Ctr Kitcher	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	G	Catching Owens Comm Ctr Office	1	0.0960	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Glenfield Middle Schoo	Ext	Covered Parking Type Cp1	42	0.0300	0.0300	LED 30w	Will not be retrofit
Glenfield Middle Schoo	Ext	Covered Parking Type Cp2	13	0.0300	0.0300	LED 30w	Will not be retrofit
Glenfield Middle Schoo	Ext	Covered Parking Type Cp3	2	0.0300	0.0300	LED 30w	Will not be retrofit
Glenfield Middle Schoo	Ext	Covered Parking Type Cp4	8	0.0300	0.0300	LED 30w	Will not be retrofit
Glenfield Middle Schoo	Ext	Covered Parking Type Cp5	3	0.0480	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Glenfield Middle Schoo	Ext	Recessed Box With Circular Lens Type X	3	0.0960	0.0440	4x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps, Extra Labor
Glenfield Middle Schoo	Ext	Wall Packs Type A	1	0.1900	0.0370	HPS 150w	LED Wallpack, Medium Full Cutoff, 4000 Lumen, Bottom Conduit
Glenfield Middle Schoo	Ext	Wall Packs Type A	1	0.1900	0.0370	HPS 150w	LED Wallpack, Medium Full Cutoff, 4000 Lumen, Bottom Conduit
Glenfield Middle School	Ext	Small Wall Packs Type B	10	0.0460	0.0240	CF PL 42w	LED Wallpack, Small Forward Throw, 3000lm, Photocell
Glenfield Middle Schoo	Ext	Recessed Can Type C	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle School	Ext	Recessed Cans Large Type D	2	0.0900	0.0240	HPS 70w	LED HID Retrofit 2000lm, E39, 14" DIA Special Lens
Glenfield Middle Schoo	Ext	Recessed Cans Large Type D-dl	3	-	-	HPS 70w- De-Lamped	Will not be retrofit
Glenfield Middle Schoo	Ext	Recessed Cans Owings Comm Ctr Type E	8	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Glenfield Middle Schoo	Ext	Large Flood Type F	2	0.4600	0.1200	MH 400w	LED Flood Light ~15,000 Lumens, Yoke Mount
Glenfield Middle Schoo	Ext	Large Flood Type F	1	0.4600	0.1200	MH 400w	LED Flood Light ~15,000 Lumens, Yoke Mount
Glenfield Middle Schoo	Ext	Large Flood Type G	2	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Yoke Mount
Glenfield Middle School	Ext	Large Recessed Can Type H	1	0.1900	0.0320	HPS 150w	LED HID Retrofit 4000lm, E39, 14" DIA Special Lens
Glenfield Middle Schoo	Ext	Flood Lamps On Poles Type I	2	0.0750	0.0135	Inc 75w	LED Lamp, R/PAR38, HLO
Glenfield Middle Schoo	Ext	Large Floods Type J	2	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Adj. Slipfitter
Glenfield Middle Schoo	Ext	Large Floods Type K	5	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Yoke Mount
Glenfield Middle Schoo	Ext	Wall Jars	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Glenfield Middle Schoo	Ext	Coach Lamps	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	2	Classroom 201	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 202	18	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 202 Alcove A	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	2	Classroom 202 Alcove B	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	2	Classroom 203	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Bathroom, Women's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 204	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	2	Library	22	0.2440	-	1x8, 1-Lamp T8	Disconnect and Remove
Hillside Elementary School	2	Library	22	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Hillside Elementary Schoo	2	Library	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary School	2	Library Annex	2	0.2440	-	1x8, 1-Lamp T8	Disconnect and Remove
Hillside Elementary School	2	Library Annex	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Hillside Elementary Schoo	2	Classroom 206	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 206 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 206 Prep	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 206 Closet	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 207	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 207 Closet	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 207 Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Bathroom, Men's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 208 A	6	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Hillside Elementary School	2	Classroom 208	9	0.1105	-	1x8, 2-Lamp T8	Disconnect and Remove
Hillside Elementary School	2	Classroom 208	9	-	0.0470	New Layout	New Layot LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Hillside Elementary School	2	Classroom 209	30	0.1113	-	1x4, 4-Lamp T8	Disconnect and Remove
Hillside Elementary School	2	Classroom 209	15	-	0.0470	New Layout	New Layot LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Hillside Elementary Schoo	2	Classroom 209 Storage A	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 209 Storage B	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 220	23	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 220 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 221	23	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 221 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 222	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 222 Storage (estimated)	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 223	14	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 223	4	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Hillside Elementary Schoo	2	Classroom 223 A	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 223 A Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 224	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 224 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 225	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Bathroom, Women's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	2	Bathroom, Women's	1	0.0310	0.0250	1x4, 1-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	2	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Storage	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Bathroom, Men's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	2	Bathroom, Men's	1	0.0843	0.0250	1x4, 3-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	2	Classroom 226	23	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 226 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Fan Room 1	5	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	2	Classroom 227	23	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 227 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 228	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 228 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Classroom 229	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Classroom 229 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Hillside Elementary Schoo	2	Studio 229	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Studio 229	1	0.0400	0.0090	Inc 40w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	2	Studio 229 Middle	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Studio 229 Rear	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	2	Hallway 201 - Stair 3	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway 201 - Stair 3	4	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	2	Hallway 201 - Stair 3	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	2	Hallway Stair 3 To Stair 4	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway Stair 3 To Stair 4	1	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	2	Hallway Stair 3 To Stair 4	1	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	2	Hallway Stair 3 To Stair 4	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	2	Hallway Stair 3 To 222	7	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway Stair 3 To 222	1	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	2	Hallway Stair 3 To 222	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	2	Hallway Stair 5 To 222	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway 222 To 225	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway 222 To 225 Display	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	2	Hallway 222 To 225	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary School	2	Hallway 222 To 225	8	0.1105	-	1x8, 2-Lamp T8	Disconnect and Remove
Hillside Elementary School	2	Hallway 222 To 225	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Hillside Elementary Schoo	2	Hallway 222 To 225 Display	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	2	Hallway 225 To 227	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway 225 To 227	1	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	2	Hallway 225 To 227	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	2	Hallway 227 To 229	6	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	2	Hallway 227 To 229	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 1	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4, High Location
Hillside Elementary Schoo	SW	Stairwell 1	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 1	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 1	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 1	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 1 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	SW	Stairwell 2 Storage (estimated)	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	SW	Stairwell 2	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 2	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 2	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 2	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 3	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 3	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 3	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 3	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 4	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 4	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 4	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 4	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 5	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4, High Location
Hillside Elementary Schoo	SW	Stairwell 5	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 5	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 5	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	SW	Stairwell 5	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	SW	Stairwell 6	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 101	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 102	18	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 102 Alcove A	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Classroom 102 Alcove B	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Classroom 103	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Bathroom, Women's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 104	30	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 104	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Classroom 104 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 104 B	8	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary School	1	Classroom 105	30	0.1113	-	1x4, 4-Lamp T8	Disconnect and Remove
Hillside Elementary School	1	Classroom 105	30	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Hillside Elementary Schoo	1	Classroom 105 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Storage By Elevator	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 107	8	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Computer Lab 106	16	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary School	1	Bathroom, Men's	3	0.0310	0.0250	1x4, 1-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	1	Closet Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Teacher Work Room	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Teacher Supply Room	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Corridor	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Safe	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	V P Office	6	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Hillside Elementary Schoo	1	Main Office	15	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Principal Office	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Closet Principal	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Bathroom Principal	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Guidance Office	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Guidance Waiting	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Nurse Office	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Nurse Office	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Vestibule Nurse	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Bathroom Nurse	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 120	24	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 120 Bathroom	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Classroom 121	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 121 Bathroom	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Classroom 122	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 122 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 122 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 123	13	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 123 A	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 124	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 124 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 124 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Office 125	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Bathroom, Women's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	1	Bathroom, Women's	1	0.0310	0.0250	1x4, 1-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	1	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Storage	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Bathroom, Men's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	1	Bathroom, Men's	1	0.0843	0.0250	1x4, 3-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	1	Classroom 126	24	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 126 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 127	24	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 127 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Classroom 128	25	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Classroom 128 Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	1	Faculty Lounge 129	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Faculty Lounge 129	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Hillside Elementary Schoo	1	Faculty Lounge 129 Bathroom	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Classroom 130	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Hallway 101 - Stair 3	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Hallway 101 - Stair 3	2	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	1	Hallway 101 - Stair 3	2	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway 101 - Stair 3	4	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To Stair 4	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Hallway Stair 3 To Stair 4	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To Stair 4	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To Stair 4	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To 122	10	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Hallway Stair 3 To 122	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To 122	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway Stair 3 To 122	1	0.1500	0.0260	Inc (2) 75w	LED Lamp, R/PAR30, NLO x2
Hillside Elementary Schoo	1	Hallway 122 To 125	4	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Hallway 122 To 125 Display	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	1	Hallway 122 To 125	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway 122 To 125 Display	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	1	Hallway 125 To 127	5	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	1	Hallway 125 To 127	1	0.0300	0.0030	Exit Sign - (2) 15w Incs	Exit Sign - New Universal LED w/ BE
Hillside Elementary Schoo	1	Hallway 125 To 127	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Hallway 127 To 130	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	1	Hallway 127 To 130	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	1	Projection Room	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	1	Auditorium Lighting Door (estimated)	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Classroom 001	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 002	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 003	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Bathroom, Men's	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Closet Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary School	G	Classroom 004	15	0.0843	-	1x4, 3-Lamp T8	Disconnect and Remove
Hillside Elementary School	G	Classroom 004	15	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Hillside Elementary School	G	Classroom 004	2	0.0310	-	1x4, 1-Lamp T8	Disconnect and Remove
Hillside Elementary School	G	Classroom 004	2	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Hillside Elementary School	G	Classroom 004	1	0.1105	-	1x8, 2-Lamp T8	Disconnect and Remove

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Hillside Elementary School	G	Classroom 004	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Hillside Elementary School	G	Classroom 005 Shop	18	0.0843	-	1x4, 3-Lamp T8	Disconnect and Remove
Hillside Elementary School	G	Classroom 005 Shop	18	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Hillside Elementary Schoo	G	Classroom 005 Shop	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary School	G	Classroom 005 Shop	12	0.0310	-	1x4, 1-Lamp T8	Disconnect and Remove
Hillside Elementary School	G	Classroom 005 Shop	12	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Hillside Elementary Schoo	G	Classroom 005 Office	1	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Classroom 005 Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 005 Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary School	G	Dishwashing	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Hillside Elementary School	G	Dishwashing	2	-	0.0470	New Layout	New Layot LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Hillside Elementary Schoo	G	Cafeteria Entry	1	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 2x4 lens
Hillside Elementary Schoo	G	Cafeteria	24	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 2x4 lens
Hillside Elementary Schoo	G	Cafeteria	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Cafeteria	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Cafeteria	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Faculty Dining	4	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 2x4 lens
Hillside Elementary School	G	Kitchen Serving	10	0.0843	0.0250	1x4, 3-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	G	Kitchen Serving	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary School	G	Kitchen	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Hillside Elementary School	G	Kitchen	8	-	0.0470	New Layout	New Layot LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Hillside Elementary School	G	Kitchen	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Hillside Elementary School	G	Kitchen	4	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x4, Pendant Mount, Serie
Hillside Elementary Schoo	G	Kitchen Hood	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Grounds Storage	3	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Kitchen Receiving	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Kitchen Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Kitchen Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Kitchen Mop Sink	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary School	G	Bathroom, All Gender	1	0.0310	0.0250	1x4, 1-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Hillside Elementary Schoo	G	Classroom 007	33	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 007	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Classroom 007 Office A	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 007 Office B	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 007 Storage	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 007 Storage	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Bathroom, Women's	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Storage (estimated)	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Storage (estimated)	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Vestibule Old Locker Room A	1	0.0100	0.0100	LED 10w	Will not be retrofit
Hillside Elementary Schoo	G	Old Locker Room A	8	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Costume Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Costume Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Vestibule	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Office Pys. Ed.	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office Pys. Ed. Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Office Pys. Ed. Bathroom	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Old Locker Room B	4	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Storage By Stairwell 5	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Mechanical Room	3	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Hillside Elementary Schoo	G	Storage By Maintenance (estimated)	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Maintenance Office	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Maintenance Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Maintenance Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Vestibule	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Resource Room	11	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Resource Room Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Classroom 22	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 22 Galley	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Classroom 22 Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Hillside Elementary Schoo	G	Classroom 22 Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Classroom 22 Closet	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Old Bathroom Storage	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Vestibule 24	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Classroom 23	4	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Hillside Elementary Schoo	G	Office 24	21	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office 24	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office 24 Storage	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office 24 Bathroom	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office 24 Vestibule	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Office 24 Galley	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Classroom 26 - Dance	12	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Hillside Elementary Schoo	G	Classroom 26 - Dance	12	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Hillside Elementary Schoo	G	Classroom 26 - Dance	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Set Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Duplicating Vestibule	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office Gymnastics	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office Gymnastics Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Office Gymnastics Shower	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Office Gymnastics Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Duplicating Office	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Duplicating Office	5	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Duplicating Office	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Duplicating Office	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Hillside Elementary Schoo	G	Duplicating Bathroom	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Duplicating Bulk Storage	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Duplicating Plan Storage	5	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Office 29 A	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Office 29 A	1	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Office 29	6	0.0220	0.0220	LED 22w	Will not be retrofit
Hillside Elementary School	G	Gymnastics Gymnasium	15	0.4600	0.1000	MH 400w	2x2 LED High Bay, 15K Lumens, WG, Surface Mount, OSF
Hillside Elementary Schoo	G	Gymnastics Gymnasium	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Gymnastics Gymnasium	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary School	G	Phys. Ed. Gymnasium	15	0.4600	0.1000	MH 400w	2x2 LED High Bay, 15K Lumens, WG, Surface Mount, OSF
Hillside Elementary Schoo	G	Phys. Ed. Gymnasium	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Stage Walls	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Stage Stair Tower	5	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Stage Walls	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium House Lighting	190	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO, High Location
Hillside Elementary Schoo	G	Stage Theatrical Incs.	128	0.0900	0.0900	Inc 90w	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Seating	6	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Side Entry R	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Auditorium Side Entry R	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Side Entry R	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Side Entry L	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Auditorium Side Entry L	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Side Entry L	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 001 To Stair 3	9	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway 001 To Stair 3	4	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 001 To Stair 3	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 004 To 007	10	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway 004 To 007	2	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 004 To 007	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 004 To 007	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 004 To 007 Display	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway Gym To 22	14	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway Gym To 22	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway Gym To 22	1	0.0750	0.0130	Inc 75w	LED Lamp, R/PAR30, NLO
Hillside Elementary Schoo	G	Hallway Gym To 22	3	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 22 To 24	2	0.0625	0.0360	2x2, 4-Lamp T8	LED Int. Driver Lamps, (4) 2' Lamps
Hillside Elementary Schoo	G	Hallway 22 To 24	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway 22 To 24	3	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 22 To 24	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Auditorium Lobby	2	0.0625	0.0360	2x2, 4-Lamp T8	LED Int. Driver Lamps, (4) 2' Lamps
Hillside Elementary Schoo	G	Auditorium Lobby	8	0.0280	0.0125	CF PL 26w	LED Retrofit Can Kit, 6 Inch, Normal Output
Hillside Elementary Schoo	G	Closet Mechanica	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Hillside Elementary Schoo	G	Hallway 24 To 29	5	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Hillside Elementary Schoo	G	Hallway 24 To 29	2	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 24 To 29	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	G	Hallway 24 To 29	5	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway 24 To 29	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Hillside Elementary Schoo	G	Hallway 24 To 29	1	-	-	Exit Sign - LED	Will not be retrofit
Hillside Elementary Schoo	Ext	Entry Surface Box Canopies 10	3	0.1300	0.0220	HPS 100w	LED Canopy, 3000 Lumen, Bronze
Hillside Elementary School	Ext	Wall Packs, Bronze 15'	5	0.1900	0.0577	HPS 150w	LED Wallpack, Medium Full Cutoff, 6000lm, PH
Hillside Elementary Schoo	Ext	Wall Jars	2	0.1500	0.0140	Inc 150w	LED Wallpack, Small Forward Throw, 2000lm
Hillside Elementary School	Ext	Small Wall Pack 6'	1	0.1300	0.0240	HPS 100w	LED Wallpack, Small Forward Throw, 3000lm, Photocell
Hillside Elementary Schoo	Ext	L E D Small Wall Pack	1	0.0140	0.0140	LED 14w	Will not be retrofit
Hillside Elementary Schoo	Ext	Surface Screw Ins In Red Housing	1	0.1200	0.0180	Inc (2) 60w	LED Lamp, A-Line, NLO, x2
Hillside Elementary School	AF	Entire Building	1	-	-	Existing Wiring for Lighting Sytems without Ground Wires	Install New Electrical Wirin With Grounds.
Montclair High Schoo	G	Closet Custodial	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Storage By Stair 14	1	-	-	No Lights Currently Installed, Existing Infrastructur	Will not be retrofit

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	G	Pit Entry	2	0.0700	0.0250	2x4, 2-Lamp T12	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Pit Storage Racks	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Pit Storage Rear	4	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	G	Pit Storage Rear	1	0.0700	0.0250	2x4, 2-Lamp T12	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High School	G	Pit Mechanical	1	0.0573	0.0250	2x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High School	G	Pit Storage Side	6	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High School	G	Pit Storage Side	2	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Pit Mechanica	3	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Art Storage	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High School	G	Classroom 16 Art	16	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 16 Art	16	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 16 Art	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 16 Art	4	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	G	Classroom 15 Art	16	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 15 Art	16	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 15 Art	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 15 Art	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Hallway 15-16	3	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Hallway 15-16	3	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway 15-16	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Hallway 15-16	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Robotics Shop 17	30	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	G	Robotics Shop 17	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Robotics Shop 17 Parts Room	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Loading Dock	5	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Loading Dock	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Loading Dock	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps, Junction Box, Aircraft
Montclair High Schoo	G	Transformer Vault (estimated)	6	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Transformer Vault (estimated)	2	0.0700	0.0220	1x4, 2-Lamp T12, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Montclair High School	G	Elevator Corridor	2	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Elevator Control Room	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Switch Gear	3	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Switch Gear	1	0.0700	0.0220	1x4, 2-Lamp T12, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Montclair High School	G	Wood Shop 14	16	0.1113	0.0470	1x8, 4-Lamp T18 4'	LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Montclair High School	G	Wood Shop 14	2	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Pendant Mount, Series
Montclair High Schoo	G	Wood Shop 14 Finishing	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High School	G	Wood Shop 14 Storage	3	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Wood Shop 14 Dust Collection	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High School	G	Wood Shop 14 Office A	2	0.1113	0.0470	1x8, 4-Lamp T18 4'	LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Montclair High School	G	Wood Shop 14 Office B	2	0.1113	0.0470	1x8, 4-Lamp T18 4'	LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Montclair High Schoo	G	Hallway By 14	2	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Hallway By 14	4	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway By 14 Display	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Hallway Ramp To Stair 12	3	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway Ramp To Stair 12	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Custodial Storage	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Bathroom Faculty	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Bathroom, Men's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Bathroom, Men's	1	0.0335	0.0180	1x2, 2-Lamp T8	LED Int. Driver Lamps, (2) 2' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	G	Custodian Lounge	6	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Bathroom Custodian	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High School	G	Custodian Supply Room Office	3	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4, Surface Mount Ceiling
Montclair High Schoo	G	Mechanical Room	8	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Office 13 B	4	0.1685	0.0660	1x8, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Montclair High Schoo	G	Office 13 B	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Office 13 B1	2	0.1685	0.0660	1x8, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Montclair High Schoo	G	Office 13 B Storage	2	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	G	Classroom 13 A	10	0.1685	0.0660	1x8, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Montclair High Schoo	G	Classroom 13 A	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Classroom 13 A	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Classroom 13 A Steps	1	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	G	13 A Storage (estimated)	2	0.1685	0.0660	1x8, 6-Lamp T8	LED Int. Driver Lamps, (6) 4' Lamps
Montclair High Schoo	G	Hallway By 13 A & 13 B	2	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Hallway By 13 A & 13 B	7	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway By 13 A & 13 B	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Hallway By 13 A & 13 B	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High School	G	Classroom 3	20	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 3	20	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 3	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 3	4	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	G	Bathroom, Men's	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Closet Custodial By Classroom 4	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	G	Vestibule Classroom 4	1	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Vestibule Classroom 4	1	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High School	G	Classroom 4	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 4	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 5	6	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 5	6	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Classroom 6	4	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Unit One Offices	1	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High School	G	Unit One Offices	5	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Unit One Offices	5	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Unit One Offices	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Unit One Offices	1	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	G	Unit One Offices	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High School	G	Unit One Break Room	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Unit One Break Room	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Unit One Office A	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Unit One Office A	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Unit One Office B	2	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Unit One Office C	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Unit One Office D	1	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High School	G	Classroom 7	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 7	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 8	26	0.1113	-	1x4, 4-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 8	26	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	G	Classroom 9	20	0.1113	-	1x4, 4-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 9	20	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	G	Classroom 9 Storage	2	0.0573	0.0220	1x4, 2-Lamp T8 4'	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	G	Storage	2	0.1400	0.0470	1x8, 4-Lamp T12 4'	LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Storage	1	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Storage	2	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Storage	1	0.0700	0.0220	1x4, 2-Lamp T12	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Bathroom, Faculty	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	G	Classroom 10	14	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 10	14	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Classroom 10 Alcove	1	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High School	G	Classroom 11	11	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 11	11	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 11	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 11	1	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	G	Classroom 11 Storage	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 11 Storage	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 11 Storage	1	0.1200	-	1x8, 2-Lamp T12	Disconnect and Remove
Montclair High School	G	Classroom 11 Storage	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 12	12	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 12	12	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 12	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 12	1	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	G	Classroom 12	2	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Classroom 12	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Classroom 12 Storage	3	0.0573	0.0250	1x4, 2-Lamp T8	LED Strip w/ Lens, NLO, 1x4
Montclair High School	G	Classroom 1 A	6	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 1 A	6	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 1 A	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 1 A	3	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	G	Classroom 1 B	6	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 1 B	6	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 1 B	2	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 1 B	2	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	G	Courtyard	6	0.1300	0.0382	MH 100w	LED Wallpack, Medium Forward Throw, 4,000LM
Montclair High Schoo	G	Courtyard	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Courtyard	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High Schoo	G	Courtyard Roof Line Floods 25'	2	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Adj. Slipfitter
Montclair High Schoo	G	Courtyard Roof Line Floods 40'	1	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Adj. Slipfitter
Montclair High Schoo	G	Closet Custodial By Classroom 1 A	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	G	Bathroom, Women's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High School	G	Classroom 2 A	6	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 2 A	6	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 2 A	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 2 A	3	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	G	Classroom 2 B	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Classroom 2 B	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	G	Classroom 2 B	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	G	Classroom 2 B	3	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	G	Hallway Cr 12 To Cr 7	4	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Hallway Cr 12 To Cr 7	20	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway Cr 12 To Cr 7	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway Cr 12 To Cr 7	8	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Hallway Cr 12 To Cr 7	4	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Hallway Cr 1 A To Stairwell 2	14	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Hallway Cr 1 A To Stairwell 2	1	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Hallway Cr 1 A To Stairwell 2	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Hallway Cr 1 A To Stairwell 2	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Girls Lockers Entry	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Girls Lockers Entry	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Girls Lockers	14	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Girls Lockers	4	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Girls Lockers	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Weight Room	15	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Weight Room	6	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Weight Room	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Girls Lockers Toilets	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	G	Girls Lockers Showers A	5	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Girls Lockers Showers B	6	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Girls Lockers Team Room	12	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Girls Lockers Storage	3	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Girls Lockers Closet (estimated)	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Boys Lockers	14	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Boys Lockers	6	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Boys Lockers	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Boys Lockers	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Boys Lockers	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Wrestling Gym	14	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Wrestling Gym	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Wrestling Gym	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Boys Lockers Custodial	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Boys Lockers Storage	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Boys Lockers Showers	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Boys Lockers Toilets	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	G	Visitors Lockers Vestibule	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Visitors Lockers	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Visitors Lockers	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Visitors Lockers	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Visitors Lockers Toilet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Visitors Lockers Showers	8	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Rowing Vestibule	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Rowing Vestibule Closet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Montclair Rowing Gym	12	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Montclair Rowing Gym	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Montclair Rowing Gym	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Home Team Lockers	6	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Home Team Lockers	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Home Team Lockers	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Home Team Storage A	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Vapor Resistant, NLO, 1x4
Montclair High Schoo	G	Home Team Storage B	2	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Kitchen Vestibule 6	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Kitchen Vestibule 6	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Kitchen Vestibule 6	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Food Services Passageway	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Food Services Passageway	1	-	-	Exit Sign - LED	Will not be retrofit

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	G	Food Services Pantry	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	G	Food Services Pantry	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	G	Food Services Walk In Cooler	1	0.0230	0.0090	CFL SI 23w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Food Services Lockers	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Food Services Bathroom	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Food Services Office	3	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Food Services Office	6	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Kitchen Pantry	4	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Kitchen	9	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 2x4 lens
Montclair High Schoo	G	Kitchen	2	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	G	Kitchen	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Kitchen	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	G	Kitchen Hood	5	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Kitchen Mop Closet	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	G	Kitchen Exterior Freezer (estimated)	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	G	Kitchen Exterior Freezer (estimated)	2	0.0230	0.0090	CFL SI 23w	LED Lamp, A-Line, NLO
Montclair High Schoo	G	Courtyard Mechanica	1	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	G	Boiler Room (10' Or Under)	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Boiler Room (10' Or Under)	14	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Boiler Room (15')	4	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	G	Boiler Room	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Classroom 101	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High School	1	Office 101 A	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office 101 A	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Office 101 A	2	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Office 101 A	2	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	1	Office 101 B	2	0.1800	0.0170	Inc (3) 60w	LED Standard Wrap, NLO, 1x2
Montclair High Schoo	1	Bathroom, Faculty	1	0.1800	0.0170	Inc (3) 60w	LED Standard Wrap, NLO, 1x2
Montclair High Schoo	1	Closet Custodial By 101	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	1	Bathroom, Women's 1 A	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	1	Classroom 102	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Classroom 103	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Supply Closet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	1	Security Office	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Security Office	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	1	Security Office	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Security Office	1	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	1	Large Group Instruction	22	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Large Group Instruction	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Large Group Instruction Closet	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High School	1	Office Athletic Director (on Map)	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Athletic Director (on Map)	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Office Adult Education (on Map)	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Adult Education (on Map)	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High Schoo	1	Nurse Vestibule	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Nurse Exam	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	1	Office Nurse	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Nurse	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Office Nurse	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Office Nurse	1	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	1	Nurse Work Room	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High Schoo	1	Nurse Toilet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Nurse Closet A	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Nurse Closet B	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High School	1	Office Nurse Cots	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Nurse Cots	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Office Nurse Cots	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Office Nurse Cots	1	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	1	Office Nurse Exam	1	0.1800	0.0170	Inc (3) 60w	LED Standard Wrap, NLO, 1x2
Montclair High Schoo	1	Bathroom, Men's 1 B	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	1	Closet Custodial By 100	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	1	Guidance Vestibule	1	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Guidance Vestibule	2	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	1	Guidance Office	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Guidance Office	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	1	Guidance Office	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Guidance Office	3	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	1	Classroom 100	7	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Child Study Team Vestibule	1	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Child Study Team Toilet A	1	0.0335	0.0180	1x2, 2-Lamp T8	LED Int. Driver Lamps, (2) 2' Lamps
Montclair High Schoo	1	Child Study Team Toilet B	1	0.0335	0.0180	1x2, 2-Lamp T8	LED Int. Driver Lamps, (2) 2' Lamps
Montclair High School	1	Child Study Team Open Office	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Team Open Office	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Child Study Team Open Office	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Child Study Team Open Office	1	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	1	Child Study Team Office A	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Team Office A	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High Schoo	1	Child Study Team Office B	4	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Montclair High School	1	Child Study Team Office C	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Team Office C	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Child Study Team Office D	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Team Office D	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Child Study Team Office E	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Team Office E	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High Schoo	1	Child Study Team Vault	2	0.1000	0.0150	Inc 100w	LED Lamp, A-Line, HLO
Montclair High School	1	Child Study Szymanski	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Child Study Szymanski	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High School	1	Main Office Private A	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Main Office Private A	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	1	Main Office Intercom	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Main Office Intercom	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	1	Main Office	18	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	1	Main Office Private B	4	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	1	Main Office Private C	4	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	1	Main Office Private D	3	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High School	1	Office Principal	6	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Principal	6	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount
Montclair High Schoo	1	Office Principal	1	0.0335	0.0180	1x2, 2-Lamp T8	LED Int. Driver Lamps, (2) 2' Lamps
Montclair High Schoo	1	Office Principal Toile	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Classroom 105	12	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Classroom 106	6	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Classroom 107	12	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Vestibule Classroom 108	2	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High School	1	Classroom 108	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Classroom 108	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	1	Classroom 108	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Classroom 108	3	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	1	Classroom 109	6	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	1	Small Gym	28	0.0650	0.0650	LED 65w	Will not be retrofit
Montclair High Schoo	1	Small Gym	4	0.0650	0.0650	LED 65w	Will not be retrofit
Montclair High Schoo	1	Small Gym	3	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Training	6	0.1113	0.0440	1x8, 4-Lamp T18 4'	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Gym Storage	4	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High School	1	Coach's Office	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Coach's Office	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	1	Coach's Office Toilet	1	0.0573	0.0573	1x4, 2-Lamp T8	Will not be retrofit
Montclair High Schoo	1	Gymnasium Lobby	20	0.1500	0.0150	Inc 150w	LED Lamp, A-Line, HLO
Montclair High Schoo	1	Bathroom, Men's Gym Lobby	4	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	1	Closet, Men's Bath Gym Lobby	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Ticket Booth	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Bathroom, Women's Gym Lobby	3	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High School	1	Gym Balcony	7	0.2900	0.1000	MH 250w	LED High Bay, 11K Lumens, WG, OSF, Pendant Mount
Montclair High Schoo	1	Gym Balcony Steps To Lobby	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Large Gym	42	0.0650	0.0650	LED 65w	Will not be retrofit
Montclair High Schoo	1	Large Gym	5	0.0650	0.0650	LED 65w	Will not be retrofit
Montclair High School	1	Coach's Office	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Coach's Office	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	1	Coach's Office	2	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	Coach's Office	2	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	1	Coach's Office Toilet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Balcony Steps To Gym	1	0.1200	0.0170	Inc (2) 60w	LED Standard Wrap, NLO, 1x2
Montclair High Schoo	1	Cafeteria Serving	10	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Cafeteria Serving	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Cafeteria Serving	6	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Serving Prep	2	0.0573	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Montclair High Schoo	1	Serving Prep Hood	4	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Cafeteria Serving	5	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Cafeteria Serving	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Serving Prep	2	0.0573	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Montclair High Schoo	1	Faculty Serving	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	1	Faculty Dining	12	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Faculty Dining	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Cafeteria	31	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Cafeteria	13	0.1113	0.0440	2x4, 4-Lamp T8, Battery Backup	LED Int. Driver Lamps, (4) 4' Lamps, MI
Montclair High Schoo	1	Cafeteria	4	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Cafeteria Custodial Closet	1	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	1	Cafeteria Storage	5	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High Schoo	1	Cafeteria Vending	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Montclair High Schoo	1	Cafeteria Vending	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Montclair High Schoo	1	Cafeteria Vending	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Montclair High Schoo	1	Cafeteria Vending	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Montclair High Schoo	1	Bathroom, All Gender	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High School	1	S R O	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	S R O	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	1	S R O	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	1	S R O	1	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	1	S R O Closet	1	0.1800	0.0170	Inc (3) 60w	LED Standard Wrap, NLO, 1x2
Montclair High Schoo	1	Classroom 114	10	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Classroom 114	1	0.0500	0.0500	Exit Sign - (2) 25w Incs	Will not be retrofit
Montclair High Schoo	1	Classroom 110	25	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Storage Classroom 110	3	0.0230	0.0090	CFL SI 23w	LED Lamp, A-Line, NLO
Montclair High School	1	Office Classroom 110	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Classroom 110	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	1	Custodial Closet By 110	1	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	1	Computer Lab Vestibule	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Computer Lab 113 A	16	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Closet Comp. Lab 113 (estimated)	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Computer Lab 113 B	16	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	M D F Server (estimated)	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	1	Band Room 111	25	0.1113	0.0440	1x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Band Room 111	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High School	1	Office Band	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Band	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	1	Office Band	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	1	Office Band	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	1	Storage A Band	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	1	Storage B Band	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	1	Band Practice Corridor	4	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room A	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room B	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room C	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room D	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room E	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Band Practice Room F	1	0.0843	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps, 1x4 Lens
Montclair High Schoo	1	Bathroom, Women's	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Bathroom, Men's Faculty	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 2 To 101	9	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 2 To 101	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Hallway Floor 1 Stair 8 To 101	5	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 8 To Lobby	7	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 8 To Lobby	2	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Hallway Floor 1 Stair 8 To Lobby	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Main Lobby	6	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Main Lobby	3	0.1200	0.0180	Inc (2) 60w	LED Lamp, A-Line, NLO, x2
Montclair High Schoo	1	Main Lobby	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Main Entry Vestibule (estimated)	3	0.1800	0.0270	Inc (3) 60w	LED Lamp, A-Line, NLO, x3
Montclair High Schoo	1	Main Lobby Display	3	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	1	Main Lobby Display	3	0.0300	0.0090	1x2, 1-Lamp T12	LED Int. Driver Lamp, (1) 2' Lamp
Montclair High Schoo	1	Hallway Floor 1 Stair 11 To Lobby	7	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 11 To Lobby	1	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Stair 11 To Lobby	4	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	1	Main Lobby	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Main Lobby	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Hallway Floor 1 - 114 To 115	7	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Gym To Stair 12	12	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway Floor 1 Gym To Stair 12	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Hallway Floor 1 Gym To Stair 12	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	1	Hallway Floor 1 - 110 To 113	8	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway By 111	5	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	1	Hallway By 111	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High School	2	Office Team 2	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	2	Office Team 2	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Office Team 2 A	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2 A	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	2	Office Team 2 B	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2 B	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	2	Office Team 2 C	1	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2 C	1	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	2	Office Team 2	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Office Team 2 D	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2 D	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	2	Office Team 2 E	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Office Team 2 E	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	2	Closet Custodial By 202	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	2	Bathroom, Women's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High School	2	Classroom 202	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 202	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 203	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 203	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	2	A V Equipment Return	6	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Library Office	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Quiet Study 2	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Quiet Study 1	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Work Room	3	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Reading Lounge	5	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Computer Lounge	11	0.0140	0.0140	LED 14w	Will not be retrofit
Montclair High Schoo	2	Library Computer Lounge	5	0.0140	0.0140	LED 14w	Will not be retrofit
Montclair High Schoo	2	Library Quiet Study 4	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library Quiet Study 3	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library	58	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Library Entry	3	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High Schoo	2	Library	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Library	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Library Storage (estimated)	2	0.0450	0.0450	LED 45w	Will not be retrofit
Montclair High School	2	Classroom 204	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 204	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 205	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 205	9	0.1113	0.0470	1x8, 4-Lamp T18 4'	LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Series
Montclair High Schoo	2	Bathroom, Men's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Closet Custodial By 207 (estimated)	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	2	Classroom 206 Vestibule	2	0.0240	0.0240	LED 24w	Will not be retrofit
Montclair High School	2	Classroom 206	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	2	Classroom 206	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 206	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	2	Classroom 206	3	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	2	Classroom 207	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 207	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 208	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 208	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	2	Classroom 209 Vestibule	2	0.0240	0.0240	LED 24w	Will not be retrofit
Montclair High School	2	Classroom 209	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 209	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 209	3	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	2	Classroom 209	3	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	2	Classroom 210	12	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 210	12	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	2	Closet 210 (estimated)	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High School	2	Classroom 210 Lounge	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 210 Lounge	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	English Office	2	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	English Office	2	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	2	English Office	2	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	2	English Office	2	-	0.0350	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	English Office Storage (estimated)	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	English Office Storage (estimated)	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	2	Bathroom, Women's Faculty	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Bathroom, Women's Faculty	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Faculty Lounge	9	0.1113	0.0440	2x4, 4-Lamp T8	LED Int. Driver Lamps, (4) 4' Lamps
Montclair High Schoo	2	Faculty Lounge	1	0.3400	0.3400	Cold Drink Vending Machine	Will not be retrofit
Montclair High Schoo	2	Faculty Lounge	1	0.0400	0.0400	Snack Vending Machine	Will not be retrofit
Montclair High Schoo	2	Bathroom, Men's Faculty	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Bathroom, Men's Faculty	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	2	Classroom 211	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 211	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 212	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	2	Classroom 212	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	2	Classroom 213	9	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	2	Classroom 213	9	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	2	Hallway Second Floor 16	20	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 16	4	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 16 Display	8	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	2	Hallway Second Floor 15	5	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 15	10	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 15	2	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Classroom 216	18	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 216 Prep	10	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 217	21	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Chemical Storage	5	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Closet Electrical	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	2	Hallway Second Floor 18	11	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 18	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Office Science	6	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Classroom 218	18	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 218 Closet	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Classroom 219	12	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 219/220 Prep	6	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 220	15	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Dental Lab (says On Map)	6	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	2	Classroom 221	15	0.0843	0.0330	2x4, 3-Lamp T8	LED ext. Driver Lamps, (3) 4' Lamps, Dimming
Montclair High Schoo	2	Classroom 221 Prep	9	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Hallway Second Floor 20	9	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 20	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 20	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	2	Classroom 222	16	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Bathroom, Faculty	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Closet Custodial	1	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	2	Bathroom, Faculty	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Bathroom, Men's 2 C	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Bathroom, Women's 2 D	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	2	Classroom 223 (estimated)	21	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 223 Prep (estimated)	10	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Classroom 224	12	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	2	Hallway Second Floor 19	15	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	2	Hallway Second Floor 19	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	3	Classroom 301	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Classroom 302 Vestibule	2	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	3	Classroom 302	11	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 302	11	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	3	Closet Custodial By 302	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	3	Bathroom, Women's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	3	Classroom 303	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Classroom 304	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Lecture Hall 305	18	0.0573	0.0220	1x4, 2-Lamp T8	LED ext. Driver Lamps, (2) 4' Lamps. Dimming
Montclair High Schoo	3	Lecture Hall 320	18	0.0573	0.0220	1x4, 2-Lamp T8	LED ext. Driver Lamps, (2) 4' Lamps. Dimming
Montclair High School	3	Classroom 306	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 306	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 306	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Classroom 306	4	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	3	Classroom 307	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 307	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 307	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Classroom 307	4	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	3	Bathroom, Men's	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	3	Closet Custodial By 307 (estimated)	1	0.0400	0.0130	1x3, 1-Lamp T12	LED Int. Driver Lamp, (1) 3' Lamp
Montclair High Schoo	3	Team 3 Vestibule	2	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	3	Unit 3 Offices Open	4	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	3	Unit 3 Office A	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	3	Unit 3 Office B	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	3	Unit 3 Office C	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	3	Unit 3 Office D	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Montclair High Schoo	3	Unit 3 Office E	2	0.0843	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	3	Office 309 (estimated)	5	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Office 309 (estimated)	5	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Office 309 (estimated)	2	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Office 309 (estimated)	2	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	3	Classroom 310	11	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 310	11	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 310	1	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Classroom 310	1	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	3	Classroom 311 Vestibule	2	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	3	Classroom 311	11	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 311	11	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 312	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 312	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 312	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Classroom 312	4	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High School	3	Classroom 313	8	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Classroom 313	8	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High School	3	Classroom 313	4	0.0573	-	1x4, 2-Lamp T8	Disconnect and Remove
Montclair High School	3	Classroom 313	4	-	0.0350	New Layout	NL- LED Strip w/ Lens, NLO, 1x4, Pendant Mount
Montclair High Schoo	3	Classroom 314	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High School	3	Language Office Front	3	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Language Office Front	3	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	3	Language Office Rear	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Language Office Rear	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	3	Social Studies Office	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Social Studies Office	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High School	3	Social Studies Book Storage	4	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove
Montclair High School	3	Social Studies Book Storage	4	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, SMC
Montclair High Schoo	3	Classroom 315	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Classroom 316	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Classroom 317	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Classroom 318 Vestibule	2	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High School	3	Classroom 318	11	0.1113	-	1x8, 4-Lamp T18 4'	Disconnect and Remove

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High School	3	Classroom 318	11	-	0.0470	New Layout	New Layout LED Strip w/ Lens, NLO, 1x8, Pendant Mount, Serie
Montclair High Schoo	3	Classroom 319	9	0.0550	0.0550	LED 55w	Will not be retrofit
Montclair High Schoo	3	Hallway Third Floor	20	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	3	Hallway Third Floor	4	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	3	Hallway Third Floor Display	4	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	SW	Stairwell 13 Serving To Bsmt	2	0.0600	0.0140	Inc 60w	LED Wallpack, Small Forward Throw, 2000lm
Montclair High Schoo	SW	Stairwell 14	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	SW	Stairwell 14	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 14	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 14	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	SW	Stairwell 12	2	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	SW	Stairwell 12	1	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	SW	Stairwell 12	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	SW	Stairwell 2	3	0.0573	0.0330	1x4, 2-Lamp T8	LED Standard Wrap, NLO, 1x4
Montclair High Schoo	SW	Stairwell 2	2	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	SW	Stairwell 11	1	-	-	Currently Under Renovatior	Will not be retrofit
Montclair High Schoo	SW	Stairwell 10	1	-	-	Currently Under Renovatior	Will not be retrofit
Montclair High Schoo	SW	Stairwell 9	1	-	-	Currently Under Renovatior	Will not be retrofit
Montclair High Schoo	SW	Stairwell 8	1	-	-	Currently Under Renovatior	Will not be retrofit
Montclair High Schoo	SW	Stairwell 7	1	-	-	Currently Under Renovatior	Will not be retrofit
Montclair High Schoo	SW	Stairwell 6	2	0.0600	0.0200	Inc 60w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	SW	Stairwell 6	1	0.0600	0.0140	Inc 60w	LED Wallpack, Small Forward Throw, 2000lm
Montclair High Schoo	SW	Stairwell 4	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 4	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 4	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 3	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 3	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 3	1	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	SW	Stairwell 1	2	0.0600	0.0200	Inc 60w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	SW	Stairwell 1	1	0.0600	0.0140	Inc 60w	LED Wallpack, Small Forward Throw, 2000lm
Montclair High Schoo	SW	Stairwell 1 Up Mechanical (est	11	0.2000	0.0150	Inc 200w	LED Lamp, A-Line, HLO
Montclair High School	Ext	M175 Wall Pack	9	0.2100	0.0382	MH 175w	LED Wallpack, Medium Forward Throw, 4,000LM
Montclair High Schoo	Ext	I60 Wall Jar	5	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High School	Ext	S250 Flood With Glare Shield No Height Indicated	6	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	S250 Flood With Glare Shield 12'	2	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	S250 Flood With Glare Shield 15'	1	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	S250 Flood With Glare Shield 20'	4	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	S250 Flood With Glare Shield 25'	2	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	S250 Flood With Glare Shield 35'	10	0.2900	0.1140	HPS 250w	LED Flood Light ~12,000 Lumens, Adj. Slipfitter
Montclair High Schoo	Ext	I60 Recessed Box	4	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	Ext	Vapor Resistant Wrap 1424 T8	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Montclair High Schoo	Ext	M250 Flood Yoke Mount Fixture 25'	2	0.2900	0.1140	MH 250w	LED Flood Light ~12,000 Lumens, Yoke Mount
Montclair High School	Ext	Led 40 Watt Corn Cob Wall Pack	3	0.0400	0.0382	LED 40w	LED Wallpack, Medium Forward Throw, 4,000LM
Montclair High Schoo	Ext	Drum Fixture Pl18x2	7	0.0400	0.0200	CF PL (2) 18w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	Ext	Wall Sconce Pl26	2	0.0280	0.0140	CF PL 26w	LED Wallpack, Small Forward Throw, 2000lm
Montclair High Schoo	Ext	Frog Eye Emergency Head	4	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Montclair High Schoo	Ext	Vapor Resistant 1818 T12 12'	4	0.0700	0.0700	1x8, 1-Lamp T12	Will not be retrofit
Montclair High Schoo	Ext	Canopy Fixture Non-operational M175	1	0.2100	0.2100	MH 175w	Will not be retrofit
Montclair High Schoo	Ext	Incandescent Coach Lantern I60	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	Ext	Recessed Box Square S50	12	0.0600	0.0240	HPS 50w	LED HID Retrofit 2000lm, E39
Montclair High Schoo	Ext	Led Wall Pack	1	0.0300	0.0300	LED 30w	Will not be retrofit
Montclair High Schoo	T-1	Stage	8	0.0230	0.0230	LED 23w	Will not be retrofit
Montclair High Schoo	T-1	Stage	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Auditorium High	58	0.0230	0.0230	LED 23w	Will not be retrofit
Montclair High Schoo	T-1	Auditorium Low	7	0.0100	0.0100	LED 10w	Will not be retrofit
Montclair High Schoo	T-1	Auditorium Exit Signs	6	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Lobby	7	0.2225	0.0880	4x4, 8-Lamp T8	LED Int. Driver Lamps, (8) 4' Lamps
Montclair High Schoo	T-1	Lobby Display Cases	16	0.0060	0.0060	LED 6w	Will not be retrofit
Montclair High Schoo	T-1	Lobby	4	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Ticket Booth Left	1	0.0750	0.0270	(3) Inc 25w	LED Lamp, A-Line, LLO, x3
Montclair High Schoo	T-1	Ticket Booth Right	1	0.0750	0.0270	(3) Inc 25w	LED Lamp, A-Line, LLO, x3
Montclair High Schoo	T-1	Bathroom, Women's	2	0.0400	0.0200	CF PL 38w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	T-1	Bathroom, Women's	1	0.1500	0.0180	Inc (2) 75w	LED Lamp, A-Line, NLO, x2
Montclair High Schoo	T-1	Bathroom, Men's	1	0.0350	0.0200	Circline 32w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	T-1	Bathroom, Men's	1	0.0400	0.0200	CF PL 38w	LED 14" Drum, 2,000 Lumens
Montclair High Schoo	T-1	Bathroom, Men's	1	0.0140	0.0140	LED 14w	Will not be retrofit
Montclair High Schoo	T-1	Corridor Left Auditorium	13	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-1	Corridor Left Auditorium	25	0.0500	0.0060	Inc 50w	LED Lamp NLO MR16
Montclair High Schoo	T-1	Corridor Left Auditorium	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Corridor Behind Stage	12	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-1	Corridor Right Auditorium	6	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-1	Corridor Right Auditorium	10	0.0500	0.0060	Inc 50w	LED Lamp NLO MR16
Montclair High Schoo	T-1	Corridor Right Auditorium	4	0.0573	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-1	Corridor Right Auditorium	2	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Steps To Balcony Left	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	T-1	Steps To Balcony Left	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-1	Steps To Balcony Right	3	0.0600	0.0090	Inc 60w	LED Lamp, A-Line, NLO
Montclair High Schoo	T-1	Steps To Balcony Right	1	-	-	Exit Sign - LED	Will not be retrofit
Montclair High Schoo	T-2	Bathroom, Men's Balcony	3	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-2	Balcony Storage Men Side	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Montclair High Schoo	T-2	Balcony Storage Men Side	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Montclair High Schoo	T-2	Bathroom, Women's Balcony	5	0.0573	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Montclair High Schoo	T-2	Balcony Storage Women Side (est)	1	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Montclair High Schoo	T-2	Projector Room (estimated)	3	0.0310	0.0110	1x4, 1-Lamp T8	LED Int. Driver Lamp, (1) 4' Lamp
Montclair High School	AF	Montclair High School	1	-	-	Existing Wiring for Lighting Sytems without Ground Wires, Montclair High School	Install New Electrical Wirin With Grounds.
Pre-K/DLC	1A	Modular Classroom 9	16	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1A	Modular Classroom 9	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1A	Modular Classroom 9	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Pre-K/DLC	1A	Bathroom 1 Classroom 9	1	0.0080	0.0080	LED 8w	Will not be retrofit
Pre-K/DLC	1A	Bathroom 2 Classroom 9	1	0.0080	0.0080	LED 8w	Will not be retrofit
Pre-K/DLC	1A	Office Classroom 9 (estimated)	2	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1A	Modular Classroom 8	15	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1A	Modular Classroom 8	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1A	Modular Classroom 8	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Pre-K/DLC	1A	Bathroom 1 Classroom 8	1	0.0080	0.0080	LED 8w	Will not be retrofit
Pre-K/DLC	1A	Bathroom 2 Classroom 8	1	0.0080	0.0080	LED 8w	Will not be retrofit
Pre-K/DLC	1A	Office Classroom 8 (estimated)	2	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	Ext	Exterior Modular Door 9	1	0.0600	0.0140	HPS 50w	LED Wallpack, Small Forward Throw, 2000lm
Pre-K/DLC	Ext	Exterior Modular Door 9	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Pre-K/DLC	Ext	Exterior Modular Door 8	1	0.0130	0.0090	CFL 13w	LED Wallpack, Small Forward Throw, 1000lm
Pre-K/DLC	Ext	Exterior Modular Door 8	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit
Pre-K/DLC	Ext	Flood Fixture On Slip Fitter 20'	1	0.4700	0.1200	HPS 400w	LED Flood Light ~15,000 Lumens, Adj. Slipfitter, Photocell,
Pre-K/DLC	Ext	L E D Wall Pack Bronze 9'	1	0.0400	0.0400	LED 40w	Will not be retrofit
Pre-K/DLC	Ext	Wall Packs With Bottom Conduit 20'	3	0.2900	0.0759	HPS 250w, Bottom Entrance Conduit	LED Wallpack, Full Cutoff, 10,000lm, Photocell, BF Conduit
Pre-K/DLC	Ext	Small Wall Packs W/ph Bronze 7'	2	0.1900	0.0577	HPS 150w	LED Wallpack, Medium Full Cutoff, 6000lm, PH
Pre-K/DLC	Ext	I75 Par 38 Spot Stalk 9'	3	0.0750	0.0135	Inc 75w	LED Lamp, R/PAR38, HLO
Pre-K/DLC	Ext	Wall Pack Bronze W/ph 16'	1	0.1900	0.0577	HPS 150w	LED Wallpack, Medium Full Cutoff, 6000lm, PH
Pre-K/DLC	Ext	Wall Pack Bronze Top Feed Conduit 16'	1	0.1900	0.0577	HPS 150w	LED Wallpack, Medium Full Cutoff, 6000lm, PH
Pre-K/DLC	2N	Adult Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	Janitor's Closet (estimated)	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2N	Classroom 10	14	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2N	Classroom 10 Storage	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2N	Classroom 10 Bathroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	Classroom 10 Bathroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	D L C Office	24	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2N	D L C Office	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2N	D L C Office	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2N	D L C Classroom 9	21	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2N	D L C Classroom 9	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2N	D L C Classroom 9	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2N	D L C Classroom 9 Bathroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	D L C Classroom 9 Bathroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	D L C Classroom 7	18	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2N	D L C Classroom 7 Bathroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	D L C Classroom 7 Bathroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2N	D L C Classroom 7 Storage (estimated)	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2N	D L C Office Director	7	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2N	D L C Hallway	8	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2N	D L C Hallway	4	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2N	D L C Hallway	3	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	2S	Corridor 202	2	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2S	Corridor 202	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2S	Office Speech Therapy A	2	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2S	Office Speech Therapy B	2	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2S	2 S Hallway	3	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	2S	2 S Hallway	2	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	2S	2 S Hallway	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	2S	2 S Hallway Restroom A (estimated)	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2S	Classroom 13	13	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2S	Classroom 13 Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2S	2 S Hallway Restroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	2S	Classroom 12	12	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2S	Classroom 11	12	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	2S	Classroom 11 Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	B	Basement Storage	4	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Storage	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Storage	4	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Storage	3	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Storage	1	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	B	Basement Storage	4	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Storage	6	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	B	Basement Electrical	3	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 1 To Basement	2	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 1 To Basement	2	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	SW	Stairwell 1 - 1 To 3	11	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 1 - 1 To 3	7	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	3	3 S Hallway	3	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	3	3 S Hallway	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	3	3 S Hallway	2	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	3	3 S Hallway Restroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	3 S Vestibule 16	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit

Building Name	Floor	Location	Existing Qty	Existing kW	Proposed kW	Existing Description	Proposed Description
Pre-K/DLC	3	3 S Adult Restroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	Classroom 16	3	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	3	Classroom 16	4	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	3	Classroom 16	3	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	3	Classroom 16 Storage (estimated)	2	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	3	Classroom 16 Office A	2	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	3	Classroom 16 Office B (estimated)	4	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	3	Janitor's Closet (estimated)	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	3	3 S Hallway Restroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	3 S Hallway Restroom C	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	3 S Vestibule 14	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	Classroom 14	12	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	3	3 S Vestibule 15	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	3	Classroom 15	12	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	SW	Stairwell 2	3	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 2	3	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps, Extra Labor
Pre-K/DLC	SW	Stairwell 2	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	SW	Stairwell 2	5	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 2	4	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	SW	Stairwell 2	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1.5	Vestibule Floor 1 S	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1.5	Vestibule Floor 1 S	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	1.5	Vestibule Floor 1 S	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1.5	Office 1 S Front	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1.5	Office 1 S Rear	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1.5	1 S Hallway	3	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1.5	1 S Hallway	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	1.5	1 S Hallway	2	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1.5	1 S Hallway Restroom A	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1.5	Classroom 6	13	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1.5	Classroom 6 Closet/bath	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1.5	Classroom 5	12	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1.5	Classroom 5	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1.5	Classroom 6 Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1.5	Classroom 6	12	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1.5	Classroom 6	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1.5	1 S Hallway Restroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Main Lobby	10	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Main Lobby	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Classroom 3	11	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1	Classroom 3 Bathroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Classroom 3 Bathroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Classroom 3 Storage	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Corridor 101	8	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Corridor 101	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1	Corridor 101	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1	Asst. Exec. Director	6	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Asst. Exec. Director Bathroom	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Janitor's Closet 1 N (estimated)	1	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Kitchen	4	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Kitchen	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Adult Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Corridor	2	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Corridor	1	0.0498	0.0220	2x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	1	Corridor	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	1	Corridor Bathroom A	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Corridor Bathroom B	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Classroom 1	16	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1	Classroom 1 Bathroom	1	0.0498	0.0270	2x2, 2-Lamp U T8	LED Int. Driver Lamps, (3) 2' Lamps, 2x2 Reflector Kit
Pre-K/DLC	1	Classroom 1 Storage	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Classroom 2	16	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	1	Classroom 2 Storage (estimated)	1	0.0498	0.0220	2x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	1	Office Business Manager	4	0.0752	0.0330	1x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	SW	Stairwell 3	2	0.0752	0.0330	2x4, 3-Lamp T8	LED Int. Driver Lamps, (3) 4' Lamps
Pre-K/DLC	SW	Stairwell 3	1	-	-	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	SW	Stairwell 3	2	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 3	2	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	SW	Stairwell 3	1	0.0020	0.0020	Exit Sign - LED	Will not be retrofit
Pre-K/DLC	SW	Stairwell 3	2	0.0498	0.0220	1x4, 2-Lamp T8	LED Int. Driver Lamps, (2) 4' Lamps
Pre-K/DLC	SW	Stairwell 3	2	0.0498	0.0220	1x4, 2-Lamp T8, Battery Backup	LED Linear Lamp Kit, (2) 4' Lamps, BB
Pre-K/DLC	SW	Stairwell 3	1	0.0020	0.0020	Frog Eyes- LED	Will not be retrofit

Montclair Board of Education
Exhibit D
ECM 1C Vending Misers
Vending Misers

ECM DESCRIPTION

Install vending machines with vending misers, mounted on the respective vending machine.

DATA / ASSUMPTIONS

Cold Drink Run Hour Reduction	34%	
Snack Machine Run Hour Reduction	40%	
Typical Cold Drink Wattage	0.339	kW
Typical Snack Machine Wattage	0.041	kW

MEASUREMENT AND VERIFICATION

Option A -Pre M&V: Measurement of KW for 5% sample machines in each category Energy Savings scope with measured KW and compare to pre retrofit calculated savings.

COMMISSIONING

Confirm vending miser operation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%

Relatively high safety factor is used for this ECM because of direct measurements are proven over the time and savings are stipulated

CALCULATIONS

Detailed energy savings calculations are in the line-by-line calculation sheet

*Inputs are blue

Building	Label	Type	Qty	Location
Bullock Elementary School	BUL-VM-1	Cold Beverage	1	Staff Room
Bullock Elementary School	BUL-VM-2	Snack	1	Staff Room
Glenfield Middle School	GMS-VM-1	Cold Beverage	1	Conference 237
Glenfield Middle School	GMS-VM-2	Snack	1	Conference 237
Glenfield Middle School	GMS-VM-3	Snack	1	Cafeteria 240
Montclair High School	MHS-VM-1	Cold Beverage	1	Cafeteria Vending
Montclair High School	MHS-VM-2	Snack	1	Cafeteria Vending
Montclair High School	MHS-VM-3	Cold Beverage	1	Cafeteria Vending
Montclair High School	MHS-VM-4	Snack	1	Cafeteria Vending
Montclair High School	MHS-VM-5,6	Cold Beverage	2	Faculty Lounge
Montclair High School	MHS-VM-7,8	Snack	2	Faculty Lounge
Totals	-	-	13	-

Montclair Board of Education
Exhibit D
ECM 1C Vending Misers
Vending Misers

CALCULATION

	Bullock Elementary Schoo	ullock Elementary Schoo	Glenfield Middle School	Glenfield Middle School	Glenfield Middle School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School
Label	BUL-VM-1	BUL-VM-2	GMS-VM-1	GMS-VM-2	GMS-VM-3	MHS-VM-1	MHS-VM-2	MHS-VM-3	MHS-VM-4	MHS-VM-5,6	MHS-VM-7,8
Type	Cold Beverage	Snack	Cold Beverage	Snack	Snack	Cold Beverage	Snack	Cold Beverage	Snack	Cold Beverage	Snack
Location	Staff Room	Staff Room	Conference 237	Conference 237	Cafeteria 240	Cafeteria Vending	Cafeteria Vending	Cafeteria Vending	Cafeteria Vending	Faculty Lounge	Faculty Lounge
Quantity	1	1	1	1	1	1	1	1	1	2	2
Run Hours	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Existing kWh Consumption	2,970	359	2,970	359	359	2,970	359	2,970	359	5,939	718
Proposed kWh Consumption	1,960	215	1,960	215	215	1,960	215	1,960	215	3,920	431
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
kWh Savings	1,010	144	1,010	144	144	1,010	144	1,010	144	2,019	287

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

ECM DESCRIPTION

Install de-stratification fans in large open ares. Fans will push and hold hot air down to reduce heating losses through the roof and upper section of the outside walls due to reducing the indoor temperature in these sections above the fan.

DATA / ASSUMPTIONS

Heating Hours	3,948	Hours
Roof - R Value (Assume between 1-2" insulation)	4.5	ft2-Deg F-hr/BTU
Wall - R Value (Assume 1/2" Wall Board, 8" LWCC, 4" Brick)	4.5	ft2-Deg F-hr/BTU
Window U Value Single Pane	1.20	Btu/ft2-Deg F-hr
Window U Value Double Pane	0.70	Btu/ft2-Deg F-hr

*Heating efficiency of de-stratification fans assumed at 60%

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify that the installed fans operate. Install clock meter on fans to verify that fans are running 24/7 during heating season

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Fuel savings recovery factor is conservatively set for 0 for the ECM due to the uncertainity in consistency of temperature difference between room and upper level temperatures, electric penalties recovery factor is at 0.

FORMULA

$$W_{TOTAL} = W_{FAN} \cdot q \cdot t_{FAN}$$

$$Q_{SAVINGS} = Q_{TOTAL} \cdot \mu$$

$$Q_{TOTAL} = Q_{WALL} + Q_{ROOF} + Q_{WIN}$$

$$Q_{WALL} = \sum_{-5}^{60} ((T_{STRAT} - T_{OCC}) \cdot A_{WALL} \cdot U_{WALL} \cdot t_{OCC}) + ((T_{STRAT} - T_{UNOCC}) \cdot A_{WALL} \cdot U_{WALL} \cdot t_{UNOCC})$$
$$Q_{WIN} = \sum_{-5}^{60} ((T_{STRAT} - T_{OCC}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{OCC}) + ((T_{STRAT} - T_{UNOCC}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{UNOCC})$$
$$Q_{ROOF} = \sum_{-5}^{60} ((T_{STRAT} - T_{OCC}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{OCC}) + ((T_{STRAT} - T_{UNOCC}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{UNOCC})$$

Variable	Units	Description
$Q_{SAVINGS}$	Therms	Annual thermal savings
$\sum_{-5}^{60}$	-	Summation of all bins from -5°F to 60°F
μ	%	Diversity factor of de-stratification fans (25% - 50%)
Q_{TOTAL}	btu	Total heat loss
Q_{WALL}	btu	Heat loss through wall (above de-stratification fan)
Q_{ROOF}	btu	Heat loss through roof
Q_{WIN}	btu	Heat loss through windows (above de-stratification fan)
T_{BIN}	°F	Temperature of respective bin
T_{OCC}	°F	Existing temperature of space during occupied hours
T_{UNOCC}	°F	Existing temperature of space during unoccupied hours
T_{STRAT}	°F	Existing stratified temperature above de-stratification fan) during all heating hours
t_{OCC}	Hrs	Occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Unoccupied Bin Hours in respective temperature bin
A_{WALL}	ft^2	Exposed wall area adove de-stratification fan
A_{ROOF}	ft^2	Exposed roof area adove de-stratification fan
A_{WINDOW}	ft^2	Exposed window area adove de-stratification fan
U_{WALL}	btu / ft^2 / °F	U-factor of wall
U_{ROOF}	btu / ft^2 / °F	U-factor of roof
U_{WIN}	btu / ft^2 / °F	U-factor of windows
W_{TOTAL}	kWh	Annual electrical consumption of fans
q	-	Quantity of fans
W_{FAN}	kW	Input kW of fan
t_{FAN}	Hrs	Annual run time of de-stratification fan (annual heating hours)

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

ASSUMPTIONS / DATA

* Inputs are in blue

Building	Location	Wall Length Perimeter (ft)	Wall Width Perimeter (ft)	Exposed Wall Height above Fan (ft)	Ceiling Height	Ceiling Type	Roof Area (ft^2)	Window Area (ft^2)	Roof U-Factor	Window U-Factor	Wall U-Factor
Valley Road Complex	Hillside Gym	72	40	3.0	23.0	Ceiling Tiles	2,880	0	0.22	0.70	0.22
Bradford Elementary School	Gym	50	25	3.0	21.0	Ceiling Tiles	1,250	48	0.22	0.70	0.22
Bradford Elementary School	Stage	70	50	3.0	21.0	Ceiling Tiles	3,500	150	0.22	0.70	0.22
Northeast Elementary School	Gym	50	25	3.0	21.0	Ceiling Tiles	1,250	48	0.22	0.70	0.22
Northeast Elementary School	Stage	70	50	3.0	21.0	Ceiling Tiles	3,500	150	0.22	0.70	0.22
Buzz Aldrin Middle School	Large Gym	91	50	5.0	24.0	Truss	4,550	54	0.22	0.70	0.22
Buzz Aldrin Middle School	Small Gym	47	60	3.0	25.0	Ceiling Tiles	2,820	0	0.22	0.70	0.22
Edgemont Elementary School	Cafetorium	49	75	3.0	20.0	Ceiling Tiles	3,675	200	0.22	0.70	0.22
George Inness Annex (HS-9th), Athletics	Gym 1	48	65	3.0	19/34/19	Truss	3,120	224	0.22	0.70	0.22
George Inness Annex (HS-9th), Athletics	Gym 2	48	65	3.0	19/34/19	Truss	3,120	224	0.22	0.70	0.22
Glenfield Middle School	Main Gym	65	102	4.0	26.0	Truss	6,630	0	0.22	0.70	0.22
Glenfield Middle School	Small Gym	46	48	4.0	26.0	Truss	2,208	0	0.22	0.70	0.22
Montclair High School	Main Gym	84	100	3.0	32.0	Truss	8,400	0	0.22	0.70	0.22
Montclair High School	Small Gym	60	100	3.0	32.0	Truss	6,000	0	0.22	0.70	0.22
Nishuane K-2	Gym	50	70	5.0	20.0	Truss	3,500	150	0.22	0.70	0.22
Renaissance Middle School	Gym	47	41	3.0	24.0	Ceiling Tiles	1,927	720	0.22	0.70	0.22
Watchung Elementary School	Gym	48	64	3.0	18.0	Ceiling Tiles	3,072	900	0.22	0.70	0.22
							-				
Totals											

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

CALCULATIONS

	Valley Road Complex	Bradford Elementary School	Bradford Elementary School	Northeast Elementary School	Northeast Elementary School	Buzz Aldrin Middle School	Buzz Aldrin Middle School	Edgemont Elementary School	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Glenfield Middle School	Montclair High School	Montclair High School	Nishuane K-2	Renaissance Middle School	Watchung Elementary School		Total	
Location #1	Hillside Gym	Gym	Stage	Gym	Stage	Large Gym	Small Gym	Cafetorium	Gym 1	Gym 2	Main Gym	Small Gym	Main Gym	Small Gym	Gym	Gym	Gym			
Wall Length	72	50	70	50	70	91	47	49	48	48	65	46	84	60	50	47	48			ft
Wall Width	40	25	50	25	50	50	60	75	65	65	102	48	100	100	70	41	64			ft
Wall Height Above Fan	3.0	3.0	3.0	3.0	3.0	5.0	3.0	3.0	3.0	3.0	4.0	4.0	3.0	3.0	5.0	3.0	3.0			ft
Roof Area	2,880	1,250	3,500	1,250	3,500	4,550	2,820	3,675	3,120	3,120	6,630	2,208	8,400	6,000	3,500	1,927	3,072			ft^2
Window Area	-	48	150	48	150	54	-	200	224	224	-	-	-	-	150	720	900			ft^2
Wall Exposed Area	336	177	210	177	210	651	321	172	115	115	668	376	552	480	450	(456)	(564)			ft^2
Roof U-Factor	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22			btu/ft2/°F
Window U-Factor	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70			btu/ft2/°F
Wall U-Factor	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22			btu/ft2/°F
Fan Model	Air Pear S-25	Air Pear S-25	Air Pear S-25	Air Pear S-25	Air Pear S-25	Air Pear A-25	Air Pear S-25	Air Pear S-25	Air Pear A-45	Air Pear A-45	Air Pear A-25	Air Pear A-25	Air Pear A-45	Air Pear A-45	Air Pear A-25	Air Pear S-25	Air Pear S-25			
Total run hours	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948			Hrs/Yr
Fan Input watts	35	35	35	35	35	35	35	35	46	46	35	35	46	46	35	35	35			kW
kwh consumed by fan	138	138	138	138	138	138	138	138	182	182	138	138	182	182	138	138	138			kWh/Yr
SF per Fan	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200			
Total Fans	4	2	4	2	4	6	4	4	4	4	6	2	9	6	4	2	4		0	
Total Kwh Consumed	553	276	553	276	553	829	553	553	726	726	829	276	1,634	1,090	553	276	553			kWh/Yr
Existing Occupied Heating Setpoint	74.0	72.0	72.0	78	78	79	79	81	76	76	76	76	75	75	77	77	78			°F
Existing Unoccup. Heating Setpoint	66.0	65.0	65.0	72	72	66	66	66	64	64	65	65	66	66	72	65	69			°F
Diversity Factor	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%		0.8	%
Boiler Efficiency	69.6%	72.5%	72.5%	64.8%	64.8%	69.4%	69.4%	72.5%	64.8%	64.8%	91.0%	91.0%	69.6%	69.6%	64.8%	72.5%	73.5%			
Additional Electric Usage	(553)	(276)	(553)	(276)	(553)	(829)	(553)	(553)	(726)	(726)	(829)	(276)	(1,634)	(1,090)	(553)	(276)	(553)		**(10,810)**	kWh/Yr
Calculated Fuel Savings Therms	977	437	1,159	615	1,629	1,726	1,009	1,363	1,245	1,245	1,663	589	2,765	2,001	1,693	1,092	1,705		**22,914**	Therms/Yr
Safety Factor Electric	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
Safety Factor Thermal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
Additional Electric usage	(553)	(276)	(553)	(276)	(553)	(829)	(553)	(553)	(726)	(726)	(829)	(276)	(1,634)	(1,090)	(553)	(276)	(553)		**(10,810)**	kWh/Yr
Calculated Fuel Savings	977	437	1,159	615	1,629	1,726	1,009	1,363	1,245	1,245	1,663	589	2,765	2,001	1,693	1,092	1,705		**22,914**	Therms/Yr

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	105	222	336	2,880	0	0.22	0.22	0.70	270,469	2,318,309	-	2,588,778
50 to 55	52.5	109	182	172	463	133	330	336	2,880	0	0.22	0.22	0.70	546,277	4,682,377	-	5,228,654
45 to 50	47.5	105	119	142	366	93	273	336	2,880	0	0.22	0.22	0.70	561,195	4,810,240	-	5,371,435
40 to 45	42.5	185	155	177	517	130	387	336	2,880	0	0.22	0.22	0.70	984,763	8,440,823	-	9,425,586
35 to 40	37.5	236	200	241	677	167	510	336	2,880	0	0.22	0.22	0.70	1,540,496	13,204,251	-	14,744,747
30 to 35	32.5	237	202	198	637	169	468	336	2,880	0	0.22	0.22	0.70	1,694,043	14,520,366	-	16,214,408
25 to 30	27.5	121	115	113	349	93	256	336	2,880	0	0.22	0.22	0.70	1,059,099	9,077,989	-	10,137,087
20 to 25	22.5	149	68	97	314	69	245	336	2,880	0	0.22	0.22	0.70	1,061,152	9,095,589	-	10,156,741
15 to 20	17.5	95	40	46	181	42	139	336	2,880	0	0.22	0.22	0.70	680,528	5,833,097	-	6,513,625
10 to 15	12.5	39	9	28	76	13	63	336	2,880	0	0.22	0.22	0.70	311,115	2,666,697	-	2,977,812
5 to 10	7.5	21	5	5	31	7	24	336	2,880	0	0.22	0.22	0.70	139,515	1,195,840	-	1,335,355
0 to 5	2.5	4	2	-	6	2	4	336	2,880	0	0.22	0.22	0.70	29,621	253,897	-	283,518
-5 to 0	-2.5							336	2,880	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							336	2,880	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							336	2,880	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,023	2,921							8,878,272	76,099,474	-	84,977,746

BRADFORD ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	98	229	177	1,250	48	0.22	0.22	0.70	123,359	871,181	105,378	1,099,918
50 to 55	52.5	109	182	172	463	123	340	177	1,250	48	0.22	0.22	0.70	261,640	1,847,743	223,503	2,332,886
45 to 50	47.5	105	119	142	366	84	282	177	1,250	48	0.22	0.22	0.70	274,989	1,942,014	234,906	2,451,909
40 to 45	42.5	185	155	177	517	113	404	177	1,250	48	0.22	0.22	0.70	488,766	3,451,736	417,522	4,358,024
35 to 40	37.5	236	200	241	677	146	531	177	1,250	48	0.22	0.22	0.70	772,507	5,455,556	659,904	6,887,966
30 to 35	32.5	237	202	198	637	147	490	177	1,250	48	0.22	0.22	0.70	854,885	6,037,326	730,275	7,622,487
25 to 30	27.5	121	115	113	349	83	266	177	1,250	48	0.22	0.22	0.70	537,539	3,796,181	459,186	4,792,906
20 to 25	22.5	149	68	97	314	56	258	177	1,250	48	0.22	0.22	0.70	540,268	3,815,451	461,517	4,817,236
15 to 20	17.5	95	40	46	181	33	148	177	1,250	48	0.22	0.22	0.70	347,387	2,453,299	296,751	3,097,437
10 to 15	12.5	39	9	28	76	9	67	177	1,250	48	0.22	0.22	0.70	159,448	1,126,042	136,206	1,421,695
5 to 10	7.5	21	5	5	31	5	26	177	1,250	48	0.22	0.22	0.70	71,488	504,861	61,068	637,417
0 to 5	2.5	4	2	-	6	2	4	177	1,250	48	0.22	0.22	0.70	15,193	107,292	12,978	135,462
-5 to 0	-2.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	899	3,045							4,447,469	31,408,681	3,799,194	39,655,344

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

BRADFORD ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	98	229	210	3,500	150	0.22	0.22	0.70	146,358	2,439,306	329,306	2,914,970
50 to 55	52.5	109	182	172	463	123	340	210	3,500	150	0.22	0.22	0.70	310,421	5,173,681	698,447	6,182,548
45 to 50	47.5	105	119	142	366	84	282	210	3,500	150	0.22	0.22	0.70	326,258	5,437,639	734,081	6,497,978
40 to 45	42.5	185	155	177	517	113	404	210	3,500	150	0.22	0.22	0.70	579,892	9,664,861	1,304,756	11,549,509
35 to 40	37.5	236	200	241	677	146	531	210	3,500	150	0.22	0.22	0.70	916,533	15,275,556	2,062,200	18,254,289
30 to 35	32.5	237	202	198	637	147	490	210	3,500	150	0.22	0.22	0.70	1,014,271	16,904,514	2,282,109	20,200,894
25 to 30	27.5	121	115	113	349	83	266	210	3,500	150	0.22	0.22	0.70	637,758	10,629,306	1,434,956	12,702,020
20 to 25	22.5	149	68	97	314	56	258	210	3,500	150	0.22	0.22	0.70	640,996	10,683,264	1,442,241	12,766,500
15 to 20	17.5	95	40	46	181	33	148	210	3,500	150	0.22	0.22	0.70	412,154	6,869,236	927,347	8,208,737
10 to 15	12.5	39	9	28	76	9	67	210	3,500	150	0.22	0.22	0.70	189,175	3,152,917	425,644	3,767,735
5 to 10	7.5	21	5	5	31	5	26	210	3,500	150	0.22	0.22	0.70	84,817	1,413,611	190,838	1,689,265
0 to 5	2.5	4	2	-	6	2	4	210	3,500	150	0.22	0.22	0.70	18,025	300,417	40,556	358,998
-5 to 0	-2.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	899	3,045							5,276,658	87,944,306	11,872,481	105,093,445

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	128	199	177	1,250	48	0.22	0.22	0.70	216,673	1,530,179	185,090	1,931,942
50 to 55	52.5	109	182	172	463	170	293	177	1,250	48	0.22	0.22	0.70	395,346	2,791,994	337,720	3,525,060
45 to 50	47.5	105	119	142	366	120	246	177	1,250	48	0.22	0.22	0.70	380,959	2,690,387	325,429	3,396,775
40 to 45	42.5	185	155	177	517	159	358	177	1,250	48	0.22	0.22	0.70	637,378	4,501,260	544,472	5,683,111
35 to 40	37.5	236	200	241	677	207	470	177	1,250	48	0.22	0.22	0.70	967,533	6,832,857	826,502	8,626,892
30 to 35	32.5	237	202	198	637	201	436	177	1,250	48	0.22	0.22	0.70	1,037,075	7,323,978	885,908	9,246,962
25 to 30	27.5	121	115	113	349	113	236	177	1,250	48	0.22	0.22	0.70	637,564	4,502,569	544,631	5,684,764
20 to 25	22.5	149	68	97	314	79	235	177	1,250	48	0.22	0.22	0.70	630,048	4,449,494	538,211	5,617,753
15 to 20	17.5	95	40	46	181	45	136	177	1,250	48	0.22	0.22	0.70	398,687	2,815,585	340,573	3,554,845
10 to 15	12.5	39	9	28	76	15	61	177	1,250	48	0.22	0.22	0.70	181,384	1,280,962	154,945	1,617,292
5 to 10	7.5	21	5	5	31	6	25	177	1,250	48	0.22	0.22	0.70	80,143	565,982	68,461	714,586
0 to 5	2.5	4	2	-	6	2	4	177	1,250	48	0.22	0.22	0.70	16,823	118,810	14,371	150,004
-5 to 0	-2.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							177	1,250	48	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,245	2,699							5,579,615	39,404,058	4,766,315	49,749,987

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	128	199	210	3,500	150	0.22	0.22	0.70	257,070	4,284,500	578,408	5,119,978
50 to 55	52.5	109	182	172	463	170	293	210	3,500	150	0.22	0.22	0.70	469,055	7,817,583	1,055,374	9,342,012
45 to 50	47.5	105	119	142	366	120	246	210	3,500	150	0.22	0.22	0.70	451,985	7,533,083	1,016,966	9,002,035
40 to 45	42.5	185	155	177	517	159	358	210	3,500	150	0.22	0.22	0.70	756,212	12,603,528	1,701,476	15,061,216
35 to 40	37.5	236	200	241	677	207	470	210	3,500	150	0.22	0.22	0.70	1,147,920	19,132,000	2,582,820	22,862,740
30 to 35	32.5	237	202	198	637	201	436	210	3,500	150	0.22	0.22	0.70	1,230,428	20,507,139	2,768,464	24,506,031
25 to 30	27.5	121	115	113	349	113	236	210	3,500	150	0.22	0.22	0.70	756,432	12,607,194	1,701,971	15,065,597
20 to 25	22.5	149	68	97	314	79	235	210	3,500	150	0.22	0.22	0.70	747,515	12,458,583	1,681,909	14,888,007
15 to 20	17.5	95	40	46	181	45	136	210	3,500	150	0.22	0.22	0.70	473,018	7,883,639	1,064,291	9,420,948
10 to 15	12.5	39	9	28	76	15	61	210	3,500	150	0.22	0.22	0.70	215,202	3,586,694	484,204	4,286,100
5 to 10	7.5	21	5	5	31	6	25	210	3,500	150	0.22	0.22	0.70	95,085	1,584,750	213,941	1,893,776
0 to 5	2.5	4	2	-	6	2	4	210	3,500	150	0.22	0.22	0.70	19,960	332,667	44,910	397,537
-5 to 0	-2.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							210	3,500	150	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,245	2,699							6,619,882	110,331,361	14,894,734	131,845,977

BUZZ ALDRIN MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	119	208	651	4,550	54	0.22	0.22	0.70	626,270	4,377,154	163,638	5,167,062
50 to 55	52.5	109	182	172	463	155	308	651	4,550	54	0.22	0.22	0.70	1,195,910	8,358,513	312,480	9,866,903
45 to 50	47.5	105	119	142	366	107	259	651	4,550	54	0.22	0.22	0.70	1,180,870	8,253,393	308,550	9,742,813
40 to 45	42.5	185	155	177	517	143	374	651	4,550	54	0.22	0.22	0.70	2,026,630	14,164,619	529,539	16,720,788
35 to 40	37.5	236	200	241	677	185	492	651	4,550	54	0.22	0.22	0.70	3,140,034	21,946,474	820,460	25,906,968
30 to 35	32.5	237	202	198	637	183	454	651	4,550	54	0.22	0.22	0.70	3,431,511	23,983,682	896,621	28,311,814
25 to 30	27.5	121	115	113	349	103	246	651	4,550	54	0.22	0.22	0.70	2,137,590	14,940,142	558,531	17,636,263
20 to 25	22.5	149	68	97	314	71	243	651	4,550	54	0.22	0.22	0.70	2,108,656	14,737,919	550,971	17,397,547
15 to 20	17.5	95	40	46	181	41	140	651	4,550	54	0.22	0.22	0.70	1,347,366	9,417,074	352,054	11,116,493
10 to 15	12.5	39	9	28	76	12	64	651	4,550	54	0.22	0.22	0.70	611,555	4,274,310	159,793	5,045,658
5 to 10	7.5	21	5	5	31	6	25	651	4,550	54	0.22	0.22	0.70	273,436	1,911,108	71,446	2,255,990
0 to 5	2.5	4	2	-	6	2	4	651	4,550	54	0.22	0.22	0.70	58,476	408,706	15,279	482,461
-5 to 0	-2.5							651	4,550	54	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							651	4,550	54	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							651	4,550	54	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,128	2,816							18,138,304	126,773,093	4,739,363	149,650,760

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

BUZZ ALDRIN MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	119	208	321	2,820	0	0.22	0.22	0.70	308,806	2,712,874	-	3,021,679
50 to 55	52.5	109	182	172	463	155	308	321	2,820	0	0.22	0.22	0.70	589,688	5,180,441	-	5,770,129
45 to 50	47.5	105	119	142	366	107	259	321	2,820	0	0.22	0.22	0.70	582,272	5,115,290	-	5,697,562
40 to 45	42.5	185	155	177	517	143	374	321	2,820	0	0.22	0.22	0.70	999,306	8,778,951	-	9,778,257
35 to 40	37.5	236	200	241	677	185	492	321	2,820	0	0.22	0.22	0.70	1,548,312	13,601,990	-	15,150,302
30 to 35	32.5	237	202	198	637	183	454	321	2,820	0	0.22	0.22	0.70	1,692,036	14,864,612	-	16,556,647
25 to 30	27.5	121	115	113	349	103	246	321	2,820	0	0.22	0.22	0.70	1,054,019	9,259,604	-	10,313,623
20 to 25	22.5	149	68	97	314	71	243	321	2,820	0	0.22	0.22	0.70	1,039,752	9,134,271	-	10,174,023
15 to 20	17.5	95	40	46	181	41	140	321	2,820	0	0.22	0.22	0.70	664,369	5,836,516	-	6,500,885
10 to 15	12.5	39	9	28	76	12	64	321	2,820	0	0.22	0.22	0.70	301,550	2,649,133	-	2,950,683
5 to 10	7.5	21	5	5	31	6	25	321	2,820	0	0.22	0.22	0.70	134,828	1,184,467	-	1,319,295
0 to 5	2.5	4	2	-	6	2	4	321	2,820	0	0.22	0.22	0.70	28,834	253,308	-	282,142
-5 to 0	-2.5							321	2,820	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							321	2,820	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							321	2,820	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,128	2,816							8,943,772	78,571,455	-	87,515,228

EDGEMONT ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	98	229	172	3,675	200	0.22	0.22	0.70	162,241	3,466,488	594,255	4,222,984
50 to 55	52.5	109	182	172	463	123	340	172	3,675	200	0.22	0.22	0.70	309,704	6,617,231	1,134,383	8,061,318
45 to 50	47.5	105	119	142	366	84	282	172	3,675	200	0.22	0.22	0.70	306,819	6,555,588	1,123,815	7,986,222
40 to 45	42.5	185	155	177	517	113	404	172	3,675	200	0.22	0.22	0.70	529,393	11,311,154	1,939,055	13,779,602
35 to 40	37.5	236	200	241	677	146	531	172	3,675	200	0.22	0.22	0.70	821,226	17,546,550	3,007,980	21,375,756
30 to 35	32.5	237	202	198	637	147	490	172	3,675	200	0.22	0.22	0.70	900,159	19,233,040	3,297,093	23,430,291
25 to 30	27.5	121	115	113	349	83	266	172	3,675	200	0.22	0.22	0.70	560,975	11,985,954	2,054,735	14,601,664
20 to 25	22.5	149	68	97	314	56	258	172	3,675	200	0.22	0.22	0.70	554,071	11,838,444	2,029,448	14,421,963
15 to 20	17.5	95	40	46	181	33	148	172	3,675	200	0.22	0.22	0.70	354,730	7,579,265	1,299,303	9,233,297
10 to 15	12.5	39	9	28	76	9	67	172	3,675	200	0.22	0.22	0.70	160,633	3,432,129	588,365	4,181,127
5 to 10	7.5	21	5	5	31	5	26	172	3,675	200	0.22	0.22	0.70	72,183	1,542,275	264,390	1,878,848
0 to 5	2.5	4	2	-	6	2	4	172	3,675	200	0.22	0.22	0.70	15,484	330,838	56,715	403,037
-5 to 0	-2.5							172	3,675	200	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							172	3,675	200	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							172	3,675	200	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	899	3,045							4,747,619	101,438,954	17,389,535	123,576,108

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	105	222	115	3,120	224	0.22	0.22	0.70	86,628	2,350,251	531,518	2,968,398
50 to 55	52.5	109	182	172	463	133	330	115	3,120	224	0.22	0.22	0.70	176,923	4,799,996	1,085,538	6,062,457
45 to 50	47.5	105	119	142	366	93	273	115	3,120	224	0.22	0.22	0.70	182,888	4,961,840	1,122,139	6,266,868
40 to 45	42.5	185	155	177	517	130	387	115	3,120	224	0.22	0.22	0.70	323,902	8,787,604	1,987,350	11,098,856
35 to 40	37.5	236	200	241	677	167	510	115	3,120	224	0.22	0.22	0.70	509,737	13,829,375	3,127,566	17,466,678
30 to 35	32.5	237	202	198	637	169	468	115	3,120	224	0.22	0.22	0.70	564,480	15,314,594	3,463,454	19,342,529
25 to 30	27.5	121	115	113	349	93	256	115	3,120	224	0.22	0.22	0.70	354,207	9,609,798	2,173,293	12,137,298
20 to 25	22.5	149	68	97	314	69	245	115	3,120	224	0.22	0.22	0.70	354,207	9,609,798	2,173,293	12,137,298
15 to 20	17.5	95	40	46	181	42	139	115	3,120	224	0.22	0.22	0.70	227,957	6,184,583	1,398,667	7,811,207
10 to 15	12.5	39	9	28	76	13	63	115	3,120	224	0.22	0.22	0.70	103,885	2,818,450	637,403	3,559,738
5 to 10	7.5	21	5	5	31	7	24	115	3,120	224	0.22	0.22	0.70	46,869	1,271,573	287,571	1,606,013
0 to 5	2.5	4	2	-	6	2	4	115	3,120	224	0.22	0.22	0.70	10,032	272,183	61,555	343,770
-5 to 0	-2.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,023	2,921							2,941,716	79,810,046	18,049,349	100,801,111

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	105	222	115	3,120	224	0.22	0.22	0.70	86,628	2,350,251	531,518	2,968,398
50 to 55	52.5	109	182	172	463	133	330	115	3,120	224	0.22	0.22	0.70	176,923	4,799,996	1,085,538	6,062,457
45 to 50	47.5	105	119	142	366	93	273	115	3,120	224	0.22	0.22	0.70	182,888	4,961,840	1,122,139	6,266,868
40 to 45	42.5	185	155	177	517	130	387	115	3,120	224	0.22	0.22	0.70	323,902	8,787,604	1,987,350	11,098,856
35 to 40	37.5	236	200	241	677	167	510	115	3,120	224	0.22	0.22	0.70	509,737	13,829,375	3,127,566	17,466,678
30 to 35	32.5	237	202	198	637	169	468	115	3,120	224	0.22	0.22	0.70	564,480	15,314,594	3,463,454	19,342,529
25 to 30	27.5	121	115	113	349	93	256	115	3,120	224	0.22	0.22	0.70	354,207	9,609,798	2,173,293	12,137,298
20 to 25	22.5	149	68	97	314	69	245	115	3,120	224	0.22	0.22	0.70	354,207	9,609,798	2,173,293	12,137,298
15 to 20	17.5	95	40	46	181	42	139	115	3,120	224	0.22	0.22	0.70	227,957	6,184,583	1,398,667	7,811,207
10 to 15	12.5	39	9	28	76	13	63	115	3,120	224	0.22	0.22	0.70	103,885	2,818,450	637,403	3,559,738
5 to 10	7.5	21	5	5	31	7	24	115	3,120	224	0.22	0.22	0.70	46,869	1,271,573	287,571	1,606,013
0 to 5	2.5	4	2	-	6	2	4	115	3,120	224	0.22	0.22	0.70	10,032	272,183	61,555	343,770
-5 to 0	-2.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							115	3,120	224	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,023	2,921							2,941,716	79,810,046	18,049,349	100,801,111

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	98	229	668	6,630	0	0.22	0.22	0.70	523,558	5,196,394	-	5,719,952
50 to 55	52.5	109	182	172	463	123	340	668	6,630	0	0.22	0.22	0.70	1,060,755	10,528,151	-	11,588,905
45 to 50	47.5	105	119	142	366	84	282	668	6,630	0	0.22	0.22	0.70	1,087,541	10,794,008	-	11,881,549
40 to 45	42.5	185	155	177	517	113	404	668	6,630	0	0.22	0.22	0.70	1,911,938	18,976,270	-	20,888,208
35 to 40	37.5	236	200	241	677	146	531	668	6,630	0	0.22	0.22	0.70	3,002,183	29,797,114	-	32,799,297
30 to 35	32.5	237	202	198	637	147	490	668	6,630	0	0.22	0.22	0.70	3,313,876	32,890,720	-	36,204,596
25 to 30	27.5	121	115	113	349	83	266	668	6,630	0	0.22	0.22	0.70	2,077,772	20,622,194	-	22,699,966
20 to 25	22.5	149	68	97	314	56	258	668	6,630	0	0.22	0.22	0.70	2,072,112	20,566,023	-	22,638,135
15 to 20	17.5	95	40	46	181	33	148	668	6,630	0	0.22	0.22	0.70	1,330,924	13,209,617	-	14,540,541
10 to 15	12.5	39	9	28	76	9	67	668	6,630	0	0.22	0.22	0.70	607,164	6,026,196	-	6,633,361
5 to 10	7.5	21	5	5	31	5	26	668	6,630	0	0.22	0.22	0.70	272,767	2,707,250	-	2,980,017
0 to 5	2.5	4	2	-	6	2	4	668	6,630	0	0.22	0.22	0.70	58,291	578,546	-	636,837
-5 to 0	-2.5							668	6,630	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							668	6,630	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							668	6,630	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	899	3,045							17,318,881	171,892,485	-	189,211,365

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	98	229	376	2,208	0	0.22	0.22	0.70	294,697	1,730,564	-	2,025,261
50 to 55	52.5	109	182	172	463	123	340	376	2,208	0	0.22	0.22	0.70	597,072	3,506,208	-	4,103,279
45 to 50	47.5	105	119	142	366	84	282	376	2,208	0	0.22	0.22	0.70	612,149	3,594,747	-	4,206,896
40 to 45	42.5	185	155	177	517	113	404	376	2,208	0	0.22	0.22	0.70	1,076,181	6,319,699	-	7,395,880
35 to 40	37.5	236	200	241	677	146	531	376	2,208	0	0.22	0.22	0.70	1,689,851	9,923,383	-	11,613,234
30 to 35	32.5	237	202	198	637	147	490	376	2,208	0	0.22	0.22	0.70	1,865,296	10,953,651	-	12,818,947
25 to 30	27.5	121	115	113	349	83	266	376	2,208	0	0.22	0.22	0.70	1,169,524	6,867,844	-	8,037,368
20 to 25	22.5	149	68	97	314	56	258	376	2,208	0	0.22	0.22	0.70	1,166,339	6,849,137	-	8,015,476
15 to 20	17.5	95	40	46	181	33	148	376	2,208	0	0.22	0.22	0.70	749,143	4,399,221	-	5,148,364
10 to 15	12.5	39	9	28	76	9	67	376	2,208	0	0.22	0.22	0.70	341,757	2,006,914	-	2,348,671
5 to 10	7.5	21	5	5	31	5	26	376	2,208	0	0.22	0.22	0.70	153,533	901,600	-	1,055,133
0 to 5	2.5	4	2	-	6	2	4	376	2,208	0	0.22	0.22	0.70	32,810	192,674	-	225,485
-5 to 0	-2.5							376	2,208	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							376	2,208	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							376	2,208	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	899	3,045							9,748,352	57,245,642	-	66,993,994

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	118	209	552	8,400	0	0.22	0.22	0.70	471,461	7,174,400	-	7,645,861
50 to 55	52.5	109	182	172	463	149	314	552	8,400	0	0.22	0.22	0.70	931,737	14,178,600	-	15,110,337
45 to 50	47.5	105	119	142	366	104	262	552	8,400	0	0.22	0.22	0.70	945,116	14,382,200	-	15,327,316
40 to 45	42.5	185	155	177	517	144	373	552	8,400	0	0.22	0.22	0.70	1,649,039	25,094,067	-	26,743,105
35 to 40	37.5	236	200	241	677	185	492	552	8,400	0	0.22	0.22	0.70	2,571,032	39,124,400	-	41,695,432
30 to 35	32.5	237	202	198	637	187	450	552	8,400	0	0.22	0.22	0.70	2,823,660	42,968,733	-	45,792,393
25 to 30	27.5	121	115	113	349	104	245	552	8,400	0	0.22	0.22	0.70	1,762,751	26,824,467	-	28,587,217
20 to 25	22.5	149	68	97	314	75	239	552	8,400	0	0.22	0.22	0.70	1,758,501	26,759,800	-	28,518,301
15 to 20	17.5	95	40	46	181	46	135	552	8,400	0	0.22	0.22	0.70	1,127,101	17,151,533	-	18,278,634
10 to 15	12.5	39	9	28	76	13	63	552	8,400	0	0.22	0.22	0.70	513,548	7,814,867	-	8,328,415
5 to 10	7.5	21	5	5	31	7	24	552	8,400	0	0.22	0.22	0.70	230,539	3,508,200	-	3,738,739
0 to 5	2.5	4	2	-	6	2	4	552	8,400	0	0.22	0.22	0.70	49,102	747,200	-	796,302
-5 to 0	-2.5							552	8,400	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							552	8,400	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							552	8,400	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,134	2,810							14,833,585	225,728,467	-	240,562,052

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	118	209	480	6,000	0	0.22	0.22	0.70	409,966	5,124,571	-	5,534,537
50 to 55	52.5	109	182	172	463	149	314	480	6,000	0	0.22	0.22	0.70	810,206	10,127,571	-	10,937,777
45 to 50	47.5	105	119	142	366	104	262	480	6,000	0	0.22	0.22	0.70	821,840	10,273,000	-	11,094,840
40 to 45	42.5	185	155	177	517	144	373	480	6,000	0	0.22	0.22	0.70	1,433,947	17,924,333	-	19,358,280
35 to 40	37.5	236	200	241	677	185	492	480	6,000	0	0.22	0.22	0.70	2,235,680	27,946,000	-	30,181,680
30 to 35	32.5	237	202	198	637	187	450	480	6,000	0	0.22	0.22	0.70	2,455,356	30,691,952	-	33,147,309
25 to 30	27.5	121	115	113	349	104	245	480	6,000	0	0.22	0.22	0.70	1,532,827	19,160,333	-	20,693,160
20 to 25	22.5	149	68	97	314	75	239	480	6,000	0	0.22	0.22	0.70	1,529,131	19,114,143	-	20,643,274
15 to 20	17.5	95	40	46	181	46	135	480	6,000	0	0.22	0.22	0.70	980,088	12,251,095	-	13,231,183
10 to 15	12.5	39	9	28	76	13	63	480	6,000	0	0.22	0.22	0.70	446,564	5,582,048	-	6,028,611
5 to 10	7.5	21	5	5	31	7	24	480	6,000	0	0.22	0.22	0.70	200,469	2,505,857	-	2,706,326
0 to 5	2.5	4	2	-	6	2	4	480	6,000	0	0.22	0.22	0.70	42,697	533,714	-	576,411
-5 to 0	-2.5							480	6,000	0	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							480	6,000	0	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							480	6,000	0	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,134	2,810							12,898,770	161,234,619	-	174,133,389

Montclair Board of Education
Exhibit D
ECM 1D De-Stratification Fans
De-stratifcation fans

NISHUANE K-2

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	111	216	450	3,500	150	0.22	0.22	0.70	529,418	4,117,694	555,889	5,203,001
50 to 55	52.5	109	182	172	463	140	323	450	3,500	150	0.22	0.22	0.70	972,716	7,565,569	1,021,352	9,559,637
45 to 50	47.5	105	119	142	366	94	272	450	3,500	150	0.22	0.22	0.70	943,888	7,341,347	991,082	9,276,317
40 to 45	42.5	185	155	177	517	127	390	450	3,500	150	0.22	0.22	0.70	1,588,766	12,357,069	1,668,204	15,614,040
35 to 40	37.5	236	200	241	677	164	513	450	3,500	150	0.22	0.22	0.70	2,417,614	18,803,667	2,538,495	23,759,776
30 to 35	32.5	237	202	198	637	165	472	450	3,500	150	0.22	0.22	0.70	2,598,873	20,213,458	2,728,817	25,541,148
25 to 30	27.5	121	115	113	349	93	256	450	3,500	150	0.22	0.22	0.70	1,599,523	12,440,736	1,679,499	15,719,759
20 to 25	22.5	149	68	97	314	62	252	450	3,500	150	0.22	0.22	0.70	1,585,238	12,329,625	1,664,499	15,579,362
15 to 20	17.5	95	40	46	181	37	144	450	3,500	150	0.22	0.22	0.70	1,004,977	7,816,486	1,055,226	9,876,689
10 to 15	12.5	39	9	28	76	10	66	450	3,500	150	0.22	0.22	0.70	457,155	3,555,653	480,013	4,492,821
5 to 10	7.5	21	5	5	31	5	26	450	3,500	150	0.22	0.22	0.70	202,673	1,576,347	212,807	1,991,827
0 to 5	2.5	4	2	-	6	2	4	450	3,500	150	0.22	0.22	0.70	42,593	331,278	44,723	418,593
-5 to 0	-2.5							450	3,500	150	0.22	0.22	0.70	-	-	-	-
-10 to -5	-7.5							450	3,500	150	0.22	0.22	0.70	-	-	-	-
-15 to -10	-12.5							450	3,500	150	0.22	0.22	0.70	-	-	-	-
Total		1,387	1,241	1,316	3,944	1,010	2,934							13,943,434	108,448,931	14,640,606	137,032,970

RENAISSANCE MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	111	216	(456)	1,927	720	0.22	0.22	0.70	(382,931)	1,618,221	1,904,580	3,139,870
50 to 55	52.5	109	182	172	463	140	323	(456)	1,927	720	0.22	0.22	0.70	(756,381)	3,196,373	3,762,000	6,201,992
45 to 50	47.5	105	119	142	366	94	272	(456)	1,927	720	0.22	0.22	0.70	(763,800)	3,227,725	3,798,900	6,262,825
40 to 45	42.5	185	155	177	517	127	390	(456)	1,927	720	0.22	0.22	0.70	(1,333,474)	5,635,099	6,632,280	10,933,904
35 to 40	37.5	236	200	241	677	164	513	(456)	1,927	720	0.22	0.22	0.70	(2,085,910)	8,814,802	10,374,660	17,103,551
30 to 35	32.5	237	202	198	637	165	472	(456)	1,927	720	0.22	0.22	0.70	(2,299,036)	9,715,445	11,434,680	18,851,088
25 to 30	27.5	121	115	113	349	93	256	(456)	1,927	720	0.22	0.22	0.70	(1,439,223)	6,081,979	7,158,240	11,800,996
20 to 25	22.5	149	68	97	314	62	252	(456)	1,927	720	0.22	0.22	0.70	(1,427,533)	6,032,581	7,100,100	11,705,147
15 to 20	17.5	95	40	46	181	37	144	(456)	1,927	720	0.22	0.22	0.70	(916,270)	3,872,047	4,557,240	7,513,016
10 to 15	12.5	39	9	28	76	10	66	(456)	1,927	720	0.22	0.22	0.70	(416,371)	1,759,535	2,070,900	3,414,063
5 to 10	7.5	21	5	5	31	5	26	(456)	1,927	720	0.22	0.22	0.70	(187,250)	791,293	931,320	1,535,364
0 to 5	2.5	4	2	-	6	2	4	(456)	1,927	720	0.22	0.22	0.70	(40,171)	169,760	199,800	329,388
-5 to 0	-2.5	4	-	-	4	0	4	(456)	1,927	720	0.22	0.22	0.70	(27,794)	117,455	138,240	227,901
-10 to -5	-7.5																
-15 to -10	-12.5																
Total		1,391	1,241	1,316	3,948	1,011	2,937							(12,076,147)	51,032,313	60,062,940	99,019,106

WATCHUNG ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Exposed Wall area	Exposed Roof area	Window area	Wall U factor	Roof U factor	Window U factor	Wall Heat loss	Roof Heat Loss	Windows Heat Loss	Total Heat loss
HEATING								ft^2	ft^2	ft^2	$btu/ft^2/°F$	$btu/ft^2/°F$	$btu/ft^2/°F$	btu/Yr	btu/Yr	btu/Yr	btu/Yr
55 to 60	57.5	86	144	97	327	111	216	(564)	3,072	900	0.22	0.22	0.70	(596,000)	3,246,299	2,995,853	5,646,152
50 to 55	52.5	109	182	172	463	140	323	(564)	3,072	900	0.22	0.22	0.70	(1,115,102)	6,073,746	5,605,166	10,563,811
45 to 50	47.5	105	119	142	366	94	272	(564)	3,072	900	0.22	0.22	0.70	(1,092,703)	5,951,744	5,492,576	10,351,617
40 to 45	42.5	185	155	177	517	127	390	(564)	3,072	900	0.22	0.22	0.70	(1,860,647)	10,134,589	9,352,721	17,626,663
35 to 40	37.5	236	200	241	677	164	513	(564)	3,072	900	0.22	0.22	0.70	(2,857,707)	15,565,385	14,364,540	27,072,218
30 to 35	32.5	237	202	198	637	165	472	(564)	3,072	900	0.22	0.22	0.70	(3,100,686)	16,888,844	15,585,896	29,374,054
25 to 30	27.5	121	115	113	349	93	256	(564)	3,072	900	0.22	0.22	0.70	(1,920,109)	10,458,466	9,651,611	18,189,968
20 to 25	22.5	149	68	97	314	62	252	(564)	3,072	900	0.22	0.22	0.70	(1,899,787)	10,347,776	9,549,461	17,997,450
15 to 20	17.5	95	40	46	181	37	144	(564)	3,072	900	0.22	0.22	0.70	(1,210,091)	6,591,134	6,082,639	11,463,682
10 to 15	12.5	39	9	28	76	10	66	(564)	3,072	900	0.22	0.22	0.70	(549,361)	2,992,262	2,761,414	5,204,315
5 to 10	7.5	21	5	5	31	5	26	(564)	3,072	900	0.22	0.22	0.70	(245,092)	1,334,967	1,231,976	2,321,852
0 to 5	2.5	4	2	-	6	2	4	(564)	3,072	900	0.22	0.22	0.70	(52,022)	283,355	261,495	492,828
-5 to 0	-2.5	4	-	-	4	0	4	(564)	3,072	900	0.22	0.22	0.70	(36,248)	197,437	182,205	343,394
-10 to -5	-7.5																
-15 to -10	-12.5																
Total		1,391	1,241	1,316	3,948	1,011	2,937							(16,535,556)	90,066,005	83,117,554	156,648,003

Montclair Board of Education
Exhibit D
ECM 1E Plug Load Management via WiFi
Smart Strips and Smart Board Projectors

ECM DESCRIPTION

Install BERT plug load management plug on the various plug loads throughout the district. Integrate equipment onto a central wifi network to schedule these pieces of equipment

DATA / ASSUMPTIONS

Electrical Power Draw When OFF

Cold Beverage Machines	384	W
Snack Machines	60	W
Large Copiers	30	W
Small Printers / Copiers	20	W
Monitor Combos (Printer)	30	W
Laptop Charging Carts	35	W
Projectors	21	W
Water Fountains	6	W
Coffee Machines	60	W
Hot / Cold Water Machines	60	W
Smart Boards	20	W
Window A/C Units	100	W
TVs	10	W
XXXs	0	W
XXXs	0	W

Annual Savings for smart strips and smart board projectors are based on logging results for the various pieces of equipment

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements over a defined time period of the existing plug load and post BERT device. A population will be measured before the switch to the BERT devices to determine a baseline usage during a defined time period.

COMMISSIONING

Review installation and network integration with the IT department

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%

The safety factor for this ECM is taken at 0 due to conserative run hours based on data logging results.

Montclair Board of Education
Exhibit D
ECM 1E Plug Load Management via WiFi
Smart Strips and Smart Board Projectors

FORMULAE

$W_{TOTAL} = (W_{STRIPS} \cdot Strips_{\#}) + (W_{PROJECTORS} \cdot Projectors_{\#})$

Variable	Units	Description
W_{TOTAL}	kWh	Total Electrical Savings associated with this measure
W_{STRIPS}	kWh	Electrical Savings associated with smart strips
$W_{PROJECTORS}$	kWh	Electrical Savings associated with smart boards projectors
$Strips_{\#}$	-	Numbers of Electrical Strips
$Projectors_{\#}$	-	Numbers of Projectors

* Inputs are in blue

Building	Cold Beverage Machines	Snack Machines	Large Copiers	Small Printers / Copiers	Coffee Machines	Hot / Cold Water Machines	Smart Boards	Window A/C Units	TVs	XXXs	XXXs
Bradford Elementary School			3				30	23			
Bullock Elementary School			2				33	-			
Buzz Aldrin Middle School			4				30	54			
Edgemont Elementary School			3				15	21			
Glenfield Middle School			4				40	5			
Valley Road Complex			7				31	91			
Montclair High School			8				73	40			
George Inness Annex (HS-9th), Athletics			3				30	19			
Nishuane K-2			4				39	31			
Northeast Elementary School			4				22	15			
Renaissance Middle School			2				-	24			
Watchung Elementary School			3				-	28			
Woodman Field			1				-	-			
Totals	-	-	48	-	-	-	343	351	-	-	-

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Cold Beverage Machines	-	-	-	-	-	-	-	-	-
Snack Machines	-	-	-	-	-	-	-	-	-
Large Copiers	3	2	4	3	4	4	2	3	1
Small Printers / Copiers	-	-	-	-	-	-	-	-	-
Monitor Combos (Printer)	-	-	-	-	-	-	-	-	-
Laptop Charging Carts	-	-	-	-	-	-	-	-	-
Projectors	-	-	-	-	-	-	-	-	-
Water Fountains	-	-	-	-	-	-	-	-	-
Coffee Machines	-	-	-	-	-	-	-	-	-
Hot / Cold Water Machines	-	-	-	-	-	-	-	-	-
Smart Boards	30	33	30	30	39	22	-	-	-
Window A/C Units	23	-	54	19	31	15	24	28	-
TVs	-	-	-	-	-	-	-	-	-
XXXs	-	-	-	-	-	-	-	-	-
XXXs	-	-	-	-	-	-	-	-	-
Total Devices	56	35	88	52	74	41	26	31	1
Total BERTs	56	35	88	52	74	41	26	31	1
kW Electrical Draw	2.990	0.720	6.120	2.590	4.000	2.060	2.460	2.890	0.030
Unoccupied Hours / Day	18.3	16.9	18.3	17.6	17.6	18.3	18.3	18.3	10.0
Unoccupied Hours / Yr	6,674	6,153	6,674	6,414	6,414	6,674	6,674	6,674	3,650
kWh Savings	19,956	4,430	40,847	16,611	25,654	13,749	16,419	19,289	110
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%
kWh Savings	19,956	4,430	40,847	16,611	25,654	13,749	16,419	19,289	110

Montclair Board of Education
Exhibit D
Boiler Efficiency Spreadsheet

*Inputs are blue
*Automatic Mechanical List pull-in colored purple

Add Controlink ECM savings to Boiler Upgrades: **N**

EXISTING													PROPOSED								BTU/SF
Building	Equipment Label	Qty	Location	Replace Boiler (Y/N)	Add Burner Controls (Y/N)	Existing Fuel	Manufacturer	Model No.	Capacity (MBH)	Heating Medium	Boiler Efficiency	Percentage of Building Served	Qty	Proposed Fuel	Manufacturer	Model No.	Capacity (MBH)	Heating Medium	Boiler Efficiency	Percentage of Building Served	
Bradford Elementary School	BRAD-B-1,2	2	Boiler Room	N	Y	Natural Gas	Weil McLain	988	2,274	Steam	83%	100%									
Bullock Elementary School	BUL-B-1,2	2	Boiler Room	N	N	Natural Gas	Lochinvar	CHN2071	1,739	Hot Water	84%	100%									
Buzz Aldrin Middle School	BUZ-B-1,2	2	Boiler Room	Y	N	Natural Gas	Weil McLain	2294	6,100	Steam	80%	100%	2	Natural Gas	Weil McLain	2094	5,520	Steam	80.5%	100.0%	
Edgemont Elementary School	EE-B-1,2	2	Boiler Room	N	Y	Natural Gas	Smith	28HE-S/W-14	3,567	Steam	83%	100%									
George Inness Annex (HS-9th), Athletics	GIA-B-1,2	2	Boiler Room	Y	N	Natural Gas	Weil McLain	H1994-WS	5,230	Steam	75%	100%	2	Natural Gas	Weil McLain	1894	4,940	Steam	80.5%	100.0%	
Glenfield Middle School	GMS-B-1-3	3	Boiler Room	N	N	Natural Gas	AERCO	BMK 3000	2,790	Hot Water	93%	100%									
Montclair High School	MHS-B-1	1	Boiler Room	N	N	Natural Gas	Cleaver-Brooks	CB800-100	3,347	Steam	80%	27%									
Montclair High School	MHS-B-2	1	Boiler Room	N	N	Natural Gas	Cleaver-Brooks	CB800-200	6,695	Steam	80%	55%									
Montclair High School	MHS-B-3	1	Boiler Room	N	N	Natural Gas	Weil McLain	H-988-WS	2,176	Steam	80%	18%									
Nishuane K-2	NK-B-1,2	2	Boiler Room	N	Y	Natural Gas	Smith	M450L-20	3,959	Steam	75%	100%									
Northeast Elementary School	NE-B-1,2	2	Boiler Room	N	Y	Natural Gas	HB Smith	28-14	3,370	Steam	75%	100%									
Renaissance Middle School	REM-B-1	1	Boiler Room	N	Y	Natural Gas	Smith	28HE-S/W-14	3,567	Steam	83%	50%									
Renaissance Middle School	REM-B-2	1	Boiler Room	N	N	Natural Gas	HB Smith	28-14	3,370	Steam	79%	50%									
Valley Road Complex	CP-B-1,2	2	Central Plant	N	Y	Natural Gas	Weil McLain	2394	6,390	Steam	80%	100%									
Watchung Elementary School	WES-B-1	1	Boiler Room	N	Y	Natural Gas	Weil McLain	1188	2,848	Steam	84%	50%									
Watchung Elementary School	WES-B-2	1	Boiler Room	N	N	Natural Gas	Weil McLain	H-1188-WS	2,724	Steam	75%	50%									
Woodman Field	FH-B-1	1	Boiler Room	N	N	Natural Gas	Weil McLain	678.00	643.0	Steam	81%	38%									
Totals		27							60,789												

	Building Load (MBH)
Natural Gas	0
Fuel Oil #2	2,941
Fuel Oil #4	2,034
Fuel Oil #6	0
Propane	3,124
	0
	2,484
	5,060
	1,656
	0
	0
	0
	659
	0
	0
	912
	0
	#N/A

EXISTING OVERALL BOILER EFFICIENCY

Building	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Montclair High School	Montclair High School	Montclair High School	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Renaissance Middle School	Valley Road Complex	Watchung Elementary School	Watchung Elementary School	Woodman Field
Location	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Boiler Room	Central Plant	Boiler Room	Boiler Room	Boiler Room
Label	BRAD-B-1,2	BUL-B-1,2	BUZ-B-1,2	EE-B-1,2	GIA-B-1,2	GMS-B-1-3	MHS-B-1	MHS-B-2	MHS-B-3	NK-B-1,2	NE-B-1,2	REM-B-1	REM-B-2	CP-B-1,2	WES-B-1	WES-B-2	FH-B-1
Capacity (MBTU)	2,274	1,739	6,100	3,567	5,230	2,790	3,347	6,695	2,176	3,959	3,370	3,567	3,370	6,390	2,848	2,724	643
Quantity	2	2	2	2	2	3	1	1	1	2	2	1	1	2	1	1	1
Existing Fuel	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Percentage of Building Load	100%	100%	100%	100%	100%	100%	27%	55%	18%	100%	100%	50%	50%	100%	50%	50%	38%
Medium	Steam	Hot Water	Steam	Steam	Steam	Hot Water	Steam	Steam	Steam	Steam	Steam	Steam	Steam	Steam	Steam	Steam	Steam
Combustion Efficiency	83.0%	84.0%	79.7%	83.0%	75.0%	93.0%	80.0%	80.0%	80.2%	75.0%	75.0%	83.0%	79.0%	80.0%	84.0%	75.0%	81.0%
Losses due to radiation	4.0%	2.0%	4.0%	4.0%	4.0%	2.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
MCR of boilers	2.3	1.7	6.1	3.6	5.2	2.8	3.3	6.7	2.2	4.0	3.4	3.6	3.4	6.4	2.8	2.7	0.6
% Makeup water	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Makeup T.D.S.	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Blowdown T.D.S.	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Energy Input into Boiler(s)	129	0	298	127	222	209	102	207	68	196	111	48	48	368	72	72	41
Feedwater temperature	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
Condensate Return Temperature	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Makeup water temperature	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Hrs/Yr of Operation	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948
Blowdown Temperature	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
Heat required to raise a lb of steam	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980
Boiler Load Rate	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Present Blowdown Rate	0.18	0.00	0.18	0.18	0.18	0.00	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Heat Content of Blowdown	160.00	0.00	160.00	160.00	160.00	0.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00
Blowdown Loss	2.5%	0.0%	2.4%	2.5%	2.2%	0.0%	2.4%	2.4%	2.4%	2.2%	2.2%	2.5%	2.4%	2.4%	2.5%	2.2%	2.4%
Radiation Losses	8.0%	2.0%	8.0%	8.0%	8.0%	2.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Overall Boiler Efficiency	**72.5%**	**82.0%**	**69.4%**	**72.5%**	**64.8%**	**91.0%**	**69.6%**	**69.6%**	**69.8%**	**64.8%**	**64.8%**	**72.5%**	**68.6%**	**69.6%**	**73.5%**	**64.8%**	**70.6%**

Montclair Board of Education
Exhibit D
Boiler Efficiency Spreadsheet

PROPOSED OVERALL BOILER EFFICIENCY

	Buzz Aldrin Middle School	George Inness Annex (HS-9th), Athletics
Boiler Replacement	Y	Y
Burner Control Links	N	N
Location	Boiler Room	Boiler Room
Label	BUZ-B-1,2	GIA-B-1,2
Quantity to be Replaced	2	2
Proposed Fuel	Natural Gas	Natural Gas
Combustion Efficiency	100.0%	100.0%
Capacity (MBTU)	5,520	4,940
Medium	Steam	Steam
Combustion Efficiency	80.5%	80.5%
Losses due to radiation	1.0%	1.0%
Losses due to blowdown	2.0	2.0
% Makeup water	8	8
Makeup T.D.S.	80	80
Blowdown T.D.S.	3,500	3,500
Energy Input into Boiler(s)	298	222
Feedwater temperature	182	184
MCR of boilers	5.5	4.9
Condensate Return Temperature	200	200
Makeup water temperature	60	60
Hrs/Yr of Operation	3,948	3,948
Blowdown Temperature	230	230
Heat required to raise a lb of steam	980	980
CALCULATIONS		
Boiler Load Rate	50.0%	50.0%
Present Blowdown Rate	0.18	0.18
Heat Content of Blowdown	170.00	170.00
Blowdown Loss	2.6%	2.6%
Radiation Losses	2.0%	2.0%
Overall Boiler Efficiency	**75.9%**	**75.9%**

Montclair Board of Education
Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

ECM DESCRIPTION

Replace boilers in respective buildings with new high efficiency condensing boilers

DATA / ASSUMPTIONS

Typical Condensing Boiler Seasonal Efficiency =	91.5%	
Heating Hours	3,948	Hours

* Utility baseline reduced by 10.5% to account for domestic hot water, science labs, and kitchen usage
* An adjusted baseline is used for the boiler baseline usage as to not double-dip on savings

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) = 0%

A safety factor of 0 is used due to minimal variables and the proven results of this measure

FORMULAE

$Q_{savings} = ((\eta_{NEW} - \eta_{OLD}) / \eta OLD) \cdot Fuel_{ADJ}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
η_{NEW}	%	Efficiency of New Boiler
η_{OLD}	%	Efficiency of Old Boiler
$Fuel_{ADJ}$	Therms	Adjusted Boiler Fuel Usage

Montclair Board of Education
Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

*Inputs are blue

Building	Label	Boilers to be Replaced
Buzz Aldrin Middle School	BUZ-B-1,2	2
George Inness Annex (HS-9th), Athletics	GIA-B-1,2	2
Totals		**4**

CALCULATIONS

	Buzz Aldrin Middle School	George Inness Annex (HS-9th), Athletics
Label	BUZ-B-1,2	GIA-B-1,2
No. of Units to be Replaced	2	2
Fuel Switch	N	N
Existing Fuel	Natural Gas	Natural Gas
Proposed Fuel	Natural Gas	Natural Gas
Current Boiler Efficiency	69.4%	64.8%
Proposed Boiler Efficiency	75.9%	75.9%
Improvement in Boiler Efficiency	6.6%	11.2%
Annual Boiler Fuel Use	56,597	42,171
Adjusted Boiler Usage	14,932	3,339
Percentage of Building Load	100%	100%
Safety Factor	**0%**	**0%**
Thermal Savings	1,889	2,234
Proposed Boiler Usage	13,044	1,105
Natural Gas Savings	1,889	2,234
Fuel Oil #2 Savings	-	-
Fuel Oil #4 Savings	-	-
Fuel Oil #6 Savings	-	-
Propane Savings	-	-
NJ BPU Ptorocol Calculations		
Fuel Savings (Therms/yr)	1,888.68	2,234.26
Capin	**11,040**	**9,880**
EFLH	**901**	**1,191**
Effb	**79.0%**	**79.0%**
Effq	**80.5%**	**80.5%**
Kbtu to Therm Conversion	100	100

Montclair Board of Education
Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

Notes:
Replacing the existing boiler with a new, high efficiency unit will reduce operating costs at this location.
Improving the air/fuel ratio will increase overall boiler combustion efficiency.
Note that the boiler efficiency discussed here is the overall boiler thermal efficiency, not just its combustion efficiency. The value of this number will be much lower than for combustion efficiency alone as it includes losses from radiation, blowdown, and other related losses. The value for annual boiler fuel has been adjusted for the effect of other ECMs.
New Non -Condensing Boilers will be Equiped with Control Links

Montclair Board of Education
Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

Prescriptive Boilers

This prescriptive measure targets the use of smaller-scale boilers (less than or equal to 4000 MBH) and furnaces (no size limitation) in all commercial facilities. Larger sized boilers are treated under the custom measure path.

This measure applies to new construction, replacement of failed equipment, or end of useful life. The baseline unit is a code compliant unit with an efficiency as required by ASHRAE Std. 90.1 – 2013, which is the current code adopted by the State of New Jersey.

Algorithms

Fuel Savings (MMBtu/yr) = Cap_{in} * $EFLH_h$ * ((Eff_q/Eff_b)-1) / 1000 kBtu/MMBtu

Definition of Variables

Cap_{in} = Input capacity of qualifying unit in kBtu/hr
$EFLH_h$ = The Equivalent Full Load Hours of operation for the average unit during the heating season in hours
Eff_b = Boiler Baseline Efficiency
Eff_q = Boiler Proposed Efficiency
1000 = Conversion from kBtu to MMBtu

Summary of Inputs

Prescriptive Boilers

Component	Type	Value	Source
Cap_{in}	Variable		Application
$EFLH_h$	Fixed	See Table Below	1
Eff_b	Variable	See Table Below	2
Eff_q	Variable		Application

$EFLH_h$ Table

Facility Type	Heating EFLH
Assembly	603
Auto repair	1910
Dormitory	465
Hospital	3366
Light industrial	714
Lodging – Hotel	1077
Lodging – Motel	619
Office – large	2034
Office – small	431
Other	681
Religious worship	722

Facility Type	Heating EFLH
Restaurant – fast food	813
Restaurant – full service	821
Retail – big box	191

Montclair Board of Education
Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

Retail – big box	191
Retail – Grocery	191
Retail – small	545
Retail – large	2101
School – Community college	1431
School – postsecondary	1191
School – primary	840
School – secondary	901
Warehouse	452

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Heating	757	723	503
High-rise, Heating	526	395	219

Baseline Boiler Efficiencies (Eff_b)

Boiler Type	Size Category (kBtu input)		Standard 90.1-2013
Hot Water – Gas fired	< 300 ≥ 300 and ≤ 2,500		82% AFUE 80% Et 82% Ec
Hot Water – Oil fired	< 300 ≥ 300 and ≤ 2,500	84% AFUE 82% Et 84% Ec	
Steam – Gas fired	< 300	80% AFUE	
Steam – Gas fired, all except natural draft	≥ 300 and ≤ 2,500	79% Et	
Steam – Gas fired, all except	> 2,500		79% Ec
Steam – Gas fired, natural draft	≥ 300 and ≤		77% Et

Boiler Type	Size Category (kBtu input)		Standard 90.1-2013
Steam – Gas fired, natural draft	> 2,500		77% Ec
Steam – Oil fired	< 300 ≥ 300 and ≤ 2,500	82% AFUE 81% Et 81% Ec	

Sources

1. New York State Joint Utilities, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs*, V6, April 2018. Appendix G – Equivalent Full-Load Hours (EFLH), For Heating and Cooling. P. 535-540. EFLH values for NYC due to proximity to NJ.
2. ASHRAE Standards 90.1-2013, *Energy Standard for Buildings Except Low-Rise*

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Exhibit D
ECM 2A Boiler Upgrade
Boiler Replacement Calculation

2. ASHRAE Standards 90.1-2013: *Energy Standard for Buildings Except Low Rise Residential Buildings*; available at: https://www.ashrae.org/standards-research--technology/standards--guidelines.

Montclair Board of Education
Exhibit D
ECM 2A.1 Vacuum Tank Replacements
Vacuum Tank Replacements

ECM DESCRIPTION

Replace existing steam condensate vacuum tanks with new units.

DATA / ASSUMPTIONS

Steam Operating Pressure (PSIG)	6
Steam Reset Pressure (PSIG)	5
Condensate Return Temperature (*F)	185
Thermal Safety Factor [%] =	0%
Heating Season Hours	3,948
Heating Season Operating Percentage	100%

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify quantities installed and proper equipment operation.

RECOVERY/SAFETY FACTOR

FORMULAE

$Q_{savings} = (1 - SF) * (Q_{em} + Q_{epr}) / n_{boiler}$

$Q_{em} = (A * W_L * (T_{CR} - T_{MW}))/100000$

$Q_{epr} = (A * (h_C - h_P)) / 100000$

Variable	Units	Description
$Q_{savings}$	Therms	Total Thermal Savings
Q_{em}	Therms	Thermal Savings from Make-up Water Loss Redution
Q_{epr}	Therms	Thermal Savings from Pressure Reset
SF	%	Safety Factor
W_L	%	Water Loss rate
n_{boiler}	%	Boiler efficiency
h_C	Btu/lbm.	Steam enthalpy at current pressure
h_P	Btu/lbm.	Steam enthalpy at proposed pressure
H	hrs.	Annual hours of operation
A	lbm.	Total annual steam output
T_{CR}	*F	Condensate return temperature
T_{MW}	*F	Makeup water temperature

Montclair Board of Education
Exhibit D
ECM 2A.1 Vacuum Tank Replacements
Vacuum Tank Replacements

* Inputs are in blue

Building	Operating Hours	Existing Boiler Efficiency (%)	Existing Steam Pressure (psig)	6 psi Steam Enthalpy (Btu/lbm)	5 psi Steam Enthalpy (Btu/lbm)	Water Loss (%)		Proposed Boiler Efficiency (%)
Bradford Elementary School	3,948.0	83.0%	6.00	1,156.90	1,155.90	10%	-	83.0%
Buzz Aldrin Middle School	3,948.0	79.7%	6.00	1,156.90	1,155.90	10%	-	80.5%
Edgemont Elementary School	3,948.0	83.0%	6.00	1,156.90	1,155.90	10%	-	83.0%
Valley Road Complex	3,948.0	80.0%	6.00	1,156.90	1,155.90	10%	-	80.0%
George Inness Annex (HS-9th), Athletics	3,948.0	75.0%	6.00	1,156.90	1,155.90	10%	-	80.5%
Nishuane K-2	3,948.0	75.0%	6.00	1,156.90	1,155.90	10%	-	75.0%
Renaissance Middle School	3,948.0	83.0%	6.00	1,156.90	1,155.90	10%	-	83.0%
Watchung Elementary School	3,948.0	84.0%	6.00	1,156.90	1,155.90	10%	-	84.0%
Totals								

CALCULATIONS

	Pressure Reset	Bradford Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Valley Road Complex	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Renaissance Middle School	Watchung Elementary School
A	Operating Hours (h)	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948
B	Total Annual Steam Output (lbm)	198,914	1,029,327	213,120	191,575	216,468	412,210	(29,277)	377,885
C	6 psi steam (Btu/lbm)	1,156.90	1,156.90	1,156.90	1,156.90	1,156.90	1,156.90	1,156.90	1,156.90
D	5 psi Steam (Btu/lbm)	1,155.90	1,155.90	1,155.90	1,155.90	1,155.90	1,155.90	1,155.90	1,155.90
E	Incremental heat (Btu/lbm)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F	Total Heat Loss (Therm)	1.99	10.29	2.13	1.92	2.16	4.12	(0.29)	3.78
G	Input heat equivalent (Therm)	2.40	12.91	2.57	2.39	2.89	5.50	(0.35)	4.50
	Make-Up								
A	Op Hrs	3,948.0	3,948.0	3,948.0	3,948.0	3,948.0	3,948.0	3,948.0	3,948.0
B	Total Annual Steam Output (lbm)	198,914	1,029,327	213,120	191,575	216,468	412,210	(29,277)	377,885
H	Water Loss (%)	10%	10%	10%	10%	10%	10%	10%	10%
I	Make-Up Rate (lbm)	19,891	102,933	21,312	19,158	21,647	41,221	(2,928)	37,788
J	Make-Up Temp (*F)	60	60	60	60	60	60	60	60
K	Total Heat Loss (Therm)	24.86	128.67	26.64	23.95	27.06	51.53	(3.66)	47.24
L	Input heat equivalent (Therm)	29.96	159.83	32.10	29.93	33.61	68.70	(4.41)	56.23
M	Safety Factor [%]	0%	0%	0%	0%	0%	0%	0%	0%
N	Thermal Savings [Therms]	32	173	35	32	36	74	(5)	61
O		nboiler							

Montclair Board of Education
Exhibit D5
ECM 2B Boiler Burner Replacement & Controls
Boiler Controlinks

ECM DESCRIPTION

Install burner controls on existing burners which optimize fuel to air ratio instantaneously

DATA / ASSUMPTIONS

Heating Hours	3,948	Hours
Controlinks improvement in boiler efficiency:	6.5%	
Delphi Combustion Controls	8.0%	
Intellidyne improvement in boiler efficiency:	4.0%	

* Utility baseline reduced by 10.5% to account for domestic hot water, science labs, and kitchen usage
* An adjusted baseline is used for the boiler baseline usage as to not double-dip on savings

Controlinks

# Projected Burner/Boiler Efficiency Savings	
Removal of Linkage Wear* (0 to 2.0)	2.0%
Improved Combustion** (.5 to 3.0)	3.0%
Increased Turndown*** (.5 to 1.5)	1.5%
Total Efficiency Savings	6.5%

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) =	0%

There is no safety factor as improvement in efficiency is conservative

Montclair Board of Education
Exhibit D5
ECM 2B Boiler Burner Replacement & Controls
Boiler Controlinks
FORMULAE

$Q_{savings} = (\eta_{BOILER} / (\eta_{BOILER} + \eta_{IMP})) \cdot Fuel_{ADJ}$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
η_{BOILER}	%	Efficiency of Existing Boiler
η_{IMP}	%	Improvement in Efficiency
$Fuel_{ADJ}$	Therms	Adjusted Boiler Fuel Usage

*Inputs are blue

Building	Label	Units to be Installed	Burner Upgrade Type	Fuel Type
Bradford Elementary School	BRAD-B-1,2	2	Control Links	Natural Gas
Edgemont Elementary School	EE-B-1,2	2	Control Links	Natural Gas
Nishuane K-2	NK-B-1,2	2	Control Links	Natural Gas
Northeast Elementary School	NE-B-1,2	2	Control Links	Natural Gas
Renaissance Middle School	REM-B-1	1	Control Links	Natural Gas
Valley Road Complex	CP-B-1,2	2	Control Links	Natural Gas
Watchung Elementary School	WES-B-1	1	Control Links	Natural Gas
-	-	-		Natural Gas
-	-	-		Natural Gas
-	-	-		Natural Gas
-	-	-		Natural Gas
Totals		**12**		

Need Burner Replacement

Bradford
Buzz
Edgemont
Northeast
Renaissance
Watchung
Field House

Bradford Elementary School	dgemont Elementary Schoc	Nishuane K-2	Northeast Elementary Schoo	enaissance Middle Schoc	Valley Road Complex	Vatchung Elementary Schoc
BRAD-B-1,2	EE-B-1,2	NK-B-1,2	NE-B-1,2	REM-B-1	CP-B-1,2	WES-B-1
2	2	2	2	1	2	1

Montclair Board of Education
Exhibit D5
ECM 2B Boiler Burner Replacement & Controls
Boiler Controlinks
CALCULATIONS

	Bradford Elementary School	Edgemont Elementary School	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Valley Road Complex	Watchung Elementary School
Label	BRAD-B-1,2	EE-B-1,2	NK-B-1,2	NE-B-1,2	REM-B-1	CP-B-1,2	WES-B-1
No. of Units to be Installed	2	2	2	2	1	2	1
Burner Upgrade	Control Links	Control Links	Control Links	Control Links	Control Links	Control Links	Control Links
Fuel Type	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Current Boiler Efficiency	72.5%	72.5%	64.8%	64.8%	72.5%	69.6%	73.5%
Improvement in Boiler Efficiency	7%	7%	7%	7%	7%	7%	7%
Percentage of Load	100.0%	100.0%	100.0%	100.0%	50.0%	100.0%	50.0%
Annual Boiler Fuel Use	24,536	24,189	37,325	21,146	9,200	69,998	13,672
Adjusted Boiler Usage	2,773	2,971	6,358	(52)	(204)	2,770	2,602
Safety Factor	0%	0%	0%	0%	0%	0%	0%
Annual Energy Savings	228	244	580	(5)	(8)	237	106

Notes:
Replacing the existing boiler with a new, high efficiency unit will reduce operating costs at this location.
Improving the air/fuel ratio will increase overall boiler combustion efficiency.
New Boiler will be Natural Gas
Note that the boiler efficiency discussed here is the overall boiler thermal efficiency, not just its combustion efficiency. The value of this number will be much lower than for combustion efficiency alone as it includes losses from radiation, blowdown, and other related losses. The value for annual boiler fuel has been adjusted for the effect of other ECMs.
New Non -Condensing Boilers will be Equiped with Control Links

Montclair Board of Education
Exhibit D
Domestic Hot Water Spreadsheet

*Inputs are blue
*Automatic Mechanical List pull-in colored purple
**If Domestic Hot Water is fed off boiler put "Y" in Column F and put the respective boiler equipment label in Column C

EXISTING												
Building	Equipment Label	Qty	Location	Fed off Boiler (Y/N)	Replace DHW (Y/N)	Fuel	Manufacturer	Model No.	Capacity (MBH)	Capacity (Gal)	Combustion Efficiency	Percentage of Building DHW Load
Bradford Elementary School	BES-DHW-1	1	Boiler Room	N	N	Natural Gas	Rheem	G75-75N-3	75	73	80%	50%
Bradford Elementary School	BES-DHW-2	1	2nd Floor	N	N	Natural Gas	AO Smith	BTH 150A 970	150	100	88%	50%
Bullock Elementary School	BUL-DHW-1	1	Storage Room	N	N	Natural Gas	AO Smith	HW399-200	399	200	84%	100%
Buzz Aldrin Middle School	BUZ-DHW-1	1	Boiler Room	N	N	Natural Gas	Bradford White	LG275H763N	76	75	80%	100%
Edgemont Elementary School	EE-DHW-1	1	Boiler Room	N	N	Natural Gas	Bradford White	LG2PV75H763N	76	75	82%	100%
George Inness Annex (HS-9th), Athletics	GIA-DHW-1	1	Boiler Room	N	N	Natural Gas	Bradford White	LG275H763N	76	75	80%	25%
George Inness Annex (HS-9th), Athletics	GIA-DHW-2	1	Custodial Closet	N	N	Natural Gas	AO Smith	-	150	100	85%	75%
Glenfield Middle School	GMS-DHW-1	1	Boiler Room	N	N	Natural Gas	Rheem	G100-200A	200	100	80%	100%
Nishuane K-2	NK-DHW-1	1	Boiler Room	N	Y	Natural Gas	Rheem	G82-156	156	82	80%	100%
Northeast Elementary School	NE-DHW-1	1	Boiler Room	N	N	Natural Gas	erican Water Heater	G62-75T75-4NOV 400	75	73	80%	50%
Northeast Elementary School	NE-DHW-2	1	Storage Room	N	Y	Natural Gas	AO Smith	BT 80 230	75	75	80%	50%
Renaissance Middle School	RMS-DHW-1	1	Boiler Room	N	N	Natural Gas	AO Smith	BT 80 300	75	74	80%	100%
Valley Road Complex	PREK-DHW-1	1	re-K Mechanical Roor	N	N	Natural Gas	AO Smith	BTH 199 100	199	100	98%	40%
Valley Road Complex	HES-DHW-1	1	llside Mechanical Roo	N	Y	Natural Gas	AO Smith	BTR 199 118	199	81	80%	40%
Valley Road Complex	HES-DHW-2	1	Kitchen Closet	N	N	Natural Gas	AO Smith	BT 80 400	80	74	80%	15%
Valley Road Complex	BOE-DHW-1	1	Admin Basement	N	N	Electricity	AO Smith	ECT 40 200	15	40	100%	5%
Woodman Field	FH-DHW-1	1	Boiler Room	N	N	Natural Gas	AO Smith	BTH-500A 300	500	119	95%	97%
Woodman Field	FH-DHW-2	1	Snack Stand	N	N	Natural Gas	AO Smith	ENS 30 100	15	30	100%	3%
Watchung Elementary School	WES-DHW-1	1	Boiler Room	N	N	Natural Gas	AO Smith	BT 80 300	75	74	80%	100%
Totals		19							2,667			

PROPOSED						
Qty	Fuel	Manufacturer	Model No.	Capacity (MBH)	Capacity (Gal)	Combustion Efficiency
2	Natural Gas	AO Smith	BTH-199(A)	199	100	97.0%
1	Natural Gas	AO Smith	BTH-120(A)	120	60	95.0%
1	Natural Gas	AO Smith	BTH-120(A)	120	60	95.0%
1	Natural Gas	AO Smith	BTH-150(A)	150	100	98.0%
1	Natural Gas	AO Smith	BTH-150(A)	150	100	98.0%
1	Natural Gas	AO Smith	BTH-120(A)	120	60	95.0%
1	Natural Gas	AO Smith	BTH-120(A)	120	60	95.0%
1	Natural Gas	AO Smith	BTH-199(A)	199	100	97.0%
9				1,178		

EXISTING DHW EFFICIENCY

Building	Bradford Elementary School	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Nishuane K-2	Northeast Elementary School	Northeast Elementary School	Renaissance Middle School	Valley Road Complex	Valley Road Complex	Valley Road Complex	Valley Road Complex	Woodman Field	Woodman Field	Watchung Elementary School
Label	BES-DHW-1	BES-DHW-2	BUL-DHW-1	BUZ-DHW-1	EE-DHW-1	GIA-DHW-1	GIA-DHW-2	GMS-DHW-1	NK-DHW-1	NE-DHW-1	NE-DHW-2	RMS-DHW-1	PREK-DHW-1	HES-DHW-1	HES-DHW-2	BOE-DHW-1	FH-DHW-1	FH-DHW-2	WES-DHW-1
Quantity	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Location	Boiler Room	2nd Floor	Storage Room	Boiler Room	Boiler Room	Boiler Room	Custodial Closet	Boiler Room	Boiler Room	Boiler Room	Storage Room	Boiler Room	Pre-K Mechanical Room	Hillside Mechanical Room	Kitchen Closet	Admin Basement	Boiler Room	Snack Stand	Boiler Room
Fuel Type	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Electricity	Natural Gas	Natural Gas	Natural Gas
Capacity (MBTU)	75	150	399	76	76	76	150	200	156	75	75	75	199	199	80	15	500	15	75
Percentage of Building Load	50%	50%	100%	100%	100%	25%	75%	100%	100%	50%	50%	100%	40%	40%	15%	5%	97%	3%	100%
Current Efficiency	80.0%	88.0%	84.0%	80.0%	82.0%	80.0%	85.0%	80.0%	80.0%	80.0%	80.0%	80.0%	98.0%	80.0%	80.0%	100.0%	95.0%	100.0%	80.0%

PROPOSED DHW EFFICIENCY

	Nishuane K-2	Northeast Elementary School	Valley Road Complex
Isolate Storage Tank	N	N	N
Label	NK-DHW-1	NE-DHW-2	HES-DHW-1
Fuel Type	Natural Gas	Natural Gas	Natural Gas
Quantity	1	1	1
Location	Boiler Room	Storage Room	Hillside Mechanical Room
Capacity (MBTU)	150.0	120.0	199.0
Proposed Efficiency	98.0%	95.0%	97.0%

Montclair Board of Education
Exhibit D
ECM 2C Domestic Hot Water Replacement
Domestic Hot Water Upgrades

ECM DESCRIPTION

Replacement of Domestic Hot Water Heaters with high efficiency condensing Domestic Hot Water Heaters

DATA / ASSUMPTIONS

*Isolating a storage tank improves the DHW system efficiency by:	**3.0%**
Current DHW Heater Efficiency	**Varies**

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify all functions of the boiler control system, safety and operation. Verify air/fuel ratio is consistent through firing range. Provide training of the boiler operators

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	**0.0%**
Safety Factor (Thermal) =	**0.0%**

No Safety Factor is used because of a minimal of variables

DHW REPLACEMENT CALCULATION

$Q_{savings} = ((\eta_{NEW} - \eta_{OLD}) / \eta OLD) \cdot Fuel_{DHW}$

Variable	Units	Description
$Q_{Savings}$	Therms	Thermal Savings
η_{NEW}	**%**	Efficiency of Existing DHW Heater
η_{OLD}	**%**	Efficiency of Proposed DHW Heater
$Fuel_{DHW}$	Therms	Annual DHW Fuel Consumption

Montclair Board of Education
Exhibit D
ECM 2C Domestic Hot Water Replacement
Domestic Hot Water Upgrades

*Inputs are blue

Building	Label	DHW Quantity
Nishuane K-2	NK-DHW-1	1
Northeast Elementary School	NE-DHW-2	1
Valley Road Complex	HES-DHW-1	1
Totals		**3**

A. DOMESTIC HOT WATER HEATER REPLACEMENT

	Nishuane K-2	Northeast Elementary School	Valley Road Complex
Label	NK-DHW-1	NE-DHW-2	HES-DHW-1
Quantity	1	1	1
Fuel Switch	N	N	N
Existing Fuel	Natural Gas	Natural Gas	Natural Gas
Proposed Fuel	Natural Gas	Natural Gas	Natural Gas
Current DHW System Efficiency	80.0%	80.0%	80.0%
Proposed DHW System Efficiency	98.0%	95.0%	97.0%
Improvement DHW System Efficiency	18%	15%	17%
Annual DHW Heater Baseline	1,964	1,113	3,684
Percentage of DHW Building Load	100%	50%	40%
Safety Factor	**0%**	**0%**	**0%**
Electric Savings	-	-	-
Natural Gas Savings	442	104	313
Fuel Oil #2 Savings	-	-	-
Fuel Oil #4 Savings	-	-	-
Fuel Oil #6 Savings	-	-	-
Propane Savings	-	-	-

B. STORAGE TANK ISOLATION

Storage Tank Isolation
Current DHW System Efficiency
Improvement in System Efficiency
New System Efficiency
Safety Factor
Electric Savings
Natural Gas Savings
Fuel Oil #2 Savings
Fuel Oil #4 Savings
Fuel Oil #6 Savings
Propane Savings

Montclair Board of Education
Exhibit D
ECM 2C Domestic Hot Water Replacement
Domestic Hot Water Upgrades

C. OIL PUMP CALCULATION

Oil Pump Savings
Oil Pump HP
Efficiency
Load Factor
Annual Run Hours
Safety Factor (Run Hours)
Adjusted Run Hours
Electric Savings

Montclair Board of Education
Exhibit D
RTU Replacement Spreadsheet

*Inputs are blue
*Automatic Mechanical List pull-in colored purple

EXISTING															
Building	Equipment Label	Qty	Location	Replace (Y/N)	DCV (Y/N)	Direct Fired	Thermal Fuel	Manufacturer	Model No.	Area Served	Tonnage	Supply CFM	Fresh Air CFM	Existing IPLV	Existing Thermal Efficiency
Bradford Elementary School	BES-RTU-1	1	New Wing Roof	N	N	N	None	AAON	-3-F0-000:YL0EA00D0	New Wing	40.3	14,400	2,160	10.9	0%
Bradford Elementary School	BES-RTU-2	1	New Wing Roof	Y	N	N	None	AAON	00:ECADE00BCE000F	New Wing Library	13.2	4,240	636	10.9	0%
Bullock Elementary School	BUL-RTU-1	1	Roof	N	N	N	Natural Gas	Renzor	-	-	5.0	-	-	-	80%
George Inness Annex (HS-9th), Athletics	GIA-RTU-1,2	2	Roof	Y	N	N	Natural Gas	AAON	RK-16-3	600B & 602	16.0	-	-	10.9	80%
George Inness Annex (HS-9th), Athletics	GIA-RTU-3,4	2	Roof	N	N	N	Natural Gas	McQuay	RWS800BA	Auditorium	-	6,000	900	-	80%
Montclair High School	MHS-RTU-1	1	Roof	N	N	N	Electric	TRANE	TCC018F100BF	Science Office	1.5	675	101	9.0	99%
Montclair High School	MHS-RTU-2	1	Roof	N	N	N	Natural Gas	ICP	PGS240H360AB	Library	20.0	-	-	10.9	81%
Montclair High School	MHS-RTU-3	1	Roof	N	N	N	Natural Gas	AAON	RM-015-8-0-BB0Z-36S	-	15.0	-	-	10.9	80%
Northeast Elementary School	NE-RTU-1	1	Roof	Y	N	N	Natural Gas	Carrier	48HJE014---551--	Media Center	12.5	4,300	645	10.9	80%
Northeast Elementary School	NE-RTU-2	1	Roof	Y	N	N	Natural Gas	Carrier	48GX-024040301--	Resource Room	2.0	800	120	10.9	80%
Northeast Elementary School	NE-RTU-3	1	Roof	Y	N	N	Natural Gas	Carrier	48HJF009---531--	Hallway	8.5	3,000	450	10.9	82%
Northeast Elementary School	NE-RTU-4	1	Roof	Y	N	N	Natural Gas	Carrier	48HJF008---531--	Hallway	7.5	3,000	450	10.9	82%
Valley Road Complex	PREK-RTU-1	1	Roof	N	N	N	Natural Gas	Carrier	48TCED12B2	Top Floors of addition	10.0	-	-	11.1	80%
Woodman Field	FH-RTU-1-3	3	Roof	N	N	N	Natural Gas	Renzor	-	-	-	-	-	-	80%
Woodman Field	FH-RTU-4	1	Roof	Y	N	N	Natural Gas	Carrier	48PGDC24	-	20.0	-	-	10.9	80%
Watchung Elementary School	WES-RTU-1,2	2	Grade	N	N	N	-	TRANE	YHC120F	Gym	10.0	-	-	-	0%
													-		
Totals		21									182				

PROPOSED							
Qty	Thermal Fuel	Direct Fired	Manufacturer	Model No.	Tonnage	Proposed IPLV	Proposed Thermal Efficiency
1	None	N	TRANE	GAN060A0A	40.0	13.3	0.0%
1	None	N	York	ZJ150C00B4*1EAA1A	12.5	15.0	0.0%
2	Natural Gas	N	York	ZJ180N40B4A1EAA1A	15.0	13.4	80.0%
1	Electric	N	TRANE	4YCY3024J1	2.0	15.0	99.0%
1	Natural Gas	N	Carrier	48HCED14B1AS-0*0C	12.5	13.9	80.0%
1	Natural Gas	N	Carrier	48VG-B2404030	2.0	15.0	81.0%
1	Natural Gas	N	Carrier	48HCED09B1AS-0*0C	8.5	13.8	82.0%
1	Natural Gas	N	Carrier	48HCED08B1AS-0*0C	7.5	13.8	82.0%
1	Natural Gas	N	Carrier	48HCDD24B1AS-0*0C	20.0	12.0	80.0%
10					120.0		

EXISTING RTU SPECIFICATIONS

Building	Bradford Elementary School	Bradford Elementary School	Bullock Elementary School	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Montclair High School	Montclair High School	Montclair High School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Valley Road Complex	Woodman Field	Woodman Field	Watchung Elementary School
Label	BES-RTU-1	BES-RTU-2	BUL-RTU-1	GIA-RTU-1,2	GIA-RTU-3,4	MHS-RTU-1	MHS-RTU-2	MHS-RTU-3	NE-RTU-1	NE-RTU-2	NE-RTU-3	NE-RTU-4	PREK-RTU-1	FH-RTU-1-3	FH-RTU-4	WES-RTU-1,2
Quantity	1	1	1	2	2	1	1	1	1	1	1	1	1	3	1	2
Area Serving	New Wing	New Wing Library	0	600B & 602	Auditorium	Science Office	Library	0	Media Center	Resource Room	Hallway	Hallway	Top Floors of addition	0	0	Gym
Tonnage	40.3	13.2	5.0	16.0	0.0	1.5	20.0	15.0	12.5	2.0	8.5	7.5	10.0	0.0	20.0	10.0
Supply CFM	14,400	4,240	0	0	6,000	675	0	0	4,300	800	3,000	3,000	0	0	0	0
Fresh Air CFM	2,160	636	0	0	900	101	0	0	645	120	450	450	0	0	0	0
Existing EER	10.9	10.9	-	10.9	-	9.0	10.9	10.9	10.9	10.9	10.9	10.9	11.1	-	10.9	-
Direct Fired	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Thermal Fuel	None	None	Natural Gas	Natural Gas	Natural Gas	Electric	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	0.0
Existing Thermal Efficiency	0.0%	0.0%	80.0%	80.0%	80.0%	99.0%	81.0%	80.0%	80.0%	80.1%	82.0%	82.0%	80.0%	80.0%	80.0%	0.0%

PROPOSED RTU SPECIFICATIONS

	Bradford Elementary School	George Inness Annex (HS-9th), Athletics	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Woodman Field
RTU Replacement	Y	Y	Y	Y	Y	Y	Y
Quantity	1	2	1	1	1	1	1
Area Serving	New Wing Library	600B & 602	Media Center	Resource Room	Hallway	Hallway	0
Tonnage (Replacement)	12.5	15.0	12.5	2.0	8.5	7.5	20.0
Thermal Fuel	None	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Direct Fired	N	N	N	N	N	N	N
Proposed EER	15.0	13.4	13.9	15.0	13.8	13.8	12.0
Proposed Thermal Efficiency	0.0%	80.0%	80.0%	81.0%	82.0%	82.0%	80.0%

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

ECM DESCRIPTION

Replace existing Rooftop Units with high efficiency units

DATA / ASSUMPTIONS

RTU Supply Air Temperature is assumed at, unless stated otherwise 85 °F
Full Load is estimated at 11°F for heating and 92.5°F for cooling unless stated otherwise

MEASUREMENT AND VERIFICATION

Option A (Electric) - Direct kW and savings measurements before and after installation conducted. A report is generated showing the reduction in kW

COMMISSIONING

Verify all functions of the rooftop system, safety and operation.

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) = 0%

A safety factor of 0 is used due to minimal variables and the proven results of this measure

FORMULAE

$W_{SAVINGS} = W_C - W_C$

$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$
$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

$Q_{SAVINGS} = \sum_{-5}^{60} Q_{INPUT} - Q_{INPUT}$

$Q_{INPUT} = \sum_{-5}^{60} (t_{OCC} \cdot Q_{LOAD} \cdot L_{\%}) / \eta_{RTU}$
$Q_{INPUT} = \sum_{-5}^{60} (t_{OCC} \cdot Q_{LOAD} \cdot L_{\%}) / \eta_{RTU}$

$Q_{LOAD} = \sum_{-5}^{60} 1.08 \cdot CFM_{SUPPLY} \cdot (T_{SUPPLY} - T_{MIXED})$

$T_{RISE} = \sum_{-5}^{60} T_{SUPPLY} - T_{MIXED}$

$T_{MIXED} = \sum_{-5}^{60} ((CFM_{RETURN} \cdot T_{RETURN}) + (CFM_{OA} \cdot T_{BIN})) / (CFM_{RETURN} + CFM_{OA})$

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

Variable	Units	Description
$W_{SAVINGS}$	kWh	Electrical Savings
W_C	kWh	Existing RTU Consumption
W_C	kWh	Proposed RTU Consumption
$\eta_{\%}$	%	Efficiency gain due to RTU optimization
$\sum_{60}^{105}$	-	Summation of all bins from 60°F to 105°F
C	Ton	Tonnage of RTU
η	-	Existing efficiency of RTU (EER)
η	-	Proposed efficiency of RTU (EER)
T_{DESIGN}	°F	Design Temperature of RTU (Usually 97.5°F)
T_{BIN}	°F	Bin Weather Temperature
T_{OCC}	°F	Temperature of building during occupied hours
T_{UNOCC}	°F	Temperature of building during unoccupied hours
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin
$Q_{SAVINGS}$	Therms	Thermal Savings
$\sum_{-5}^{60}$	-	Summation of all bins from -5°F to 60°F
T_{BIN}	°F	Temperature of respective bin
Q_{INPUT}	Therms	Existing Input heat provided by RTUs at respective bin temperature
Q_{INPUT}	Therms	Proposed Input heat provided by RTUs at respective bin temperature
Q_{LOAD}	Therms	Heat load on the unit vent
$L_{\%}$	%	Load % at respective bin
T_{RISE}	°F	Temperature rise across the coil (100% Design at 10°F)
T_{MIXED}	°F	Mixed air temperature
T_{SUPPLY}	Hrs	Temperature of supply air
T_{RETURN}	Hrs	Temperature of return air
CFM_{SUPPLY}	CFM	Total supply CFM of unit vent
CFM_{OA}	CFM	Total outside air CFM of unit vent
CFM_{RETURN}	CFM	Total return air CFM of unit vent
q	-	Quantity of replaced/refurbished RTUs
η_{REFURB}	%	Efficiency improvement of refurbished unit vent
$\eta_{REPLACE}$	%	Efficiency improvement of replaced unit vent
t_{OCC}	Hrs	Occupied Bin Hours in respective temperature bin

* Inputs are in blue
*Checks against baseline are in purple

Building	Label	Thermal Fuel	Area Serving
Bradford Elementary School	BES-RTU-2	None	New Wing Library
George Inness Annex (HS-9th), Athletics	GIA-RTU-1,2	Natural Gas	600B & 602
Northeast Elementary School	NE-RTU-1	Natural Gas	Media Center
Northeast Elementary School	NE-RTU-2	Natural Gas	Resource Room
Northeast Elementary School	NE-RTU-3	Natural Gas	Hallway
Northeast Elementary School	NE-RTU-4	Natural Gas	Hallway
Woodman Field	FH-RTU-4	Natural Gas	0
Totals			

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

CALCULATIONS

	Bradford Elementary School	George Inness Annex (HS-9th), Athletics	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Woodman Field
Label	BES-RTU-2	GIA-RTU-1,2	NE-RTU-1	NE-RTU-2	NE-RTU-3	NE-RTU-4	FH-RTU-4
Fuel Switch	N	N	N	N	N	N	N
Existing Thermal Fuel	None	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Proposed Thermal Fuel	None	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Area Serving	New Wing Library	600B & 602	Media Center	Resource Room	Hallway	Hallway	-
Quantity	1	2	1	1	1	1	1
RTU Tonnage	13.2	16.0	12.5	2.0	8.5	7.5	20.0
RTU Supply Air CFM	4,240	-	4,300	800	3,000	3,000	-
RTU Fresh Air CFM	636	-	645	120	450	450	-
RTU Return Air CFM	3,604	-	3,655	680	2,550	2,550	-
Current Thermal Efficiency	0%	80%	80%	80%	82%	82%	80%
Proposed Thermal Efficiency	0%	80%	80%	81%	82%	82%	80%
Current IEER	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Proposed IEER	15.0	13.4	13.9	15.0	13.8	13.8	12.0
Existing Occupied Heating Setpoint	72.0	76.0	78.0	78.0	78.0	78.0	72.0
Existing Unoccupied Heating Setpoint	65.0	64.0	72.0	72.0	72.0	72.0	72.0
Existing Occupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Existing Unoccupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Supply Air Temperature	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Current RTU kWh Consumption	8,772	16,038	12,372	1,980	8,413	7,423	19,869
Current RTU Thermal Consumption	-	-	1,032	192	703	703	-
Percent of Electric Baseline Consumption	2.8%	2.9%	4.6%	0.7%	3.1%	2.8%	9.2%
Percent of Thermal Baseline Consumption	0.0%	0.0%	4.9%	0.9%	3.3%	3.3%	0.0%
Proposed RTU kWh Consumption	6,375	13,046	9,702	1,438	6,645	5,863	18,047
Proposed RTU Thermal Consumption	-	-	1,032	190	703	703	-
Safety Factor	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	904	3,192	592	45	1,768	1,560	1,821
Natural Gas Savings	-	-	-	2	-	-	-
Fuel Oil #2 Savings	-	-	-	-	-	-	-
Fuel Oil #4 Savings	-	-	-	-	-	-	-
Fuel Oil #6 Savings	-	-	-	-	-	-	-
Propane Savings	-	-	-	-	-	-	-
	NJ BPU Protocol Calculations						
Demand Saving	**1.15**	**1.32**	**0.75**	**0.06**	**0.32**	**0.28**	**(0.16)**
Energy Savings (kWh/Yr)	**904**	**3,192**	**592**	**45**	**252**	**223**	**(219)**
N	1	2	1	1	1	1	1
Tons	12.50	15.00	12.50	2.00	8.50	7.50	20.00
kBtu/Ton	12	12	12	12	12	12	12
EERb	12.20	12.20	12.20	14.00	12.70	12.70	12.20
EERq	15.00	13.40	13.90	15.00	13.80	13.80	12.00
EFLHc	394	1,208	394	394	394	394	669

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

BRADFORD ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	13.2	13.2	8	5	15	11	4
95 to 100	97.5	-	19	2	21	12	9	13.2	13.2	157	120	305	222	83
90 to 95	92.5	-	44	13	57	28	30	13.2	13.2	363	389	828	602	226
85 to 90	87.5	1	167	60	228	104	124	9.1	6.3	955	778	1,907	1,386	521
80 to 85	82.5	31	283	162	476	180	296	7.1	4.3	1,277	1,264	2,797	2,033	765
75 to 80	77.5	191	235	280	706	164	542	5.1	2.2	832	1,211	2,249	1,635	615
70 to 75	72.5	203	177	222	602	129	473	3.0	0.2	392	96	538	391	147
65 to 70	67.5	325	165	204	694	132	562	1.0	-	134	-	148	107	40
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-
								-	-					
Total		931	1,242	1,138	3,311	859	2,452	-	-	4,110	3,858	8,772	6,375	2,402

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	98	229	63.9	21.1	96,736	73.8%	6,973,276
50 to 55	52.5	109	182	172	463	123	340	63.1	21.9	100,170	76.4%	9,452,450
45 to 50	47.5	105	119	142	366	84	282	62.4	22.6	103,604	79.0%	6,858,136
40 to 45	42.5	185	155	177	517	113	404	61.6	23.4	107,039	81.7%	9,911,356
35 to 40	37.5	236	200	241	677	146	531	60.9	24.1	110,473	84.3%	13,600,161
30 to 35	32.5	237	202	198	637	147	490	60.1	24.9	113,908	86.9%	14,591,480
25 to 30	27.5	121	115	113	349	83	266	59.4	25.6	117,342	89.5%	8,684,900
20 to 25	22.5	149	68	97	314	56	258	58.6	26.4	120,776	92.1%	6,209,992
15 to 20	17.5	95	40	46	181	33	148	57.9	27.1	124,211	94.8%	3,940,913
10 to 15	12.5	39	9	28	76	9	67	57.1	27.9	127,645	97.4%	1,132,025
5 to 10	7.5	21	5	5	31	5	26	56.4	28.6	131,080	100.0%	655,398
0 to 5	2.5	4	2	-	6	2	4	55.6	29.4	134,514	100.0%	216,183
-5 to 0	-2.5	4	-	-	4	0	4	54.9	30.1	137,948	100.0%	49,267
-10 to -5	-7.5	-	-	-	-	-	-	54.1	30.9	141,383	100.0%	-
-15 to -10	-12.5	-	-	-	-	-	-	53.4	31.6	144,817	100.0%	-
Total		1,391	1,241	1,316	3,948	802	3,048					82,275,537

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	0	16.0	16.0	10	6	18	14	3
95 to 100	97.5	-	19	2	21	12	9	16.0	16.0	190	146	370	301	69
90 to 95	92.5	-	44	13	57	28	30	16.0	13.5	440	399	924	752	172
85 to 90	87.5	1	167	60	228	105	123	11.1	11.1	1,158	1,367	2,780	2,262	519
80 to 85	82.5	31	283	162	476	182	294	8.6	8.6	1,572	2,529	4,515	3,672	842
75 to 80	77.5	191	235	280	706	181	525	6.2	6.2	1,114	3,231	4,783	3,891	892
70 to 75	72.5	203	177	222	602	147	455	3.7	3.7	542	1,680	2,447	1,991	457
65 to 70	67.5	325	165	204	694	161	533	1.2	-	198	-	218	178	41
60 to 65	62.5	180	152	195	527	127	400	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	943	2,369	62.8	59.1	5,214	9,354	16,038	13,046	2,995

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	105	222	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
50 to 55	52.5	109	182	172	463	133	330	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
45 to 50	47.5	105	119	142	366	93	273	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
40 to 45	42.5	185	155	177	517	130	387	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
35 to 40	37.5	236	200	241	677	167	510	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
30 to 35	32.5	237	202	198	637	169	468	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
25 to 30	27.5	121	115	113	349	93	256	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20 to 25	22.5	149	68	97	314	69	245	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15 to 20	17.5	95	40	46	181	42	139	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10 to 15	12.5	39	9	28	76	13	63	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5 to 10	7.5	21	5	5	31	7	24	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
0 to 5	2.5	4	2	-	6	2	4	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-5 to 0	-2.5	4	-	-	4	1	3	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-10 to -5	-7.5	-	-	-	-	-	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-15 to -10	-12.5	-	-	-	-	-	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
Total		1,391	1,241	1,316	3,948	1,024	2,924					#DIV/0!

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	0	12.5	12.5	9	4	14	11	3
95 to 100	97.5	-	19	2	21	14	7	12.5	12.5	174	88	289	227	62
90 to 95	92.5	-	44	13	57	34	23	12.5	10.6	422	246	735	577	159
85 to 90	87.5	1	167	60	228	130	98	8.7	8.7	1,126	847	2,172	1,703	469
80 to 85	82.5	31	283	162	476	234	242	6.7	6.7	1,574	1,630	3,527	2,766	761
75 to 80	77.5	191	235	280	706	235	471	4.8	4.8	1,129	2,265	3,737	2,930	806
70 to 75	72.5	203	177	222	602	184	418	2.9	2.9	531	1,205	1,912	1,499	413
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	48.1	46.2	4,956	6,282	12,372	9,702	2,673

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	128	199	69.8	15.2	70,473	66.9%	6,030,139
50 to 55	52.5	109	182	172	463	170	293	69.1	15.9	73,956	70.2%	8,853,025
45 to 50	47.5	105	119	142	366	120	246	68.3	16.7	77,439	73.5%	6,818,477
40 to 45	42.5	185	155	177	517	159	358	67.6	17.4	80,922	76.8%	9,877,531
35 to 40	37.5	236	200	241	677	207	470	66.8	18.2	84,405	80.2%	14,001,971
30 to 35	32.5	237	202	198	637	201	436	66.1	18.9	87,888	83.5%	14,729,504
25 to 30	27.5	121	115	113	349	113	236	65.3	19.7	91,371	86.8%	8,968,772
20 to 25	22.5	149	68	97	314	79	235	64.6	20.4	94,854	90.1%	6,766,664
15 to 20	17.5	95	40	46	181	45	136	63.8	21.2	98,337	93.4%	4,157,016
10 to 15	12.5	39	9	28	76	15	61	63.1	21.9	101,820	96.7%	1,467,988
5 to 10	7.5	21	5	5	31	6	25	62.3	22.7	105,303	100.0%	667,544
0 to 5	2.5	4	2	-	6	2	4	61.6	23.4	108,786	100.0%	194,260
-5 to 0	-2.5	4	-	-	4	0	4	60.8	24.2	112,269	100.0%	40,096
-10 to -5	-7.5	-	-	-	-	-	-	60.1	24.9	115,752	100.0%	-
-15 to -10	-12.5	-	-	-	-	-	-	59.3	25.7	119,235	100.0%	-
Total		1,391	1,241	1,316	3,948	1,246	2,702					82,572,988

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	0	2.0	2.0	1	1	2	2	1
95 to 100	97.5	-	19	2	21	14	7	2.0	2.0	28	14	46	34	13
90 to 95	92.5	-	44	13	57	34	23	2.0	1.7	68	39	118	85	32
85 to 90	87.5	1	167	60	228	130	98	1.4	1.4	180	136	348	253	95
80 to 85	82.5	31	283	162	476	234	242	1.1	1.1	252	261	564	410	154
75 to 80	77.5	191	235	280	706	235	471	0.8	0.8	181	362	598	434	163
70 to 75	72.5	203	177	222	602	184	418	0.5	0.5	85	193	306	222	84
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	7.7	7.4	793	1,005	1,980	1,438	542

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	128	199	69.8	15.2	13,111	66.9%	1,121,886
50 to 55	52.5	109	182	172	463	170	293	69.1	15.9	13,759	70.2%	1,647,074
45 to 50	47.5	105	119	142	366	120	246	68.3	16.7	14,407	73.5%	1,268,554
40 to 45	42.5	185	155	177	517	159	358	67.6	17.4	15,055	76.8%	1,837,680
35 to 40	37.5	236	200	241	677	207	470	66.8	18.2	15,703	80.2%	2,605,018
30 to 35	32.5	237	202	198	637	201	436	66.1	18.9	16,351	83.5%	2,740,373
25 to 30	27.5	121	115	113	349	113	236	65.3	19.7	16,999	86.8%	1,668,609
20 to 25	22.5	149	68	97	314	79	235	64.6	20.4	17,647	90.1%	1,258,914
15 to 20	17.5	95	40	46	181	45	136	63.8	21.2	18,295	93.4%	773,398
10 to 15	12.5	39	9	28	76	15	61	63.1	21.9	18,943	96.7%	273,114
5 to 10	7.5	21	5	5	31	6	25	62.3	22.7	19,591	100.0%	124,194
0 to 5	2.5	4	2	-	6	2	4	61.6	23.4	20,239	100.0%	36,141
-5 to 0	-2.5	4	-	-	4	0	4	60.8	24.2	20,887	100.0%	7,460
-10 to -5	-7.5	-	-	-	-	-	-	60.1	24.9	21,535	100.0%	-
-15 to -10	-12.5	-	-	-	-	-	-	59.3	25.7	22,183	100.0%	-
Total		1,391	1,241	1,316	3,948	1,246	2,702					15,362,416

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	0	8.5	8.5	6	2	9	7	2
95 to 100	97.5	-	19	2	21	14	7	8.5	8.5	118	60	197	155	41
90 to 95	92.5	-	44	13	57	34	23	8.5	7.2	287	167	500	395	105
85 to 90	87.5	1	167	60	228	130	98	5.9	5.9	766	576	1,477	1,167	310
80 to 85	82.5	31	283	162	476	234	242	4.6	4.6	1,070	1,108	2,398	1,894	504
75 to 80	77.5	191	235	280	706	235	471	3.3	3.3	768	1,540	2,541	2,007	534
70 to 75	72.5	203	177	222	602	184	418	2.0	2.0	361	820	1,300	1,027	273
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	32.7	31.4	3,370	4,271	8,413	6,645	1,770

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	128	199	69.8	15.2	49,167	66.9%	4,207,074
50 to 55	52.5	109	182	172	463	170	293	69.1	15.9	51,597	70.2%	6,176,529
45 to 50	47.5	105	119	142	366	120	246	68.3	16.7	54,027	73.5%	4,757,077
40 to 45	42.5	185	155	177	517	159	358	67.6	17.4	56,457	76.8%	6,891,301
35 to 40	37.5	236	200	241	677	207	470	66.8	18.2	58,887	80.2%	9,768,817
30 to 35	32.5	237	202	198	637	201	436	66.1	18.9	61,317	83.5%	10,276,398
25 to 30	27.5	121	115	113	349	113	236	65.3	19.7	63,747	86.8%	6,257,283
20 to 25	22.5	149	68	97	314	79	235	64.6	20.4	66,177	90.1%	4,720,929
15 to 20	17.5	95	40	46	181	45	136	63.8	21.2	68,607	93.4%	2,900,244
10 to 15	12.5	39	9	28	76	15	61	63.1	21.9	71,037	96.7%	1,024,178
5 to 10	7.5	21	5	5	31	6	25	62.3	22.7	73,467	100.0%	465,728
0 to 5	2.5	4	2	-	6	2	4	61.6	23.4	75,897	100.0%	135,530
-5 to 0	-2.5	4	-	-	4	0	4	60.8	24.2	78,327	100.0%	27,974
-10 to -5	-7.5	-	-	-	-	-	-	60.1	24.9	80,757	100.0%	-
-15 to -10	-12.5	-	-	-	-	-	-	59.3	25.7	83,187	100.0%	-
Total		1,391	1,241	1,316	3,948	1,246	2,702					57,609,061

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	0	7.5	7.5	5	2	8	7	2
95 to 100	97.5	-	19	2	21	14	7	7.5	7.5	104	53	173	137	36
90 to 95	92.5	-	44	13	57	34	23	7.5	6.3	253	148	441	348	93
85 to 90	87.5	1	167	60	228	130	98	5.2	5.2	675	508	1,303	1,029	274
80 to 85	82.5	31	283	162	476	234	242	4.0	4.0	944	978	2,116	1,672	445
75 to 80	77.5	191	235	280	706	235	471	2.9	2.9	678	1,359	2,242	1,771	471
70 to 75	72.5	203	177	222	602	184	418	1.7	1.7	319	723	1,147	906	241
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	28.8	27.7	2,974	3,769	7,423	5,863	1,562

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	128	199	69.8	15.2	49,167	66.9%	4,207,074
50 to 55	52.5	109	182	172	463	170	293	69.1	15.9	51,597	70.2%	6,176,529
45 to 50	47.5	105	119	142	366	120	246	68.3	16.7	54,027	73.5%	4,757,077
40 to 45	42.5	185	155	177	517	159	358	67.6	17.4	56,457	76.8%	6,891,301
35 to 40	37.5	236	200	241	677	207	470	66.8	18.2	58,887	80.2%	9,768,817
30 to 35	32.5	237	202	198	637	201	436	66.1	18.9	61,317	83.5%	10,276,398
25 to 30	27.5	121	115	113	349	113	236	65.3	19.7	63,747	86.8%	6,257,283
20 to 25	22.5	149	68	97	314	79	235	64.6	20.4	66,177	90.1%	4,720,929
15 to 20	17.5	95	40	46	181	45	136	63.8	21.2	68,607	93.4%	2,900,244
10 to 15	12.5	39	9	28	76	15	61	63.1	21.9	71,037	96.7%	1,024,178
5 to 10	7.5	21	5	5	31	6	25	62.3	22.7	73,467	100.0%	465,728
0 to 5	2.5	4	2	-	6	2	4	61.6	23.4	75,897	100.0%	135,530
-5 to 0	-2.5	4	-	-	4	0	4	60.8	24.2	78,327	100.0%	27,974
-10 to -5	-7.5	-	-	-	-	-	-	60.1	24.9	80,757	100.0%	-
-15 to -10	-12.5	-	-	-	-	-	-	59.3	25.7	83,187	100.0%	-
Total		1,391	1,241	1,316	3,948	1,246	2,702					57,609,061

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

WOODMAN FIELD

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption (kWh)	Proposed Condensing Unit Consumption (kWh)	Savings (kWh)
COOLING														
100 to 105	102.5	-	1	-	1	1	-	20.0	20.0	20	-	22	20	2
95 to 100	97.5	-	19	2	21	21	0	20.0	20.0	415	5	462	420	42
90 to 95	92.5	-	44	13	57	55	2	20.0	16.9	1,108	28	1,250	1,135	115
85 to 90	87.5	1	167	60	228	221	8	13.8	13.8	3,053	104	3,476	3,157	319
80 to 85	82.5	31	283	162	476	456	20	10.8	10.8	4,908	218	5,643	5,126	517
75 to 80	77.5	191	235	280	706	671	35	7.7	7.7	5,162	269	5,979	5,431	548
70 to 75	72.5	203	177	222	602	574	28	4.6	4.6	2,650	128	3,059	2,778	280
65 to 70	67.5	325	165	204	694	669	26	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	503	24	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	3,169	142	76.9	73.8	17,296	752	19,869	18,047	1,823

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Mixed Air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp (Note 1)	Heat provided by unit
HEATING								°F	°F	btu/hr	%	Btu/Yr
55 to 60	57.5	86	144	97	327	315	12	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
50 to 55	52.5	109	182	172	463	442	22	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
45 to 50	47.5	105	119	142	366	348	18	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
40 to 45	42.5	185	155	177	517	495	22	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
35 to 40	37.5	236	200	241	677	647	30	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
30 to 35	32.5	237	202	198	637	612	25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
25 to 30	27.5	121	115	113	349	335	14	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20 to 25	22.5	149	68	97	314	302	12	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15 to 20	17.5	95	40	46	181	175	6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10 to 15	12.5	39	9	28	76	73	4	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5 to 10	7.5	21	5	5	31	30	1	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
0 to 5	2.5	4	2	-	6	6	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-5 to 0	-2.5	4	-	-	4	4	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-10 to -5	-7.5	-	-	-	-	-	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
-15 to -10	-12.5	-	-	-	-	-	-	#DIV/0!	#DIV/0!	#DIV/0!	100.0%	#DIV/0!
Total		1,391	1,241	1,316	3,948	3,784	165					#DIV/0!

Electric HVAC Systems

This measure provides energy and demand savings algorithms for C&I Electric HVAC systems. The type of systems included in this measure are: split systems, single package systems, air to air cooled heat pumps, packaged terminal systems (PTAC and PTHP), single package vertical systems (SPVAC and SPVHP), central DX AC systems, water source heat pumps, ground water source heat pumps, and/or ground source heat pumps.

This measure applies to new construction, replacement of failed equipment, or end of useful life. The baseline unit is a code compliant unit with an efficiency as required by ASHRAE Std. 90.1 – 2013, which is the current code adopted by the state of New Jersey.

Algorithms

Air Conditioning Algorithms:

Energy Savings (kWh/yr) = N * Tons * 12 kBtuh/Ton * (1/EER_b-1/EER_q) * $EFLH_c$

Peak Demand Savings (kW) = N * Tons * 12 kBtuh/Ton * (1/EER_b-1/EER_q) * CF

Heat Pump Algorithms:

Cooling Energy Savings (kWh/yr) = N * Tons * 12 kBtuh/Ton * (1/EER_b-1/EER_q) * $EFLH_c$

Heating Energy Savings (Btu/yr) = N * Tons * 12 kBtuh/Ton * ((1/ (COP_b * 3.412))-(1/ (COP_q * 3.412)) * $EFLH_h$

Where *c* is for cooling and *h* is for heating.

Definition of Variables

N = Number of units

Tons = Rated cooling capacity of unit.This value comes from ARI/AHRI or AHAM rating or manufacturer data.

EER_b = Energy Efficiency Ratio of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER should be used in place of EER.

COP_b = Coefficient of Performance of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

EER_q = Energy Efficiency Ratio of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 (5.4 tons) BtuH, SEER should be used in place of EER.

COP_q = Coefficient of Performance of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 BtuH (5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

CF = Coincidence Factor – This value represents the percentage of the total load which is on during electric system's Peak Window. This value is based on existing measured usage and determined as the average number of operating hours during the peak window period.

$EFLH_{c\ or\ h}$ = Equivalent Full Load Hours – This represents a measure of energy use by season during the on-peak and off-peak periods.

Summary of Inputs

HVAC and Heat Pumps

Component	Type	Value	Source
Tons	Variable	Rated Capacity, Tons	Application
EER_b	Variable	See Table below	1
EER_q	Variable	ARI/AHRI or AHAM Values	Application
CF	Fixed	50%	2
EFLH	Variable	See Tables below	3

$EFLH_{(c\ or\ h)}$	Variable	See Tables below	5

HVAC Baseline Efficiencies Table – New Construction/EUL/RoF

Equipment Type	Baseline = ASHRAE Std. 90.1 – 2013
Unitary HVAC/Split Systems and Single Package, Air Cooled	
<=5.4 tons, split	13 SEER
<=5.4 tons, single	14 SEER
>5.4 to 11.25 tons	11.0 EER, 12.7 IEER
>11.25 to 20 tons	10.8 EER, 12.2 IEER
> 21 to 63 tons	9.8 EER, 11.4 IEER
>63 Tons	9.5 EER, 11.0 IEER
Air Cooled Heat Pump Systems, Split System and Single Package	
<=5.4 tons, split	14 SEER, 8.2 HSPF
<=5.4 tons, single	14 SEER, 8.0 HSPF
>5.4 to 11.25 tons	10.8 EER, 11.0 IEER, 3.3 heating COP
>11.25 to 20 tons	10.4 EER, 11.4 IEER, 3.2 heating COP
>= 21	9.3 EER, 10.4 IEER, 3.2 heating COP

Equipment Type	Baseline = ASHRAE Std. 90.1 – 2013
Water Source Heat Pumps (water to air, water loop)	
<=1.4 tons	12.2 EER, 4.3 heating COP
>1.4 to 5.4 tons	13.0 EER, 4.3 heating COP
>5.4 to 11.25 tons	13.0 EER, 4.3 heating COP
Ground Water Source Heat Pumps <=11.25 tons	18.0 EER, 3.7 heating COP
Ground Source Heat Pumps (brine to air, ground loop) <=11.25 tons	14.1 EER, 3.2 heating COP
Package Terminal Air Conditioners[37]	14.0 – (0.300 * Cap/1,000), EER
Package Terminal Heat Pumps	14.0 – (0.300 * Cap/1,000), EER 3.7 – (0.052 * Cap/1,000), heating COP
Single Package Vertical Air Conditioners	
<=5.4 tons	10.0 EER
>5.4 to 11.25 tons	10.0 EER
>11.25 to 20 tons	10.0 EER
Single Package Vertical Heat Pumps	
<=5.4 tons	10.0 EER, 3.0 heating COP
>5.4 to 11.25 tons	10.0 EER, 3.0 heating COP
>11.25 to 20 tons	10.0 EER, 3.0 heating COP

EFLH Table

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Assembly	603	669
Auto repair	1910	426
Dormitory	465	800
Hospital	3366	1424
Light industrial	714	549
Lodging – Hotel	1077	2918

Montclair Board of Education
Exhibit D
ECM 2D Rooftop Unit Replacement (DI)
Rooftop Unit Replacement

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Lodging – Motel	619	1233
Office – large	2034	720
Office – small	431	955
Other	681	736
Religious worship	722	279
Restaurant – fast food	813	645
Restaurant – full service	821	574
Retail – big box	191	1279
Retail – Grocery	191	1279
Retail – small	545	882
Retail – large	2101	1068
School – Community college	1431	846
School – postsecondary	1191	1208
School – primary	840	394
School – secondary	901	466
Warehouse	452	400

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Cooling	507	550	562
Low-rise, Heating	757	723	503
High-rise, Cooling	793	843	954
High-rise, Heating	526	395	219

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

ECM DESCRIPTION

Kitchen hoods in the district's kitchens are ventilated by exhaust fans. Fans are running most of the time at full speed when kitchen is in operation even if there are no activities under the hoods. e new ventilaton control systems will control exhaust fans based on hood exhaust temperatures. The exhaust fan will be equipped with VFDs will control air flows. If the exhaust fan is combined with a make up air unit, then variable air flow will be controlled on both exhaust and make up air fans.

DATA / ASSUMPTIONS

Existing equipment schedule was given by personnel operating the kitchen equipment and with interviews with facility staff

MEASUREMENT AND VERIFICATION

Option A (Both Electric and Fuel) - Measure kW, logging fan operation and calculate energy savings, both electric and fuel, from collected data with fan and make up air information from manufacturer.

COMMISSIONING

Test exhaust fans and make up air units that they operate per design intent, which include simulation of the exhaust temperature driving fan motor speeds. Verify all safety interlocks.

RECOVERY/SAFETY FACTOR

Recovery/Safety Factor (Electric) =	0%
Recovery/Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, make up air flow and operating schedules. A more conservative is used for heating losses due to the uncertainty of the basic operating information in terms of the volume of air being exhausted and other operating perimeters. The heating fuel saving calculations are based upon information provided by the equipment vendor. The exhaust fan electric savings are based on existing fan schedules and proposed fan schedules. Recovery factor of the electric savings is less conservative due to knowledge of technical data and agreed operating schedule.

FORMULAE

$W_{SAVINGS} = (W_{FAN} - W_{FAN})$

$Q_{SAVINGS} = (Q_{HOOD} - Q_{HOOD}) / \eta_{Boiler}$

$W_{FAN} = \sum_{0\%}^{100\%} HP \cdot Lf \cdot .746 \cdot t_{HOOD}$

$W_{FAN} = \sum_{0\%}^{100\%} (HP \cdot Lf \cdot .746) \cdot RPM_{\%}^{3} \cdot t_{HOOD}$

$Q_{HOOD} = (1.08 \cdot V_{EX} \cdot HD_{OCC} \cdot (t_{HOOD} / t_{HOOD} + t_{OCC})) / (\eta_{sys} \cdot 100{,}000)$

$Q_{HOOD} = (1.08 \cdot V_{EX} \cdot HD_{OCC} \cdot (t_{HOOD} / t_{HOOD} + t_{OCC})) / (\eta_{sys} \cdot 100{,}000)$

$V_{EX} = V_{EX} \cdot RPM_{W}$

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

Variable	Units	Description
$W_{savings}$	kWh	kWh Savings
$Q_{savings}$	Therms	Thermal Savings
W_{FAN}	kWh	Existing Annual Fan Electricial Consumption
W_{FAN}	kWh	Proposed Annual Fan Electricial Consumption
HP	HP	Horsepower of Exhaust Fan
$\sum_{0\%}^{100\%}$	-	Summation of run times
$RPM_{\%}$	RPM	Percentage of RPM compared to the motors full speed (0% - 100%)
RPM_{W}	RPM	Weighted RPM of Exhaust Fan
Lf	-	Load Factor of motor
η_{sys}	-	Existing system efficiency
V_{EX}	CFM	Current Exhaust Volume
V_{EX}	CFM	Proposed Exhaust Volume
Q_{HOOD}	Therms	Existing Heat Load of Kitchen Hood
Q_{HOOD}	Therms	Proposed Heat Load of Kitchen Hood
T_{OCC}	°F	Existing temperature of space during occupied hours
η_{Boiler}	-	Existing system efficiency
t_{HOOD}	Hrs	Existing Hood Run Hours
t_{OCC}	Hrs	Occupied Bin Hours
HD_{OCC}	Hrs	Existing occupied heating degree hours

* Inputs are in blue

Building	Kitchen Hood Area (ft^2)	HP of Exhaust Fan Motor	HP of MAU Motor	Annual Run Hours	System Efficiency	Current Exhaust Volume (CFM)
Valley Road Complex	60	3.0	1.5	180	60%	4,500
Bradford Elementary School	16	1.0	0.5	180	60%	1,200
Bullock Elementary School	96	2.0	2.0	180	60%	7,200
Edgemont Elementary School	16	1.0	0.5	180	60%	1,200
George Inness Annex (HS-9th), Athlet	32	2.0	1.0	180	60%	2,400
Glenfield Middle School	25	1.0	0.5	180	60%	1,875
Montclair High School	160	6.0	3.0	-	60%	12,000
Nishuane K-2	16	1.0	0.5	180	60%	1,200
Northeast Elementary School	16	1.0	0.5	180	60%	1200
Woodman Field	16	1.0	0.5	64	60%	1200
Totals	**453**	**19.0**	**10.5**			**33,975**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

	Valley Road Complex	Bradford Elementary School	Bullock Elementary School	Edgemont Elementary School	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Montclair High School	Nishuane K-2	Northeast Elementary School	Woodman Field
Kitchen Hood Area	60	16	96	16	32	25	160	16	16	16
HP of Fan Motor	3	1.0	2.0	1.0	2.0	1.0	6.0	1.0	1.0	1.0
HP Fan MAU Motor	1.5	0.5	2.0	0.5	1.0	0.5	3.0	0.5	0.5	0.5
Load Factor	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Annual Run Hours	180	180	180	180	180	180	0	180	180	64
System Efficiency	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Current Exhaust Volume	4,500	1,200	7,200	1,200	2,400	1,875	12,000	1,200	1,200	1,200
Proposed Exhaust Volume	2,903	774	4,644	774	1,548	1,209	7,740	774	774	774
Existing Heat Load	435	106	677	135	245	185	-	124	131	46
Proposed Heat Load	281	68	436	87	158	120	-	80	85	30
Existing Occupied Heating Setpoint	74.0	72.0	73.0	81.0	76.0	76.0	75.0	77.0	78.0	72.0
Boiler Efficiency	69.6%	72.5%	82.0%	72.5%	64.8%	91.0%	69.6%	64.8%	64.8%	70.6%
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	6,788	2,260	4,562	2,260	4,520	2,266	13,602	2,260	2,260	2,260
Thermal Savings	18	5	24	5	10	6	48	5	5	5
NJ BPU Protocol Calculations										
Fan Savings (kWh/yr)	**6,749**	**2,250**	**4,499**	**2,250**	**4,499**	**2,250**	**13,497**	**2,250**	**2,250**	**2,250**
N	1	1	1	1	1	1	1	1	1	1
HP	3.0	1.0	2.0	1.0	2.0	1.0	6.0	1.0	1.0	1.0
LF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
RH	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250
PR	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
FEFF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Heating Savings (Therms/yr)	**18**	**5**	**24**	**5**	**10**	**6**	**48**	**5**	**5**	**5**
SF	60	16	96	16	32	25	160	16	16	16
CFM/SF	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
OF	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
FR	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295
HDD	2,783	2,783	2,783	2,783	2,783	2,783	2,783	2,783	2,783	2,783
Heff	0.70	0.73	0.82	0.73	0.65	0.91	0.70	0.65	0.65	0.71
Cooling Savings (kWh/yr)	**39**	**10**	**63**	**10**	**21**	**16**	**105**	**10**	**10**	**10**
SF	60	16	96	16	32	25	160	16	16	16
CFM/SF	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
OF	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
FR	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295
CDD	893	893	893	893	893	893	893	893	893	893
Ceff	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total kWh Savings	**6,788**	**2,260**	**4,562**	**2,260**	**4,520**	**2,266**	**13,602**	**2,260**	**2,260**	**2,260**
Total Therm Savings	**18**	**5**	**24**	**5**	**10**	**6**	**48**	**5**	**5**	**5**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

ELECTRICAL CALCULATIONS

VALLEY ROAD COMPLEX

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	45	45	0
90%	5%	9	5%	23	17	6
80%	5%	9	4%	23	12	11
70%	15%	27	11%	68	23	45
60%	30%	54	18%	136	29	107
50%	35%	63	18%	159	20	139
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**453**	**146**	**307**

BRADFORD ELEMENTARY SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

BULLOCK ELEMENTARY SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	40	40	0
90%	5%	9	5%	20	15	5
80%	5%	9	4%	20	10	10
70%	15%	27	11%	60	21	40
60%	30%	54	18%	121	26	95
50%	35%	63	18%	141	18	123
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**403**	**130**	**273**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

EDGEMONT ELEMENTARY SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	30	30	0
90%	5%	9	5%	15	11	4
80%	5%	9	4%	15	8	7
70%	15%	27	11%	45	16	30
60%	30%	54	18%	91	20	71
50%	35%	63	18%	106	13	93
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**302**	**97**	**205**

GLENFIELD MIDDLE SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

MONTCLAIR HIGH SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	91	91	0
90%	5%	9	5%	45	33	12
80%	5%	9	4%	45	23	22
70%	15%	27	11%	136	47	89
60%	30%	54	18%	272	59	213
50%	35%	63	18%	317	40	278
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**906**	**292**	**614**

NISHUANE K-2

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

NORTHEAST ELEMENTARY SCHOOL

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

WOODMAN FIELD

Variable Exhaust Volume Analysis

% Rated RPM	% Run Time	Time Hrs/Yr	Weighted RPM	Existing kWh	Proposed kWh	kWh Savings
100%	10%	18	10%	15	15	0
90%	5%	9	5%	8	6	2
80%	5%	9	4%	8	4	4
70%	15%	27	11%	23	8	15
60%	30%	54	18%	45	10	36
50%	35%	63	18%	53	7	46
40%	0%	-	0%	0	0	0
30%	0%	-	0%	0	0	0
20%	0%	-	0%	0	0	0
10%	0%	-	0%	0	0	0
Total		180	**65%**	**151**	**49**	**102**

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

New and Retrofit Kitchen Hoods with Variable Frequency Drives

Kitchen Hoods with Variable Frequency Control utilize optical and temperature sensors at the hood inlet to monitor cooking activity. Kitchen hood exhaust fans are throttled in response to real time ventilation requirements. Energy savings result from fan power reduction during part load operation as well as a decrease in heating and cooling requirement of make-up air.

Algorithms

Electric Fan Savings (kWh/yr) = N * (HP * *LF * 0.746/FEFF) * RH * PR

Heating Savings (MMBtu/yr) = SF * CFM/SF * OF * FR * HDD * 24 * 1.08 / (HEFF * 1,000,000)

Cooling Savings (kWh/yr) = SF * CFM/SF * OF * FR * CDD * 24 * 1.08 / (CEFF * 3,412)

Definition of Variables

N = Number of Kitchen Hood Fan Motors
HP = Kitchen Hood Fan Motor HP
LF = Existing Motor Loading Factor
0.746 = Conversion factor = HP to kW
F_{EFF} = Efficiency of Kitchen Hood Fan Motors (%)
RH = Kitchen Hood Fan Run Hours
PR = Fan Motor Power Reduction resultant from VFD/Control Installation
SF = Kitchen Square Footage
CFM/SF = Code required ventilation rate per square foot for Commercial Kitchen spaces
OF = Ventilation rate oversize factor (compared to code requirement)
FR = Flow Reduction resultant from VFD/Control Installation
HDD_{mod} = Modified Heating Degree Days based on location and facility type
CDD_{mod} = Modified Cooling Degree Days based on location and facility type
24 = Hours per Day
1.08 = Sensible heat factor for air ((Btu/hr) / (CFM * Deg F))
H_{EFF} = Efficiency of Heating System (AFUE %)
C_{EFF} = Efficiency of Cooling System (COP)
3,412 = Conversion factor from Btu to kWh (3,412 Btu = 1 kWh)
1,000,000 = Btu/MMBtu

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

Summary of Inputs

Kitchen Hoods with VFDs

Component	Type	Value	Source
N	Variable	Quantity	Application
HP	Variable	Nameplate	Application
LF	Fixed	0.9	Melink Analysis Sample[39]
F_{EFF}	Variable	Based on Motor HP	NEMA Premium Efficiency, TEFC 1800 RPM
RH	Variable	See Table Below	2
PR	Variable	See Table Below	2
SF	Variable	Kitchen Square Footage	Application
CFM / SF	Fixed	0.7	1
OF	Fixed	1.4	Estimated Typical Kitchen Design[40]
FR	Variable	Based on Facility Type	2
HDD_{mod}	Variable	See Table Below	3
CDD_{mod}	Variable	See Table Below	4
H_{EFF}	Fixed	0.8	Estimated Heating System Efficiency[41]
C_{EFF}	Fixed	3.00	Estimated Cooling System Efficiency[42]

Facility-Specific Values Table

Facility Type	Run Hours	Power Reduction (PR)	Flow Reduction (FR)
Campus	5250	0.568	0.295
Lodging	8736	0.618	0.330
Restaurant	5824	0.552	0.295
Supermarket	5824	0.597	0.320
Other	5250	0.584	0.310

Modified Heating Degree Days Table

Building Type	Heating Energy Density (kBtu/sf)	Degree Day Adjustment Factor	Atlantic City (HDD)	Newark (HDD)	Philadelphia (HDD)	Monticello (HDD)
Education	29.5	0.55	2792	2783	2655	3886
Food Sales	35.6	0.66	3369	3359	3204	4689

Montclair Board of Education
Exhibit D
ECM 2E Kitchen Hood Controls
Kitchen Hood Replacement

Food Sales	39.0	0.66	3369	3359	3204	4869
Food Service	39.0	0.73	3691	3680	3510	5137
Health Care	53.6	1.00	5073	5057	4824	7060
Lodging	15.0	0.28	1420	1415	1350	1976
Retail	29.3	0.55	2773	2764	2637	3859
Office	28.1	0.52	2660	2651	2529	3701
Public Assembly	33.8	0.63	3199	3189	3042	4452
Public Order/Safety	24.1	0.45	2281	2274	2169	3174
Religious Worship	29.1	0.54	2754	2745	2619	3833
Service	47.8	0.89	4524	4510	4302	6296
Warehouse/Storage	20.2	0.38	1912	1906	1818	2661

Modified Cooling Degree Days Table

Building Type	Degree Day Adjustment Factor	Atlantic City (CDD)	Newark (CDD)	Philadelphia (CDD)	Monticello (CDD)
Education	0.55	824	893	806	625
Food Sales	0.66	989	1071	967	750
Food Service	0.73	1094	1185	1069	830
Health Care	1.00	1499	1623	1465	1137
Lodging	0.28	420	454	410	318
Retail	0.55	824	893	806	625
Office	0.52	779	844	762	591
Public Assembly	0.63	944	1022	923	716
Public Order/Safety	0.45	675	730	659	512
Religious Worship	0.54	809	876	791	614
Service	0.89	1334	1444	1304	1012
Warehouse/Storage	0.38	570	617	557	432

Montclair Board of Education
Exhibit D
ECM 2F Walk In Compressor Controls
Walk-In Freezer/Cooler Controllers

ECM DESCRIPTION

Installation of a refrigeration controller made by intellidyne on walk-in freezers and refrigerators. This will reduce cycling and improve operating efficiency of the compressor.

DATA / ASSUMPTIONS

Assumed compressor and controller savings	15%	
Assumed Run Hours	4,200	Hours

MEASUREMENT AND VERIFICATION

Option A - Measure kW of selected freezer compressors. Logging compressor operation before and after the controller installations. Calculate savings based on measured results.

COMMISSIONING

Test compressors after installation.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

Recovery factor taken at 0 due to few installations and not proven savings record.

FORMULAE

$W_{SAVINGS} = (\ kW_{REFRIG} + kW_{FREEZER}\ ) \cdot t \cdot \delta_{\%SAVINGS}$

Variable	Units	Description
$W_{savings}$	kWh	Electrical Savings for Motor Replacement
kW_{REFRIG}	kW	Horsepower of motor
$kW_{FREEZER}$	kW	Existing Run Hours
t	Hrs	Run hours (assumed)
$\delta_{\%SAVINGS}$	%	Compressor and controller savings (assumed)

Montclair Board of Education
Exhibit D
ECM 2F Walk In Compressor Controls
Walk-In Freezer/Cooler Controllers

*Inputs are blue

Building	Location	No. of Walk-In Refrigators	No. of Walk-In Freezers	kW of Refrigator	kW of Freezer
Bullock Elementary School	Kitchen	1	-	1.152	
Bullock Elementary School	Kitchen	-	1		2.863
George Inness Annex (HS-9th), Athletics	Kitchen	1	-	1.152	
George Inness Annex (HS-9th), Athletics	Kitchen	-	1		2.863
Montclair High School	Kitchen	1	-	1.152	
Montclair High School	Kitchen	-	1		2.863
Totals	-	**3**	**3**	**3.5**	**8.6**

CALCULATIONS

	Bullock Elementary School	Bullock Elementary School	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Montclair High School	Montclair High School
No. of Walk-In Refrigerators	1	0	1	0	1	0
No. of Walk-In Freezers	0	1	0	1	0	1
kW of Refrigerator	1.152	-	1.152	-	1.152	-
kW of Freezer	-	2.863	-	2.863	-	2.863
Run Hours	4,200	4,200	4,200	4,200	4,200	4,200
Total Electrical Consumption	4,838	12,025	4,838	12,025	4,838	12,025
Compressor and Controller Savings	15%	15%	15%	15%	15%	15%
Safety Factor	0%	0%	0%	0%	0%	0%
Electrical Savings	214	533	214	533	214	533
NJ BPU Protocol Calculations						
kWh Savings EC	**214**	**533**	**214**	**533**	**214**	**533**
Amps Cp	3.2	7.9	3.2	7.9	3.2	7.9
Volts Cp	208	208	208	208	208	208
Phase Cp^1/2	1.73	1.73	1.73	1.73	1.73	1.73
WH	2,195	2,195	2,195	2,195	2,195	2,195
NWH	6,565	6,565	6,565	6,565	6,565	6,565

Montclair Board of Education
Exhibit D
ECM 2F Walk In Compressor Controls
Walk-In Freezer/Cooler Controllers

Algorithms

Gross Energy Savings (kWh/yr) = $kWh\ Savings_{EF} + kWh\ Savings_{RH} + kWh\ Savings_{EC}$

$kWh\ SavingsEF = ((Amps_{EF} * Volts_{EF} * (Phase_{EF})^{1/2})/1000) * 0.55 * 8{,}760 * 35.52\%$

$kWh\ SavingsRH = kWh\ Savings_{EF} * 0.28 * 1.6$

$kWh\ SavingsEC = (((Amps_{CP} * Volts_{CP} * (Phase_{CP})^{1/2})/1000) * 0.85 * ((35\% * WH) + (55\% * NWH)) * 5\%) + (((Amps_{EF} * Volts_{EF} * (Phase_{EF})^{1/2})/1000) * 0.55 * 8{,}760 * 35.52\% * 5\%)$

Gross kW Savings = $((Amps_{EF} * Volts_{EF} * (Phase_{EF})^{1/2})/1000) * 0.55 * D$

Definition of Variables

$kWh\ Savings_{EF}$	= Savings due to Evaporator Fan being off
$kWh\ Savings_{RH}$	= Savings due to reduced heat from Evaporator Fans
$kWh\ Savings_{EC}$	= Savings due to the electronic controls on compressor and evaporator
$Amps_{EF}$	= Nameplate Amps of Evaporator Fan
$Volts_{EF}$	= Nameplate Volts of Evaporator Fan
$Phase_{EF}$	= Phase of Evaporator Fan
0.55	= Evaporator Fan Motor power factor
8,760	= Annual Operating Hours

35.52%	= Percent of time Evaporator Fan is turned off
0.28	= Conversion from kW to tons (Refrigeration)
1.6	= Efficiency of typical refrigeration system in kW/ton [3]
$Amps_{CP}$	= Nameplate Amps of Compressor
$Volts_{CP}$	= Nameplate Volts of Compressor
$Phase_{CP}$	= Phase of Compressor

Montclair Board of Education
Exhibit D
ECM 2F Walk In Compressor Controls
Walk-In Freezer/Cooler Controllers

0.85	= Compressor power factor.
35%	= Compressor duty cycle during winter months
WH	= Compressor hours during winter months
55%	= Compressor duty cycle during non-winter months
NWH	= Compressor hours during non-winter months (6,565)
5%	= Reduced run time of Compressor and Evaporator due to electronic controls
D	= Diversity Factor

Summary of Inputs

Evaporator Fan Control - Commercial Refrigeration

Component	Type	Value	Source
$Amps_{EF}$	Variable	Manufacturer data	Application
$Volts_{EF}$	Variable	Manufacturer data	Application
$Phase_{EF}$	Variable	Manufacturer data	Application
0.55	Variable	Default	Estimate
8,760	Variable	Default	Estimate
35.52%	Variable	Default	Estimate[44]
0.28	Variable	Conversion	
1.6	Variable	Default	Estimate, 1
$Amps_{CP}$	Variable	Manufacturer data	Application
$Volts_{CP}$	Variable	Manufacturer data	Application
$Phase_{CP}$	Variable	Manufacturer data	Application
0.85	Variable	Default	Estimate
35%	Variable	Default	Estimate

Montclair Board of Education
Exhibit D
ECM 2F Walk In Compressor Controls
Walk-In Freezer/Cooler Controllers

Component	Type	Value	Source
WH	Variable	2,195 - Default	Estimate
55%	Variable	Default	Estimate
NWH	Variable	6,565 - Default	Estimate
5%	Variable	Default	2
D	Variable	0.228	3

Montclair Board of Education
Exhibit D
Variable Frequency Drives and Motor Table

0
0
0

VARIABLE FREQUENCY DRIVE AND MOTOR TABLE

*Inputs are blue
*Total Horsepower of primary motors only. Do not take into account the horsepower of standby motors

MOTORS TO BE REPLACED								
Building	Equipment Label	Equipment Configuration	Qty	HP*	Existing Efficiency	Replace Motor (Y/N)	Add VFD (Y/N)	
George Inness Annex (HS-9th), Athletics	GIA-P-3,4	Chilled Water Pump	2	5.0	84.0%	Y	Y	Primary/Standby
George Inness Annex (HS-9th), Athletics	GIA-P-5,6	Chilled Water Pump	2	10.0	84.0%	Y	Y	Lead/Lag
Montclair High School	MHS-P-1-3	eating Hot Water Pum	3	5.0	89.5%	Y	Y	Primary
Montclair High School	MHS-P-4,5	oiler Feed Water Pum	2	1.5	84.0%	Y	Y	Standby
Montclair High School	MHS-P-6	eating Hot Water Pum	1	3.0	84.0%	Y	Y	Fan Return
Valley Road Complex	CP-M-1,2	Combustion Fan	2	7.5	85.0%	Y	Y	Fan Supply
Montclair High School	MHS-M-1	Combustion Fan	1	10.0	85.0%	Y	Y	
Totals			13	42.0				

	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Montclair High School	Montclair High School	Montclair High School	Valley Road Complex	Montclair High School	
Equipment Label	GIA-P-3,4	GIA-P-5,6	MHS-P-1-3	MHS-P-4,5	MHS-P-6	CP-M-1,2	MHS-M-1	
Equipment Configuration	Chilled Water Pump	Chilled Water Pump	Heating Hot Water Pump	Boiler Feed Water Pump	Heating Hot Water Pump	Combustion Fan	Combustion Fan	
Qty	2	2	3	2	1	2	1	
HP	5.0	10.0	5.0	1.5	3.0	7.5	10.0	
Existing Efficiency	84.0%	84.0%	89.5%	84.0%	84.0%	85.0%	85.0%	
Replace Motor	Y	Y	Y	Y	Y	Y	Y	
VFD to be Installed	Y	Y	Y	Y	Y	Y	Y	

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

ECM DESCRIPTION

There are standard efficiency motors and motors that need to be replaced due to poor condition throughout the district. These motors will be replaced with premium high efficiency motors to save electrical energy. In addition some new motors will be equipped with variable frequency drives (VFDs) for additional savings.

DATA / ASSUMPTIONS

Load Factor	**50%**

*VFD run speed percentages are based on typical VFD curves for hot water / chilled water loops
*Run hours are based on the audit, data logging, and through interviews with facility staff

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed motors and operating hours. All existing motors will be measured before removal and new motors after the installation. VFD kW will be measured through the load range and selected motors with VFDs will be monitored for the time period using kW loggers. Equipment operating hours are based on the audit, logging and operating personnel input.

COMMISSIONING

Review installation documents for alignments and vibrations. Start up equipment and measure vibration through the load range along with motor kW. Verify that VFDs are capable of operating in full design range upon the control signal demand.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	**0%**

The safety factor for this ECM is taken at 0 due to some unknown data such as actual existing motor kW loads and operation hours.

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

FORMULAE

VFD

$W_{SAVINGSVFD} = W_{PROPOSED} - W_{VFD}$

$W_{VFD} = \sum_{0}^{60} Hp \cdot Lf \cdot \eta \cdot f^{\wedge 2.8} \cdot t_f$

MOTOR

$W_{SAVINGS} = W_{EXISTING} - W_{PROPOSED}$

$W_{EXISTING} = Hp \cdot Lf \cdot \eta \cdot t$
$W_{PROPOSED} = Hp \cdot Lf \cdot \eta \cdot t$

Variable	Units	Description
$W_{savingsVFD}$	kWh	Electrical Savings associated with VFD
$W_{savings}$	kWh	Electrical Savings for Motor Replacement
Hp	HP	Horsepower of motor
t	Hrs	Existing Run Hours
t	Hrs	Proposed Run Hours
Lf	-	Load Factor of motor
η	-	Existing efficiency of motor
η	-	Proposed efficiency of motor
$\sum_{0}^{60}$	-	Summation of all frequences (0 Hz to 60 Hz)
f	-	Frequency of drive, as a percentage of full frequency (60 Hz)
t_f	Hrs	Percentage of time motor will run at a particular frequency
W_{VFD}	kWh	Electrical consumption with VFD
$W_{EXISTING}$	kWh	Existing electrical consumption of motor
$W_{PROPOSED}$	kWh	Proposed electrical consumption of motor

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

ASSUMPTIONS / INPUTS

* Inputs are in blue

Building	Equipment Label	Configuration	Qty	HP	Existing Efficiency	Replace Motor	Add VFD
George Inness Annex (HS-9th), Athletics	GIA-P-3,4	Chilled Water Pump	2	5.0	84.0%	Y	Y
George Inness Annex (HS-9th), Athletics	GIA-P-5,6	Chilled Water Pump	2	10.0	84.0%	Y	Y
Montclair High School	MHS-P-1-3	eating Hot Water Pur	3	5.0	89.5%	Y	Y
Montclair High School	MHS-P-4,5	oiler Feed Water Pun	2	1.5	84.0%	Y	Y
Montclair High School	MHS-P-6	eating Hot Water Pur	1	3.0	84.0%	Y	Y
Total							

CALCULATIONS (MOTOR)

	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics	Montclair High School	Montclair High School	Montclair High School	Valley Road Complex	Montclair High School
Equipment Label	GIA-P-3,4	GIA-P-5,6	MHS-P-1-3	MHS-P-4,5	MHS-P-6	CP-M-1,2	MHS-M-1
Equipment Configuration	Chilled Water Pump	Chilled Water Pump	eating Hot Water Pur	oiler Feed Water Pur	eating Hot Water Pur	Combustion Fan	Combustion Fan
Replace Motor	Y	Y	Y	Y	Y	Y	Y
VFD to be Installed	Y	Y	Y	Y	Y	Y	Y
Qty	2	2	3	2	1	2	1
HP	5.0	10.0	5.0	1.5	3.0	7.5	10.0
Run Hours	3,311	3,311	3,948	3,948	3,948	3,948	3,948
Load Factor	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Existing Motor Efficiency	0.840	0.840	0.895	0.840	0.840	0.850	0.850
Proposed Motor Efficiency	0.907	0.917	0.907	0.890	0.900	0.910	0.917
Existing kW	2.2	4.4	2.1	0.7	1.3	3.3	4.4
Proposed kW	2.1	4.1	2.1	0.6	1.2	3.1	4.1
Existing Motor kWh Consumption	7,351	14,702	8,227	2,630	5,259	12,994	17,325
Proposed Motor kWh Consumption	6,808	13,468	8,118	2,482	4,909	12,137	16,059
Proposed Motor kWh Consumption w/ VFD	1,601	3,168	1,910	584	1,155	2,855	3,777
Safety Factor	0%	0%	0%	0%	0%	0%	0%
kW Savings	2.1	4.2	1.5	1.5	0.4	1.7	1.4
kWh Savings	16,938	34,042	23,322	4,903	4,973	24,024	16,668

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

Motor	**NJ BPU Protocol Calculations**						
Delta kW	0.295	0.671	0.050	0.067	0.160	0.391	0.577
HP	5.0	10.0	5.0	1.5	3.0	7.5	10.0
IFvfd	**0.90**	**0.90**	**0.90**	**0.90**	**0.90**	**0.90**	**0.90**
LF	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**
Nbase	0.840	0.840	0.895	0.840	0.840	0.850	0.850
Nprem	0.907	0.917	0.907	0.890	0.900	0.910	0.917
Hrs	**2,745**	**2,745**	**2,745**	**2,745**	**2,745**	**2,745**	**2,745**
CF	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**
Demand Savings (kW)	0.218	0.497	0.037	0.050	0.118	0.289	0.427
Energy Savings (kWh)	608	1,382	102	139	329	804	1,188
VFD							
N	**2**	**2**	**3**	**2**	**1**	**2**	**1**
HP	5.0	10.0	5.0	1.5	3.0	7.5	10.0
ESF	**1,633**	**1,633**	**1,548**	**1,588**	**1,548**	**1,548**	**1,548**
DSF	**0.185**	**0.185**	**0.096**	**0.498**	**0.096**	**0.096**	**0.096**
Energy Savings (kWh)	16,330	32,660	23,220	4,764	4,644	23,220	15,480
Peak Demand Savings (kW)	1.8500	3.7000	1.4400	1.4940	0.2880	1.4400	0.9600
Total kWh Savings	**16,938**	**34,042**	**23,322**	**4,903**	**4,973**	**24,024**	**16,668**
Total Demand Savings	**2.0685**	**4.1967**	**1.4767**	**1.5438**	**0.4063**	**1.7290**	**1.3871**

MOTOR RUN PERCENTAGES AT RESPECTIVE SPEED

30%	0	0	0	0	0	0	0
40%	0.16	0.16	0.16	0.16	0.16	0.16	0.16
50%	0.23	0.23	0.23	0.23	0.23	0.23	0.23
60%	0.23	0.23	0.23	0.23	0.23	0.23	0.23
70%	0.2	0.2	0.2	0.2	0.2	0.2	0.2
80%	0.09	0.09	0.09	0.09	0.09	0.09	0.09
90%	0.03	0.03	0.03	0.03	0.03	0.03	0.03
100%	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	0.95	0.95	0.95	0.95	0.95	0.95	0.95

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

KWH CONSUMPTION W/ VFD

30%	0	0	0	0	0	0	0
40%	70	138	83	25	50	124	164
50%	196	387	233	71	141	349	462
60%	338	669	403	123	244	603	798
70%	467	924	557	170	337	833	1,102
80%	314	621	374	114	226	559	740
90%	149	295	178	54	107	265	351
100%	68	135	81	25	49	121	161

30%	0.06	0.11	0.06	0.02	0.03	0.08	0.11
40%	0.13	0.26	0.13	0.04	0.08	0.20	0.26
50%	0.26	0.51	0.26	0.08	0.16	0.38	0.51
60%	0.44	0.88	0.44	0.14	0.27	0.66	0.88
70%	0.71	1.40	0.71	0.22	0.43	1.05	1.40
80%	1.05	2.08	1.05	0.32	0.64	1.57	2.08
90%	1.50	2.97	1.50	0.46	0.91	2.24	2.97
100%	2.06	4.07	2.06	0.63	1.24	3.07	4.07

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

Variable Frequency Drives

This section provides algorithms and assumptions for reporting of energy and demand savings for C/I Variable Frequency Drive (VFD) installations for HVAC systems including: supply air fans, return air fans, chilled water and condenser water pumps, hot water circulation pumps, water source heat pump circulation pumps, cooling tower fans, and boiler feed water pumps. VFD applications for other end uses should follow the custom path.

Algorithms

Energy Savings (kWh/yr) = N * HP * ESF

Peak Demand Savings (kW) = N * HP * DSF

Definitions of Variables

N = Number of motors controlled by VFD(s) per application
HP = Nameplate motor horsepower or manufacturer specification sheet per application
ESF = Energy Savings Factor (kWh/year per HP)
DSF = Demand Savings Factor (kW per HP)

Summary of Inputs

Variable Frequency Drives

Component	Type	Value	Source
HP	Variable	Nameplate/Manufacturer Spec. Sheet	Application
ESF	Variable	See Table Below	Derived value based on the following sources: 1, 2, 3
DSF	Variable	See Table Below	Derived value based on the following sources: 1, 2, 3

The ESF for the supply and return fans and circulating pumps are derived from a 2014 NEEP-funded study of 400 VFD installations in eight northeast states. The derived values are based on actual logged input power data and reflect average operating hours, load factors, and motor efficiencies for the sample. Savings factors representing cooling tower fans and boiler feed water pumps are not reflected in the NEEP report. Values representing these applications are taken from April 2018 New York TRM, Appendix K, and represent average values derived from DOE2.2 simulation of various building types

and climate zones, supplemented with results from an earlier analysis of actual program data completed by NSTAR in 2010.

The DSF are derived from the same sources. The NEEP values reflect the actual average impact for the category occurring in the PJM defined peak demand period. The NY values are based on a similar but not identically defined peak period. In all cases the values are expressed in kW/HP rating of the controlled motor and reflect average load factors during the peak period and motor efficiencies for the sample.

VFD Savings Factors

Application	ESF (kWh/Year-HP)	DSF (kW/HP)	Source
Supply Air Fan	2,033	0.286	1
Return Air Fan	1,788	0.297	1
CHW or CW Pump	1,633	0.185	1
HHW Pump	1,548	0.096	1
WSHP Pump	2,562	0.234	1
CT Fan	290	-0.025	2, 3
Boiler Feedwater Pump	1,588	0.498	2, 3

Motors

For premium efficiency motors 1-200 HP.
Algorithms

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

From application form calculate ΔkW where:

$$\Delta kW = 0.746 * HP * IF_{VFD} * (1/\eta_{base} - 1/\eta_{prem})$$

Demand Savings = (ΔkW) * CF

Energy Savings = (ΔkW)*HRS * LF

Definition of Variables
ΔkW = kW Savings at full load

HP = Rated horsepower of qualifying motor, from nameplate/manufacturer specs.

LF = Load Factor, percent of full load at typical operating condition

IF_{VFD} = VFD Interaction Factor, 1.0 without VFD, 0.9 with VFD

η_{base} = Efficiency of the baseline motor

η_{prem} = Efficiency of the energy-efficient motor

HRS = Annual operating hours

CF = Coincidence Factor

Component	Type	Value	Source
HP	Variable	Nameplate/Manufacturer Spec. Sheet	Application
LF	Fixed	0.75	1
η_{base}	Fixed	ASHRAE 90.1-2013 Baseline Efficiency Table	ASHRAE
η_{prem}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
IF_{VFD}	Fixed	1.0 or 0.9	3

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

Efficiency - η_{ee}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
CF	Fixed	0.74	1
HRS	Fixed	Annual Operating Hours Table	1

NEMA ASHRAE 90.1-2013 Motor Efficiency Table – General Purpose Subtype I

Motor Horsepower	1200 RPM (6 pole)		1800 RPM (4 pole)		3600 RPM (2 pole)	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
1	0.825	0.825	0.855	0.855	0.77	0.77
1.5	0.865	0.875	0.865	0.865	0.84	0.84
2	0.875	0.885	0.865	0.865	0.855	0.855
3	0.885	0.895	0.895	0.895	0.855	0.865
5	0.895	0.895	0.895	0.895	0.865	0.885
7.5	0.902	0.91	0.91	0.917	0.885	0.895
10	0.917	0.91	0.917	0.917	0.895	0.902
15	0.917	0.917	0.93	0.924	0.902	0.91
20	0.924	0.917	0.93	0.93	0.91	0.91
25	0.93	0.93	0.936	0.936	0.917	0.917
30	0.936	0.93	0.941	0.936	0.917	0.917
40	0.941	0.941	0.941	0.941	0.924	0.924
50	0.941	0.941	0.945	0.945	0.93	0.93
60	0.945	0.945	0.95	0.95	0.936	0.936
75	0.945	0.945	0.95	0.954	0.936	0.936
100	0.95	0.95	0.954	0.954	0.936	0.941
100	0.95	0.95	0.954	0.954	0.941	0.95
150	0.954	0.958	0.958	0.958	0.941	0.95
200	0.954	0.958	0.958	0.962	0.95	0.954

Annual Operating Hours Table

Motor Horsepower	Operating Hours, HRS
1 to 5 HP	2,745
6 to 20 HP	3,391
21 to 50 HP	4,067
51 to 100 HP	5,329
101 to 200 HP	5,200

Montclair Board of Education
Exhibit D
ECM 2G Premium Efficiency Motors and VFDs
Variable Frequency Drives and Motor Replacements

Montclair Board of Education
Exhibit D
ECM 2H Piping Insulation
Piping Insulation

ECM DESCRIPTION

Insulate bare hot water, steam and condensate piping located in boiler rooms and in transition areas. Repair damaged insulation on piping.
Insulate condensate storage tanks where applicable. Insulate steam heat exchangers where applicable.

DATA / ASSUMPTIONS

Run Hours	Varies by building
* Insulation "k" Factor of New Piping Insulation	0.270 Btu / ft^2 / °F / hr. / inch

*Respective boiler efficiencies are used

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Visual inspection per scope of work from subcontractor.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

The safety factor for this ECM is taken at 0 due to uncertainty of on going steam and hot water piping temperatures incorporated in the savings calculation.

FORMULAE

Detailed energy savings calculations are in the Piping Insulation calculation sheet

* Inputs are in blue

Subcontractor Calculations N * If Yes - Please Refer to tab 'Sub Pipe Insulation' for details

Montclair Board of Education
Exhibit D
ECM 2H Piping Insulation
Piping Insulation

Diameter (in) of Pipe - Input linear feet per diameter

Building	12+	10.00	8.00	6.00	5.00	4.00	3.00	2.50	2.00	1.50	1.00	0.75	0.50	Traps/Fittings/Etc.
Bradford Elementary School						35.0	50.0		75.0	-	180.0			
Bullock Elementary School						-	-	-	-	-	-	-		-
Buzz Aldrin Middle School						27.0	26.0		218.0	-	80.5	75.0		
Edgemont Elementary School						48.0		133.0		80.0	298.0	249.0	-	
Glenfield Middle School						6.0			35.0	64.0	4.0			51
Valley Road Complex			1.0		145.0	96.0	498.5	152.5	149.5	1,343.0	739.0	181.5	37.0	1,056
Montclair High School	2.0	10.0	2.0	5.0		11.0	149.5	56.5	64.0	673.5	81.5	64.0	1.0	592
George Inness Annex (HS-9th), Athletics									168.0	80.0	113.5	102.0		
Nishuane K-2						3.0	42.0		83.0		65.0	27.0		
Northeast Elementary School						13.0		52.0	64.0		77.0	29.0		
Renaissance Middle School						26.0			76.0	45.0	134.0	2.0		
Watchung Elementary School						12.0	9.0			69.0	158.0	55.0		
Woodman Field								15.5		116.0	5.0	14.5		
Totals	2.0	10.0	3.0	5.0	145.0	277.0	775.0	409.5	932.5	2,470.5	1,935.5	799.0	38.0	1,699

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Total Linear Feet of Insulation	340.0	-	426.5	808.0	109.0	3,306.0	1,119.0	463.5	220.0	235.0	283.0	303.0	151.0
Losses from Bare Pipe	67,235	-	82,794	130,189	21,525	676,050	226,916	75,363	42,673	44,635	51,313	45,419	26,531
Losses from Insulated Pipe	29,754	-	37,776	63,758	9,451	291,178	96,921	37,364	19,362	20,446	23,692	22,886	12,133
Boiler Efficiency	72.5%	82.0%	69.4%	72.5%	91.0%	69.6%	69.6%	64.8%	64.8%	64.8%	72.5%	73.5%	70.6%
Thermal Savings (Therms/hr)	0.52	-	0.65	0.92	0.13	5.53	1.87	0.59	0.36	0.37	0.38	0.31	0.20
Safety Factor	0%	0%	0%	15%	0%	0%	0%	35%	0%	20%	0%	0%	0%
Thermal Savings	2,040	-	2,562	3,074	524	21,828	7,373	1,506	1,421	1,180	1,504	1,210	805
	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5
Nominal Pipe Size (inches)	12.00	10.00	8.00	6.00	5.00	4.00	3.00	2.50	2.00	1.50	1.00	0.75	0.50
Contact Temperature of Bare Pipe (baseline)	200	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Thickness of Insulation (inches)	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5
Insulation "k" Factor	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
Pipe Length	1	1	1	1	1	1	1	1	1	1	1	1	1
Hours of Operation	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948	3,948
Temperature of Environment	70	70	70	70	70	70	70	70	70	70	70	70	70
Contact Temperature of Floor	60	60	60	60	60	60	60	60	60	60	60	60	60
Contact Temperature of Ceiling	90	90	90	90	90	90	90	90	90	90	90	90	90
Contact Temperature of walls	75	75	75	75	75	75	75	75	75	75	75	75	75
Initial Insulation Fim Coefficient Estimate	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Emissivity of Bare Pipe	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Emissivity of Insulated Pipe	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Outside Diameter of Bare Pipe (inches)	12.750	10.750	8.625	6.625	5.563	4.500	3.500	2.875	2.375	1.900	1.315	1.050	0.840
Outside Diameter of Insulated Pipe (inches)	17.750	15.750	13.625	11.625	10.563	8.500	7.500	6.875	6.375	4.900	4.315	4.050	3.840
Characteristic Length of Bare Pipe (feet)	1.063	0.896	0.719	0.552	0.464	0.375	0.292	0.240	0.198	0.158	0.110	0.088	0.070
Characteristic Length of Insulated Pipe (feet)	1.479	1.313	1.135	0.969	0.880	0.708	0.625	0.573	0.531	0.408	0.360	0.338	0.320
Average Film Temp. For Bare Pipe (deg. F)	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
Average Film Temp. For Insulated Pipe (deg. F)	109	108	107	106	105	108	107	106	105	108	106	105	104
Film Coefficient for Bare Pipe (BTU/hr.F.sqft)	0.898	0.937	0.990	1.058	1.105	1.165	1.241	1.303	1.367	1.445	1.585	1.676	1.772
Film Coefficient for Insulated Pipe (BTU/hr.F.sqft)	0.61	0.63	0.65	0.67	0.68	0.73	0.75	0.76	0.77	0.84	0.85	0.86	0.87
Convective Losses for Bare Pipe (BTU/hr.)	389.82	343.00	290.77	238.57	209.27	178.50	147.84	127.56	110.53	93.50	70.95	59.93	50.69
Convective Losses for Insulated Pipe (BTU/hr.)	185.07	168.37	150.02	132.05	122.16	105.56	95.30	88.67	83.21	69.94	62.78	59.38	56.59
Radiant Losses for Bare Pipe (BTU/hr.)	555	468	376	288	242	196	152	125	103	83	57	46	37
Radiant Losses for Insulated Pipe (BTU/hr.)	35	31	27	23	21	17	15	13	12	10	8	8	7
Total Losses for Bare Pipe (BTU/hr.)	945	811	666	527	451	374	300	253	214	176	128	106	87
Total Losses for Insulated Pipe (BTU/hr.)	220	199	177	155	143	122	110	102	96	79	71	67	64
Savings (BTU/hr.) With Boiler Eff. =	**725**	**612**	**490**	**372**	**309**	**252**	**190**	**151**	**118**	**97**	**57**	**38**	**23**
Savings (MMBTU)	**2.58**	**2.17**	**1.74**	**1.32**	**1.10**	**0.90**	**0.68**	**0.54**	**0.42**	**0.34**	**0.20**	**0.14**	**0.08**

Montclair Board of Education
Exhibit D
ECM 2H Piping Insulation
Piping Insulation

SURFACE TEMPERATURE CALCULATION 12.0 inch pipe			
		First Iteration Heat Loss	400
		First Iteration Insulation Surface Temp.	122
		First Iteration Film Coefficient	0.689
		Second Iteration Heat Loss	256
NPS Pipe Size (inches)	12.00	Second Iteration Insulation Surface Temp.	150
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.732
Initial Film Coefficient	1.65	Third Iteration Heat Loss	266
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	148
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.728
Environment Temperature	70	Fourth Iteration Heat Loss	265
External Pipe Diameter	12.75	Fourth Iteration Insulation Surface Temp.	148
Insulation Surface Temp	**148**	Fourth Iteration Film Coefficient	0.728

SURFACE TEMPERATURE CALCULATION 10.0 inch pipe			
		First Iteration Heat Loss	349
		First Iteration Insulation Surface Temp.	121
		First Iteration Film Coefficient	0.686
		Second Iteration Heat Loss	225
NPS Pipe Size (inches)	10.00	Second Iteration Insulation Surface Temp.	149
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.753
Initial Film Coefficient	1.65	Third Iteration Heat Loss	238
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	147
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.746
Environment Temperature	70	Fourth Iteration Heat Loss	236
External Pipe Diameter	10.75	Fourth Iteration Insulation Surface Temp.	147
Insulation Surface Temp	**147**	Fourth Iteration Film Coefficient	0.747

SURFACE TEMPERATURE CALCULATION 8.0 inch pipe			
		First Iteration Heat Loss	296
		First Iteration Insulation Surface Temp.	120
		First Iteration Film Coefficient	0.683
		Second Iteration Heat Loss	191
NPS Pipe Size (inches)	8.00	Second Iteration Insulation Surface Temp.	148
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.779
Initial Film Coefficient	1.65	Third Iteration Heat Loss	207
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	144
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.768
Environment Temperature	70	Fourth Iteration Heat Loss	205
External Pipe Diameter	8.625	Fourth Iteration Insulation Surface Temp.	145
Insulation Surface Temp	**145**	Fourth Iteration Film Coefficient	0.769

SURFACE TEMPERATURE CALCULATION 6.0 inch pipe			
		First Iteration Heat Loss	245
		First Iteration Insulation Surface Temp.	119
		First Iteration Film Coefficient	0.678
		Second Iteration Heat Loss	159
NPS Pipe Size (inches)	6.00	Second Iteration Insulation Surface Temp.	147
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.807
Initial Film Coefficient	1.65	Third Iteration Heat Loss	176
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	142
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.792
Environment Temperature	70	Fourth Iteration Heat Loss	174
External Pipe Diameter	6.625	Fourth Iteration Insulation Surface Temp.	142
Insulation Surface Temp	**142**	Fourth Iteration Film Coefficient	0.794

SURFACE TEMPERATURE CALCULATION 5.0 inch pipe			
		First Iteration Heat Loss	218
		First Iteration Insulation Surface Temp.	118
		First Iteration Film Coefficient	0.674
		Second Iteration Heat Loss	142
NPS Pipe Size (inches)	5.00	Second Iteration Insulation Surface Temp.	146
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.824
Initial Film Coefficient	1.65	Third Iteration Heat Loss	159
Insulation Thickness (inches)	2.5	Third Iteration Insulation Surface Temp.	140
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.806
Environment Temperature	70	Fourth Iteration Heat Loss	157
External Pipe Diameter	5.563	Fourth Iteration Insulation Surface Temp.	141
Insulation Surface Temp	**141**	Fourth Iteration Film Coefficient	0.808

SURFACE TEMPERATURE CALCULATION 3.0 inch pipe			
		First Iteration Heat Loss	172
		First Iteration Insulation Surface Temp.	123
		First Iteration Film Coefficient	0.692
		Second Iteration Heat Loss	110
NPS Pipe Size (inches)	3.00	Second Iteration Insulation Surface Temp.	151
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	0.910
Initial Film Coefficient	1.65	Third Iteration Heat Loss	129
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	142
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.885
Environment Temperatur	70	Fourth Iteration Heat Loss	127
External Pipe Diameter	3.5	Fourth Iteration Insulation Surface Temp.	143
Insulation Surface Te	**143**	Fourth Iteration Film Coefficient	0.888

SURFACE TEMPERATURE CALCULATION 2.5 inch pipe			
		First Iteration Heat Loss	153
		First Iteration Insulation Surface Temp.	121
		First Iteration Film Coefficient	0.687
		Second Iteration Heat Loss	98
NPS Pipe Size (inches)	2.50	Second Iteration Insulation Surface Temp.	149
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	0.927
Initial Film Coefficient	1.65	Third Iteration Heat Loss	117
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	140
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.898
Environment Temperatur	70	Fourth Iteration Heat Loss	115
External Pipe Diameter	2.875	Fourth Iteration Insulation Surface Temp.	141
Insulation Surface Te	**141**	Fourth Iteration Film Coefficient	0.901

SURFACE TEMPERATURE CALCULATION 2.0 inch pipe			
		First Iteration Heat Loss	138
		First Iteration Insulation Surface Temp.	120
		First Iteration Film Coefficient	0.682
		Second Iteration Heat Loss	89
NPS Pipe Size (inches)	2.00	Second Iteration Insulation Surface Temp.	148
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	0.940
Initial Film Coefficient	1.65	Third Iteration Heat Loss	107
Insulation Thickness (inch	2.0	Third Iteration Insulation Surface Temp.	138
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.908
Environment Temperatur	70	Fourth Iteration Heat Loss	105
External Pipe Diameter	2.375	Fourth Iteration Insulation Surface Temp.	139
Insulation Surface Te	**139**	Fourth Iteration Film Coefficient	0.912

SURFACE TEMPERATURE CALCULATION 1.5 inch pipe			
		First Iteration Heat Loss	126
		First Iteration Insulation Surface Temp.	130
		First Iteration Film Coefficient	0.712
		Second Iteration Heat Loss	79
NPS Pipe Size (inches)	1.50	Second Iteration Insulation Surface Temp.	156
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	1.029
Initial Film Coefficient	1.65	Third Iteration Heat Loss	99
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	145
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.993
Environment Temperatur	70	Fourth Iteration Heat Loss	97
External Pipe Diameter	1.9	Fourth Iteration Insulation Surface Temp.	146
Insulation Surface Te	**146**	Fourth Iteration Film Coefficient	0.997

SURFACE TEMPERATURE CALCULATION 1.0 inch pipe			
		First Iteration Heat Loss	105
		First Iteration Insulation Surface Temp.	126
		First Iteration Film Coefficient	0.703
		Second Iteration Heat Loss	66
NPS Pipe Size (inches)	1.00	Second Iteration Insulation Surface Temp.	154
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	1.054
Initial Film Coefficient	1.65	Third Iteration Heat Loss	84
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	141
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	1.012
Environment Temperatur	70	Fourth Iteration Heat Loss	83
External Pipe Diameter	1.315	Fourth Iteration Insulation Surface Temp.	142
Insulation Surface Te	**142**	Fourth Iteration Film Coefficient	1.016

Montclair Board of Education
Exhibit D
ECM 2H Piping Insulation
Piping Insulation

SURFACE TEMPERATURE CALCULATION 4.0 inch pipe		First Iteration Heat Loss	201
		First Iteration Insulation Surface Temp.	125
		First Iteration Film Coefficient	0.697
		Second Iteration Heat Loss	128
NPS Pipe Size (inches)	4.00	Second Iteration Insulation Surface Temp.	152
Bare Pipe Surface Temperature	200	Second Iteration Film Coefficient	0.886
Initial Film Coefficient	1.65	Third Iteration Heat Loss	147
Insulation Thickness (inches)	2.0	Third Iteration Insulation Surface Temp.	145
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	0.865
Environment Temperature	70	Fourth Iteration Heat Loss	145
External Pipe Diameter	4.5	Fourth Iteration Insulation Surface Temp.	145
Insulation Surface Temp	**145**	Fourth Iteration Film Coefficient	0.868

SURFACE TEMPERATURE CALCULATION 0.8 inch pipe		First Iteration Heat Loss	95
		First Iteration Insulation Surface Temp.	124
		First Iteration Film Coefficient	0.696
		Second Iteration Heat Loss	60
NPS Pipe Size (inches)	0.75	Second Iteration Insulation Surface Temp.	152
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	1.066
Initial Film Coefficient	1.65	Third Iteration Heat Loss	77
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	138
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	1.019
Environment Temperatur	70	Fourth Iteration Heat Loss	76
External Pipe Diameter	1.05	Fourth Iteration Insulation Surface Temp.	140
Insulation Surface Te	**140**	Fourth Iteration Film Coefficient	1.024

SURFACE TEMPERATURE CALCULATION 0.5 inch pipe		First Iteration Heat Loss	**87**
		First Iteration Insulation Surface Temp.	**122**
		First Iteration Film Coefficient	**0.690**
		Second Iteration Heat Loss	**56**
NPS Pipe Size (inches)	0.50	Second Iteration Insulation Surface Temp.	**150**
Bare Pipe Surface Temper	200	Second Iteration Film Coefficient	**1.074**
Initial Film Coefficient	1.65	Third Iteration Heat Loss	**71**
Insulation Thickness (inch	1.5	Third Iteration Insulation Surface Temp.	**136**
Insulation "K" Factor	0.270	Third Iteration Film Coefficient	**1.023**
Environment Temperatur	70	Fourth Iteration Heat Loss	**70**
External Pipe Diameter	0.84	Fourth Iteration Insulation Surface Temp.	**138**
Insulation Surface Te	**138**	Fourth Iteration Film Coefficient	**1.030**

SURFACE TEMPERATURE CALCULATION Use this section to find the expected insulation surface temperature if unknown or evaluating project potential		First Iteration Heat Loss	**219**
		First Iteration Insulation S	**104**
		First Iteration Film Coeffic	**0.621**
		Second Iteration Heat Los	**179**
NPS Pipe Size (inches)	10	Second Iteration Insulatio	**145**
Bare Pipe Surface Temperature	325	Second Iteration Film Coe	**0.754**
Initial Film Coefficient	1.65	Third Iteration Heat Loss	**189**
Insulation Thickness (inches)	2	Third Iteration Insulation	**135**
Insulation "K" Factor	0.05	Third Iteration Film Coeffi	**0.728**
Environment Temperature	70	Fourth Iteration Heat Loss	**187**
External Pipe Diameter	10.75	Fourth Iteration Insulatio	**137**
Insulation Surface Temp	**137**	Fourth Iteration Film Coef	**0.732**

This spreadsheet calculates insulation performance and bare pipe thermal losses for schedule 40 steel horizontal pipes. The calculation computes natural convective and radiant losses based on actual conditions using the Stephan-Boltzmann, radial heat flow and Nusselt equations. This calculation does not depend on insulation "k" factors but rather actual measured temperature data.

To use this spreadsheet, simply fill in all the blue cells. The tan cells contain fixed data or calculations and should not normally require change. All temperatures are in degrees F. If the nominal pipe size (NPS) for an application is greater than 10 inches, or other than listed, use the "OTHER" column. Other parameters will then be calculated automatically. If the insulation temp is known, insert the figures in row 20, (this color) otherwise the program will calculate an estimated value for you.

0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00
0.84	1.05	1.32	1.66	1.90	2.38	2.88	3.50	4.00	4.50	5.56	6.63	8.63	10.75	12.75	14.00

Montclair Board of Education
Exhibit D
Condensing Unit Replacement Spreadsheet

EXISTING								
Building	Equipment Label	Qty	Replace (Y/N)	Manufacturer	Model No.	Area Served	Tonnage	Existing SEER
George Inness Annex (HS-9th	GIA-CU-1	1	Y	Mitsubishi	PU12EK	Room 602C	1.0	10.9
Glenfield Middle School	GMS-CU-1	1	Y	HEIL	CBA060HA1	Offices	5.0	10.9
Glenfield Middle School	GMS-CU-2,3	2	Y	HEIL	CBA048HA1	Offices	4.0	10.9
Glenfield Middle School	GMS-CU-4	1	Y	HEIL	CBA036HA1	Offices	3.0	10.9
Glenfield Middle School	GMS-CU-5-9	5	N	HEIL	CBA048	Library	4.0	10.9
Montclair High School	MHS-CU-5-8	4	Y	ICP	AD036HD	Computer Lab	3.0	10.9
Montclair High School	MHS-CU-11,12	2	Y	TRANE	2TTA3048A3000AA	Rms 305 & 320	4.0	10.9
Montclair High School	MHS-CU-13,-15	3	Y	TRANE	2TTA3042A3000BA	s 207 & 3rd Floor Classroo	3.5	10.9
Montclair High School	MHS-CU-16-20	1	Y	TRANE	2TTB2018A1000AA	3rd Floor Classroom	1.5	10.9
Montclair High School	MHS-CU-22,23	2	Y	Toshiba	RAV-120AH2U	Food Service	1.0	10.9
Northeast Elementary Schoo	NE-CU-1-3	3	Y	Carrier	38BRC042---521--	Classrooms/Offices	3.5	10.9
Northeast Elementary Schoo	NE-CU-5-8	4	Y	Carrier	38BRC024---311--	Classrooms/Offices	2.0	10.9
Northeast Elementary Schoo	NE-CU-9,10	2	Y	Carrier	38BRC036---521--	Music Room	3.0	10.9
Valley Road Complex	PREK-CU-1	1	N	Carrier	38BRC060---321--	PLC	5.0	10.0
Valley Road Complex	PREK-CU-2	1	N	Carrier	38BRC036---321--	Rooms 14-16	3.0	10.0
Valley Road Complex	HES-CU-1	1	Y	TRANE	TTP018C100A2	208A	1.5	10.0
Bradford Elementary School	BES-CU-1	1	N	AAON	CA-02-3:AA000A0	Kitchen	2.0	10.9
Bradford Elementary School	BES-CU-2	1	N	AAON	CA-08-3:AA000A0	Music Room	8.0	10.9
Bradford Elementary School	BES-CU-3,4	2	N	Mitsubishi	MU-A09WA	IT Room & Copy Room	0.8	10.9
Buzz Aldrin Middle School	BUZ-PTAC-1	1	N	-	-	Various	1.2	10.9
George Inness Annex (HS-9th	GIA-CU-2	1	N	TRANE	2TTA3048	500A	4.0	10.9
Montclair High School	MHS-CU-1,2	2	N	Mitsubishi	PUZ-A24	-	2.0	10.9
Montclair High School	MHS-CU-3	1	N	Fujitsu	ASU24CL	-	2.0	10.9
Montclair High School	MHS-CU-4	1	N	Mitsubishi	PUY-A18	-	1.5	10.9
Montclair High School	MHS-CU-9	1	N	Mitsubishi	PUY-A24	-	2.0	10.9
Montclair High School	MHS-CU-10	1	N	Fujitsu	AOU012	-	1.0	10.9
Montclair High School	MHS-CU-17-21	5	N	TRANE	4TTA3060	-	5.0	10.9
Nishuane K-2	NK-CU-1	1	N	Mitsubishi	PUZ-A18	Server Room / 217	1.5	10.9
Northeast Elementary Schoo	NE-CU-4	1	N	Thermal Zone	TZAA336	-	3.0	10.9
Renaissance Middle School	REM-CU-1	1	N	Fujitsu	AOU18CL	Computer Lab	1.5	10.9
Watchung Elementary Schoo	WES-CU-1-3	3	N	TRANE	-	cher Room, Room 33, Roor	1.5	10.9
Watchung Elementary Schoo	WES-CU-4-6	3	N	TRANE	-	oom 22, Room 21,Room 33	3.0	10.9
Watchung Elementary Schoo	WES-CU-7	1	N	TRANE	-	Cafeteria	3.5	10.9
Watchung Elementary Schoo	WES-CU-8	1	N	TRANE	-	Speech Room	2.0	10.9
Woodman Field	FH-CU-1	1	N	Carrier	38ARD014	Multi-Purpose Bldg	12.5	10.9
Valley Road Complex	HES-CU-2,3	2	N	TRANE	2TTA2042B3000AB	Library unit ventilators	3.5	12.0
Totals		**65**					**109**	

PROPOSED				
Manufacturer	Model No.	Qty	Tonnage	Proposed SEER
Mitsubishi	PUZ-A12NKA7	1	1.0	20.8
TRANE	4TTR7060	1	5.0	17.0
TRANE	4TTR7048	2	4.0	17.0
TRANE	4TTR7036	1	3.0	17.0
TRANE	4TTR7036	4	3.0	17.0
TRANE	4TTA7048	2	4.0	17.0
TRANE	4TTA4042	3	3.5	14.5
TRANE	4TTR6018	1	1.5	16.0
Mitsubishi	PUZ-A12NKA7	2	1.0	20.8
TRANE	4TTA4042	3	3.5	14.5
TRANE	4TTR7024	4	2.0	17.0
TRANE	4TTA7036	2	3.0	17.0
TRANE	4TTR6018	1	1.5	16.0
		27	**36.0**	

EXISTING CONDENSING UNIT SPECIFICATIONS

Building	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Glenfield Middle School	Glenfield Middle School	Glenfield Middle School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Valley Road Complex	Valley Road Complex	Valley Road Complex	Bradford Elementary School	Bradford Elementary School	Bradford Elementary School	Buzz Aldrin Middle School	George Inness Annex (HS-9th), Athletics	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School
Label	GIA-CU-1	GMS-CU-1	GMS-CU-2,3	GMS-CU-4	GMS-CU-5-9	MHS-CU-5-8	MHS-CU-11,12	MHS-CU-13,-15	MHS-CU-16-20	MHS-CU-22,23	NE-CU-1-3	NE-CU-5-8	NE-CU-9,10	PREK-CU-1	PREK-CU-2	HES-CU-1	BES-CU-1	BES-CU-2	BES-CU-3,4	BUZ-PTAC-1	GIA-CU-2	MHS-CU-1,2	MHS-CU-3	MHS-CU-4	MHS-CU-9	MHS-CU-10	MHS-CU-17-21
Area Serving	Room 602C	Offices	Offices	Offices	Library	Computer Lab	Rms 305 & 320	Rm 207 & 3rd Floor Classrooms	3rd Floor Classroom	Food Service	Classrooms/Offices	Classrooms/Offices	Music Room	PLC	Rooms 14-16	208A	Kitchen	Music Room	IT Room & Copy Room	Various	500A	0	0	0	0	0	0
Quantity	1	1	2	1	5	4	2	3	1	2	3	4	2	1	1	1	1	1	2	1	1	2	1	1	1	1	5
Tonnage	1.0	5.0	4.0	3.0	4.0	3.0	4.0	3.5	1.5	1.0	3.5	2.0	3.0	5.0	3.0	1.5	2.0	8.0	0.8	1.2	4.0	2.0	2.0	1.5	2.0	1.0	5.0
Existing EER	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.0	10.0	10.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Total TONS	1	5	8	3	20	12	8	10.5	1.5	2	10.5	8	6	5	3	1.5	2	8	1.5	1.17	4	4	2	1.5	2	1	25

PROPOSED CONDENSING UNIT SPECIFICATIONS

	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Glenfield Middle School	Glenfield Middle School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Valley Road Complex
CU Replacement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Label	GIA-CU-1	GMS-CU-1	GMS-CU-2,3	GMS-CU-4	MHS-CU-5-8	MHS-CU-11,12	MHS-CU-13,-15	MHS-CU-16-20	MHS-CU-22,23	NE-CU-1-3	NE-CU-5-8	NE-CU-9,10	HES-CU-1
Area Serving	Room 602C	Offices	Offices	Offices	Computer Lab	Rms 305 & 320	Rm 207 & 3rd Floor Classrooms	3rd Floor Classroom	Food Service	Classrooms/Offices	Classrooms/Offices	Music Room	208A
Quantity	1	1	2	1	4	2	3	1	2	3	4	2	1
Tonnage	1.0	5.0	4.0	3.0	3.0	4.0	3.5	1.5	1.0	3.5	2.0	3.0	1.5
Proposed EER	20.8	17.0	17.0	17.0	17.0	17.0	14.5	16.0	20.8	14.5	17.0	17.0	16.0
Total TONS	1	5	8	3	12	8	10.5	1.5	2	10.5	8	6	1.5

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

ECM DESCRIPTION

Replace existing low efficiency condensing units in respective buildings with new high efficiency condensing units with an EER of 12+

CLARIFICATIONS, DELETIONS

*Run Hours based on occupancy schedule
*Full Load is estimated at (unless stated otherwise) : 97.5 °F
*Run hours are based on chiller cutoff temperature and bin weather data

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed condensing unit and operating hours.

COMMISSIONING

Start up equipment ensure proper operation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

The safety factor for this ECM is taken at 0 due to some variances on the run hours and the estimated part load efficiencies of the existing chiller.

FORMULAE

OPTIMIZATION

$W_{SAVINGS} = W_C \cdot \eta_{\%}$

REPLACEMENT

$W_{SAVINGS} = W_C - W_C$

$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$
$W_C = (W_{C\text{-}OCC} + W_{C\text{-}UNOCC})$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

$W_{C\text{-}OCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{OCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{OCC} \cdot \eta$
$W_{C\text{-}UNOCC} = \sum_{60}^{105} C \cdot (T_{BIN} - T_{UNOCC}) / (T_{BIN} - T_{DESIGN}) \cdot t_{UNOCC} \cdot \eta$

Variable	Units	Description
$W_{SAVINGS}$	kWh	Electrical Savings
W_C	kWh	Existing condensing unit Consumption
W_C	kWh	Proposed condensing unit Consumption
$\eta_{\%}$	%	Efficiency gain due to condensing unit optimization
$\sum_{60}^{105}$	-	Summation of all bins from 60°F to 105°F
C	Ton	Tonnage of condensing unit
η	-	Existing efficiency of condensing unit (EER)
η	-	Proposed efficiency of condensing unit (EER)
T_{DESIGN}	°F	Design Temperature of condensing unit (Usually 97.5°F)
T_{BIN}	°F	Bin Weather Temperature
T_{OCC}	°F	Temperature of building during occupied hours
T_{UNOCC}	°F	Temperature of building during unoccupied hours
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

* Inputs are in blue
*Checks against baseline are in purple

Building	Label	Tonnage	Current EER	Proposed EER	Area Serving
George Inness Annex (HS-9th), Athletics	GIA-CU-1	1.0	10.9	20.8	Room 602C
Glenfield Middle School	GMS-CU-1	5.0	10.9	17.0	Offices
Glenfield Middle School	GMS-CU-2,3	8.0	10.9	17.0	Offices
Glenfield Middle School	GMS-CU-4	3.0	10.9	17.0	Offices
Montclair High School	MHS-CU-5-8	12.0	10.9	17.0	Computer Lab
Montclair High School	MHS-CU-11,12	8.0	10.9	17.0	Rms 305 & 320
Montclair High School	MHS-CU-13,-15	10.5	10.9	14.5	207 & 3rd Floor Classrooms
Montclair High School	MHS-CU-16-20	1.5	10.9	16.0	3rd Floor Classroom
Montclair High School	MHS-CU-22,23	2.0	10.9	20.8	Food Service
Northeast Elementary School	NE-CU-1-3	10.5	10.9	14.5	Classrooms/Offices
Northeast Elementary School	NE-CU-5-8	8.0	10.9	17.0	Classrooms/Offices
Northeast Elementary School	NE-CU-9,10	6.0	10.9	17.0	Music Room
Valley Road Complex	HES-CU-1	1.5	10.0	16.0	208A
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Totals		**77.0**			

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement
CALCULATIONS

	George Inness Annex (HS-9th), Athletics	Glenfield Middle School	Glenfield Middle School	Glenfield Middle School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Montclair High School	Northeast Elementary School	Northeast Elementary School	Northeast Elementary School	Valley Road Complex
Label	GIA-CU-1	GMS-CU-1	GMS-CU-2,3	GMS-CU-4	MHS-CU-5-8	MHS-CU-11,12	MHS-CU-13,-15	MHS-CU-16-20	MHS-CU-22,23	NE-CU-1-3	NE-CU-5-8	NE-CU-9,10	HES-CU-1
Area Serving	Room 602C	Offices	Offices	Offices	Computer Lab	Rms 305 & 320	207 & 3rd Floor Classroo	3rd Floor Classroom	Food Service	Classrooms/Offices	Classrooms/Offices	Music Room	208A
Condensing Unit Total Tonnage	1.0	5.0	8.0	3.0	12.0	8.0	10.5	1.5	2.0	10.5	8.0	6.0	1.5
Current EER	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.0
Proposed EER	20.8	17.0	17.0	17.0	17.0	17.0	14.5	16.0	20.8	14.5	17.0	17.0	16.0
Existing Occupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Existing Unoccupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Current Condensing Unit Consumption	635	3,174	5,079	1,905	7,618	5,079	6,666	952	1,270	6,666	5,079	3,809	1,038
Percent of Baseline Consumption	0.1%	0.4%	0.6%	0.2%	0.8%	0.5%	0.7%	0.1%	0.1%	2.5%	1.9%	1.4%	0.2%
Proposed Condensing Unit Consumption	333	2,035	3,256	1,221	4,885	3,256	5,011	649	665	5,011	3,256	2,442	649
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	418	506	1,435	304	5,874	3,721	3,340	314	836	1,089	1,214	910	102
						NJ BPU Protocol Calculations							
Peak Demand Savings	**0.17**	**0.54**	**1.54**	**0.33**	**2.43**	**1.54**	**1.38**	**0.13**	**0.35**	**1.38**	**1.54**	**1.16**	**0.13**
Energy Savings (kWh/Yr)	**418**	**506**	**1,435**	**304**	**5,874**	**3,721**	**3,340**	**314**	**836**	**1,089**	**1,214**	**910**	**102**
N	1	1	2	1	4	2	3	1	2	3	4	2	1
Tons	1.0	5.0	4.0	3.0	3.0	4.0	3.5	1.5	1.0	3.5	2.0	3.0	1.5
kBtu/Ton	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
EERb	13.0	13.0	11.0	13.0	10.8	11.0	11.0	13.0	13.0	11.0	11.0	11.0	13.0
EERq	20.8	17.0	17.0	17.0	17.0	17.0	14.5	16.0	20.8	14.5	17.0	17.0	16.0
EFLHc	1,208	466	466	466	1,208	1,208	1,208	1,208	1,208	394	394	394	394
CF	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	1.0	1.0	1	0	1	1	1
95 to 100	97.5	-	19	2	21	12	9	1.0	1.0	12	9	23	12	11
90 to 95	92.5	-	44	13	57	28	30	1.0	1.0	28	30	63	33	30
85 to 90	87.5	1	167	60	228	105	123	0.6	0.6	64	75	153	80	73
80 to 85	82.5	31	283	162	476	182	294	0.4	0.4	75	121	216	113	103
75 to 80	77.5	191	235	280	706	181	525	0.2	0.2	39	113	168	88	80
70 to 75	72.5	203	177	222	602	147	455	0.0	0.0	3	9	13	7	6
65 to 70	67.5	325	165	204	694	161	533	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	127	400	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	943	2,369	3.3	3.3	220	357	635	333	303

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	5.0	5.0	3	2	6	4	2
95 to 100	97.5	-	19	2	21	12	9	5.0	5.0	59	46	116	74	41
90 to 95	92.5	-	44	13	57	28	30	5.0	5.0	138	148	314	201	113
85 to 90	87.5	1	167	60	228	104	124	3.0	3.0	317	375	763	489	274
80 to 85	82.5	31	283	162	476	180	296	2.1	2.1	370	610	1,079	692	387
75 to 80	77.5	191	235	280	706	164	542	1.1	1.1	177	585	838	537	301
70 to 75	72.5	203	177	222	602	129	473	0.1	0.1	13	46	65	42	23
65 to 70	67.5	325	165	204	694	132	562	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	859	2,452	16.3	16.3	1,074	1,810	3,174	2,035	1,141

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	8.0	8.0	5	3	9	6	3
95 to 100	97.5	-	19	2	21	12	9	8.0	8.0	95	73	185	119	66
90 to 95	92.5	-	44	13	57	28	30	8.0	8.0	220	236	502	322	180
85 to 90	87.5	1	167	60	228	104	124	4.9	4.9	508	601	1,221	783	438
80 to 85	82.5	31	283	162	476	180	296	3.3	3.3	592	976	1,726	1,107	619
75 to 80	77.5	191	235	280	706	164	542	1.7	1.7	283	935	1,341	860	481
70 to 75	72.5	203	177	222	602	129	473	0.2	0.2	20	74	104	67	37
65 to 70	67.5	325	165	204	694	132	562	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	859	2,452	26.0	26.0	1,718	2,896	5,079	3,256	1,826

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	3.0	3.0	2	1	3	2	1
95 to 100	97.5	-	19	2	21	12	9	3.0	3.0	36	27	69	44	25
90 to 95	92.5	-	44	13	57	28	30	3.0	3.0	83	89	188	121	68
85 to 90	87.5	1	167	60	228	104	124	1.8	1.8	190	225	458	293	164
80 to 85	82.5	31	283	162	476	180	296	1.2	1.2	222	366	647	415	232
75 to 80	77.5	191	235	280	706	164	542	0.6	0.6	106	351	503	322	180
70 to 75	72.5	203	177	222	602	129	473	0.1	0.1	8	28	39	25	14
65 to 70	67.5	325	165	204	694	132	562	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	859	2,452	9.8	9.8	644	1,086	1,905	1,221	685

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	12.0	12.0	9	3	13	8	5
95 to 100	97.5	-	19	2	21	14	7	12.0	12.0	163	89	277	178	100
90 to 95	92.5	-	44	13	57	31	26	12.0	12.0	377	307	753	483	270
85 to 90	87.5	1	167	60	228	119	109	7.3	7.3	871	792	1,831	1,174	657
80 to 85	82.5	31	283	162	476	208	268	4.9	4.9	1,026	1,326	2,589	1,660	929
75 to 80	77.5	191	235	280	706	202	504	2.6	2.6	523	1,305	2,012	1,290	722
70 to 75	72.5	203	177	222	602	163	439	0.2	0.2	38	103	156	100	56
65 to 70	67.5	325	165	204	694	176	518	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	141	386	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,053	2,258	39.1	39.1	2,999	3,921	7,618	4,885	2,738

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	8.0	8.0	6	2	9	6	3
95 to 100	97.5	-	19	2	21	14	7	8.0	8.0	109	59	185	119	66
90 to 95	92.5	-	44	13	57	31	26	8.0	8.0	251	205	502	322	180
85 to 90	87.5	1	167	60	228	119	109	4.9	4.9	581	528	1,221	783	438
80 to 85	82.5	31	283	162	476	208	268	3.3	3.3	684	884	1,726	1,107	619
75 to 80	77.5	191	235	280	706	202	504	1.7	1.7	348	870	1,341	860	481
70 to 75	72.5	203	177	222	602	163	439	0.2	0.2	26	69	104	67	37
65 to 70	67.5	325	165	204	694	176	518	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	141	386	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,053	2,258	26.0	26.0	1,999	2,614	5,079	3,256	1,826

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	10.5	10.5	8	3	12	9	3
95 to 100	97.5	-	19	2	21	14	7	10.5	10.5	143	78	243	182	60
90 to 95	92.5	-	44	13	57	31	26	10.5	10.5	330	269	659	495	164
85 to 90	87.5	1	167	60	228	119	109	6.4	6.4	762	693	1,602	1,204	398
80 to 85	82.5	31	283	162	476	208	268	4.3	4.3	898	1,160	2,266	1,703	563
75 to 80	77.5	191	235	280	706	202	504	2.3	2.3	457	1,141	1,760	1,323	437
70 to 75	72.5	203	177	222	602	163	439	0.2	0.2	33	90	136	103	34
65 to 70	67.5	325	165	204	694	176	518	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	141	386	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,053	2,258	34.2	34.2	2,624	3,431	6,666	5,011	1,658

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	1.5	1.5	1	0	2	1	1
95 to 100	97.5	-	19	2	21	14	7	1.5	1.5	20	11	35	24	11
90 to 95	92.5	-	44	13	57	31	26	1.5	1.5	47	38	94	64	30
85 to 90	87.5	1	167	60	228	119	109	0.9	0.9	109	99	229	156	73
80 to 85	82.5	31	283	162	476	208	268	0.6	0.6	128	166	324	221	103
75 to 80	77.5	191	235	280	706	202	504	0.3	0.3	65	163	251	171	80
70 to 75	72.5	203	177	222	602	163	439	0.0	0.0	5	13	19	13	6
65 to 70	67.5	325	165	204	694	176	518	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	141	386	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,053	2,258	4.9	4.9	375	490	952	649	304

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	2.0	2.0	1	1	2	1	1
95 to 100	97.5	-	19	2	21	14	7	2.0	2.0	27	15	46	24	22
90 to 95	92.5	-	44	13	57	31	26	2.0	2.0	63	51	126	66	60
85 to 90	87.5	1	167	60	228	119	109	1.2	1.2	145	132	305	160	145
80 to 85	82.5	31	283	162	476	208	268	0.8	0.8	171	221	432	226	205
75 to 80	77.5	191	235	280	706	202	504	0.4	0.4	87	217	335	176	160
70 to 75	72.5	203	177	222	602	163	439	0.0	0.0	6	17	26	14	12
65 to 70	67.5	325	165	204	694	176	518	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	141	386	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,053	2,258	6.5	6.5	500	654	1,270	665	605

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	10.5	10.5	8	3	12	9	3
95 to 100	97.5	-	19	2	21	14	7	10.5	10.5	146	74	243	182	60
90 to 95	92.5	-	44	13	57	34	23	10.5	10.5	354	244	659	495	164
85 to 90	87.5	1	167	60	228	130	98	6.4	6.4	830	625	1,602	1,204	398
80 to 85	82.5	31	283	162	476	234	242	4.3	4.3	1,011	1,047	2,266	1,703	563
75 to 80	77.5	191	235	280	706	235	471	2.3	2.3	532	1,067	1,760	1,323	437
70 to 75	72.5	203	177	222	602	184	418	0.2	0.2	38	86	136	103	34
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	34.2	34.2	2,912	3,143	6,666	5,011	1,658

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	8.0	8.0	6	2	9	6	3
95 to 100	97.5	-	19	2	21	14	7	8.0	8.0	111	57	185	119	66
90 to 95	92.5	-	44	13	57	34	23	8.0	8.0	270	186	502	322	180
85 to 90	87.5	1	167	60	228	130	98	4.9	4.9	633	476	1,221	783	438
80 to 85	82.5	31	283	162	476	234	242	3.3	3.3	770	798	1,726	1,107	619
75 to 80	77.5	191	235	280	706	235	471	1.7	1.7	405	813	1,341	860	481
70 to 75	72.5	203	177	222	602	184	418	0.2	0.2	29	66	104	67	37
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	26.0	26.0	2,219	2,395	5,079	3,256	1,826

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	6.0	6.0	4	2	7	4	2
95 to 100	97.5	-	19	2	21	14	7	6.0	6.0	84	42	139	89	50
90 to 95	92.5	-	44	13	57	34	23	6.0	6.0	203	140	377	241	135
85 to 90	87.5	1	167	60	228	130	98	3.6	3.6	474	357	915	587	328
80 to 85	82.5	31	283	162	476	234	242	2.5	2.5	578	598	1,295	830	465
75 to 80	77.5	191	235	280	706	235	471	1.3	1.3	304	610	1,006	645	361
70 to 75	72.5	203	177	222	602	184	418	0.1	0.1	22	49	78	50	28
65 to 70	67.5	325	165	204	694	183	511	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	159	368	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	1,173	2,138	19.5	19.5	1,664	1,796	3,809	2,442	1,369

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occupied Tons	Unoccupied Tons	Occupied Ton-Hrs	Unoccupied Ton-Hrs	Current Condensing Unit Consumption	Proposed Condensing Unit Consumption	Savings
COOLING												kWh	kWh	kWh
100 to 105	102.5	-	1	-	1	1	0	1.5	1.5	1	1	2	1	1
95 to 100	97.5	-	19	2	21	12	9	1.5	1.5	18	14	38	24	14
90 to 95	92.5	-	44	13	57	28	30	1.5	1.5	41	44	103	64	38
85 to 90	87.5	1	167	60	228	105	123	0.9	0.9	95	113	249	156	94
80 to 85	82.5	31	283	162	476	182	294	0.6	0.6	113	181	353	221	132
75 to 80	77.5	191	235	280	706	181	525	0.3	0.3	59	170	274	171	103
70 to 75	72.5	203	177	222	602	147	455	0.0	0.0	4	13	21	13	8
65 to 70	67.5	325	165	204	694	161	533	-	-	-	-	-	-	-
60 to 65	62.5	180	152	195	527	127	400	-	-	-	-	-	-	-
Total		931	1,242	1,138	3,311	943	2,369	4.9	4.9	330	535	1,038	649	390

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

Electric HVAC Systems

This measure provides energy and demand savings algorithms for C&I Electric HVAC systems. The type of systems included in this measure are: split systems, single package systems, air to air cooled heat pumps, packaged terminal systems (PTAC and PTHP), single package vertical systems (SPVAC and SPVHP), central DX AC systems, water source heat pumps, ground water source heat pumps, and/or ground source heat pumps.

This measure applies to new construction, replacement of failed equipment, or end of useful life. The baseline unit is a code compliant unit with an efficiency as required by ASHRAE Std. 90.1 – 2013, which is the current code adopted by the state of New Jersey.

Algorithms

Air Conditioning Algorithms:

Energy Savings (kWh/yr) = N * Tons * 12 kBtuh/Ton * $(1/EER_b - 1/EER_q) * EFLH_c$

Peak Demand Savings (kW) = N * Tons * 12 kBtuh/Ton * $(1/EER_b - 1/EER_q) * CF$

Heat Pump Algorithms:

Cooling Energy Savings (kWh/yr) = N * Tons * 12 kBtuh/Ton * $(1/EER_b - 1/EER_q) * EFLH_c$

Heating Energy Savings (Btu/yr) = N * Tons * 12 kBtuh/Ton * $((1/(COP_b * 3.412)) - (1/(COP_q * 3.412)) * EFLH_h$

Where $_c$ is for cooling and $_h$ is for heating.

Definition of Variables

N = Number of units

Tons = Rated cooling capacity of unit.This value comes from ARI/AHRI or AHAM rating or manufacturer data.

EER_b = Energy Efficiency Ratio of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER should be used in place of EER.

COP_b = Coefficient of Performance of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

EER_q = Energy Efficiency Ratio of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 (5.4 tons) BtuH, SEER should be used in place of EER.

COP_q = Coefficient of Performance of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 BtuH (5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

CF = Coincidence Factor – This value represents the percentage of the total load which is on during electric system's Peak Window. This value is based on existing measured usage and determined as the average number of operating hours during the peak window period.

$EFLH_{c\ or\ h}$ = Equivalent Full Load Hours – This represents a measure of energy use by season during the on-peak and off-peak periods.

Summary of Inputs

HVAC and Heat Pumps

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

Component	Type	Value	Source
Tons	Variable	Rated Capacity, Tons	Application
EER_b	Variable	See Table below	1
EER_q	Variable	ARI/AHRI or AHAM Values	Application
CF	Fixed	50%	2
$EFLH_{(c\ or\ h)}$	Variable	See Tables below	3

HVAC Baseline Efficiencies Table – New Construction/EUL/RoF

Equipment Type	Baseline = ASHRAE Std. 90.1 – 2013
Unitary HVAC/Split Systems and Single Package, Air Cooled	
<=5.4 tons, split	13 SEER
<=5.4 tons, single	14 SEER
>5.4 to 11.25 tons	11.0 EER, 12.7 IEER
>11.25 to 20 tons	10.8 EER, 12.2 IEER
> 21 to 63 tons	9.8 EER, 11.4 IEER
>63 Tons	9.5 EER, 11.0 IEER
Air Cooled Heat Pump Systems, Split System and Single Package	
<=5.4 tons, split	14 SEER, 8.2 HSPF
<=5.4 tons, single	14 SEER, 8.0 HSPF
>5.4 to 11.25 tons	10.8 EER, 11.0 IEER, 3.3 heating COP
>11.25 to 20 tons	10.4 EER, 11.4 IEER, 3.2 heating COP
>= 21	9.3 EER, 10.4 IEER, 3.2 heating COP
Water Source Heat Pumps (water to air, water loop)	
<=1.4 tons	12.2 EER, 4.3 heating COP
>1.4 to 5.4 tons	13.0 EER, 4.3 heating COP
>5.4 to 11.25 tons	13.0 EER, 4.3 heating COP
Ground Water Source Heat Pumps <=11.25 tons	18.0 EER, 3.7 heating COP
Ground Source Heat Pumps (brine to air, ground loop) <=11.25 tons	14.1 EER, 3.2 heating COP
Package Terminal Air Conditioners[37]	14.0 – (0.300 * Cap/1,000), EER
Package Terminal Heat Pumps	14.0 – (0.300 * Cap/1,000), EER 3.7 – (0.052 * Cap/1,000), heating COP
Single Package Vertical Air Conditioners	
<=5.4 tons	10.0 EER
>5.4 to 11.25 tons	10.0 EER
>11.25 to 20 tons	10.0 EER
Single Package Vertical Heat Pumps	
<=5.4 tons	10.0 EER, 3.0 heating COP
>5.4 to 11.25 tons	10.0 EER, 3.0 heating COP
>11.25 to 20 tons	10.0 EER, 3.0 heating COP

Montclair Board of Education
Exhibit D
ECM 2I Split System Replacement
Condensing Unit Replacement

EFLH Table

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Assembly	603	669
Auto repair	1910	426
Dormitory	465	800
Hospital	3366	1424
Light industrial	714	549
Lodging – Hotel	1077	2918

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Lodging – Motel	619	1233
Office – large	2034	720
Office – small	431	955
Other	681	736
Religious worship	722	279
Restaurant – fast food	813	645
Restaurant – full service	821	574
Retail – big box	191	1279
Retail – Grocery	191	1279
Retail – small	545	882
Retail – large	2101	1068
School – Community college	1431	846
School – postsecondary	1191	1208
School – primary	840	394
School – secondary	901	466
Warehouse	452	400

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Cooling	507	550	562
Low-rise, Heating	757	723	503
High-rise, Cooling	793	843	954
High-rise, Heating	526	395	219

Montclair Board of Education

Exhibit D

ECM 2J Steam Trap Replacement

Steam Trap Retrofit

ECM DESCRIPTION

Steam trap audit identified that there are steam traps that are not currently working or are partially working. Faulty steam traps will be either replaced or repaired.

DATA / ASSUMPTIONS

* Percentage of failed steam traps based on audit	0.270	Btu / ft^2 / °F / hr. / inch
*Respective boiler efficiencies are used		
Heating Hours	3,948	Hours
* # of traps/SF	0.0022	
Steam Enthalpy (5 psi, 230F)	961	

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Verify function of all steam traps per scope of work

RECOVERY/SAFETY FACTOR

Diversity Factor =	75%	Percentage of "lost" steam from orifice size from a failed trap (i.e. Not all all
Safety Factor (Thermal) =	0%	steam will flow through open orifice)

The safety factor for this ECM is taken at 0 due to exactness of the existing trap losses

FORMULAE

$Q_{savings} = (q_{loss} \cdot 1{,}194/100{,}000) / \eta$

$q_{loss} = \sum^{TRAPS} q_{trap} \cdot st_{fail\%} \cdot t$

$q_{trap} = 10.1 \cdot d^2 \cdot (p + 14.7)$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
$\sum^{TRAPS}$	-	Summation of all steam traps
q_{loss}	lb / yr	Annual steam loss through failed office
q_{trap}	lb / hr	Steam loss through failed office
$st_{fail\%}$	%	Percentage of failed steam traps
t	hrs	Annual heating system run hours
p	psig	Pressure of steam through respective system
d	inches	Orifice Diameter
η	%	Boiler Efficiency

* Inputs are in blue

Building	% of Population Failed	SF	# traps based on SF
Bradford Elementary School	20%	58,129	128
Buzz Aldrin Middle School	20%	58,128	128
Edgemont Elementary School	20%	34,638	76
George Inness Annex (HS-9th),	20%	89,261	196
Valley Road Complex	20%	172,102	379
Montclair High School	20%	262,855	578
Nishuane K-2	20%	87,440	192
Northeast Elementary School	20%	56,549	124
Renaissance Middle School	20%	37,167	82
Watchung Elementary School	20%	52,109	115
Woodman Field	20%	13,184	29

Montclair Board of Education

Exhibit D

ECM 2J Steam Trap Replacement

Steam Trap Retrofit

CALCULATIONS

Hours / Yr	Equipment	Steam Trap Type	% of trap types per SF	Steam Pressure (Psi)	Orifice Diameter (inches)	Failed Loss/hr	Bradford Elementary School Qty	Buzz Aldrin Middle School Qty	Edgemont Elementary School Qty	George Inness Annex (HS-9th), Athletics Qty	Valley Road Complex Qty	Montclair High School Qty	Nishuane K-2 Qty	Northeast Elementary School Qty	Renaissance Middle School Qty	Watchung Elementary School Qty	Woodman Field Qty
3621	Drip	1/2 Thermo.	0.479962721	5.0	0.188	5.3	42	128	13	17	195	4	6	53	24	30	19
3621	Drip	3/4 Thermo.	0.25722274	5.0	0.188	5.3	23	44	51	98	43	0	103	10	17	58	1
3621	Drip	1" Thermo.		5.0	0.250	9.3	0	0	1	0	0	0	0	0	0	0	0
3621	Drip	3/4" F&T	0.063373719	5.0	0.218	7.1	7	21	2	20	25	14	8	8	4	15	5
3621	Drip	1" F&T	0.041006524	5.0	0.218	7.1	4	6	3	3	27	4	22	3	4	4	0
3621	Drip	1-1/4" F&T	0.029822926	5.0	0.218	7.1	3	5	2	0	4	1	4	1	2	3	0
3621	Drip	1-1/2" F&T	0.000931966	5.0	0.218	7.1	1	1	1	2	0	4	1	3	0	0	0
3621	Drip	2" F&T	0.003727866	5.0	0.312	14.5	0	0	0	1	1	3	0	0	0	0	0
3621	Conrol Vlv	Thermo.	0.123951538	5.0	0.250	9.3	0	0	0	0	0	0	0	0	0	0	0
3621		Vac Breaker		5.0	0.188	5.3	0	8	0	8	0	2	0	0	0	0	0
3621						0.0	0	0	0	0	0	0	0	0	0	0	0
3621						0.0	0	0	0	0	0	0	0	0	0	0	0
						Total Traps	80	213	73	149	295	32	144	78	51	110	25
						% of Population Failed	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
						Failed Strem Traps	16	43	15	30	59	7	29	16	11	22	5
						Steam Loss	325,316	857,022	292,299	608,735	1,207,209	172,605	596,099	317,677	207,965	449,120	102,073
						Safety Factor	0%	0%	0%	25%	0%	0%	0%	25%	0%	0%	90%
						Annual Steam Losses	3,126	8,236	2,809	4,387	11,601	1,659	5,729	2,290	1,999	4,316	98
						Boiler Efficency	72.5%	69.4%	72.5%	64.8%	69.6%	69.6%	64.8%	64.8%	72.5%	73.5%	70.6%
						Annual Heat Input Losses	4,311	11,873	3,873	6,775	16,666	2,383	8,846	3,536	2,756	5,873	139

Montclair Board of Education
Exhibit D
ECM 2K Air Handling Unit Refurbishment
Replace/Refurbished Air Handling Units

ECM DESCRIPTION

Replace and/or refurbish existing air handlers with new units.

DATA / ASSUMPTIONS

Efficiency Gain with refurbishment	2.5%	
Efficiency Gain with replacement	5.0%	
Supply Air Temperature	85.0	°F

*Air Handler Supply CFM and OA CFM is obtained by drawings and equipment manuals
*Air Handler load is assumed to occur at 7.5 degrees F bin average temperature

MEASUREMENT AND VERIFICATION

Option A - Engineering calculations based on comparison of existing operations and post installation operation

COMMISSIONING

Review installation documents for wiring and vibrations. Start up equipment, test thermostat/building management system response, and inspect perimeter of new units for any air infiltration.

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) =	0%

The safety factor for this ECM is taken at 0 due to some variability in schedule and load changes.

FORMULAE

$Q_{SAVINGS} = \sum_{-5}^{60} Q_{INPUT} \cdot \eta_{REFURB/REPLACE}$

$Q_{INPUT} = \sum_{-5}^{60} (t_{OCC} \cdot Q_{LOAD} \cdot L_{\%}) / \eta_{BOILER}$

$Q_{LOAD} = \sum_{-5}^{60} 1.08 \cdot CFM_{SUPPLY} \cdot (T_{SUPPLY} - T_{MIXED})$

$T_{RISE} = \sum_{-5}^{60} T_{SUPPLY} - T_{MIXED}$

$T_{MIXED} = \sum_{-5}^{60} ((CFM_{RETURN} \cdot T_{RETURN}) + (CFM_{OA} \cdot T_{BIN})) / (CFM_{RETURN} + CFM_{OA})$

Montclair Board of Education
Exhibit D
ECM 2K Air Handling Unit Refurbishment
Replace/Refurbished Air Handling Units

Variable	Units	Description
$Q_{SAVINGS}$	Therms	Thermal Savings
$\sum_{-5}^{60}$	-	Summation of all bins from -5°F to 60°F
η_{BOILER}	%	Efficiency of boiler
T_{BIN}	°F	Temperature of respective bin
Q_{INPUT}	Therms	Input heat provided by air handlers at respective bin temperature
Q_{LOAD}	Therms	Heat load on the air handler
$L_{\%}$	%	Load % at respective bin
T_{RISE}	°F	Temperature rise across the coil (100% Design at 10°F)
T_{MIXED}	°F	Mixed air temperature
T_{SUPPLY}	Hrs	Temperature of supply air
T_{RETURN}	Hrs	Temperature of return air
CFM_{SUPPLY}	CFM	Total supply CFM of air handler
CFM_{OA}	CFM	Total outside air CFM of air handler
CFM_{RETURN}	CFM	Total return air CFM of air handler
q	-	Quantity of replaced/refurbished air handlers
η_{REFURB}	**%**	Efficiency improvement of refurbished air handler
$\eta_{REPLACE}$	**%**	Efficiency improvement of replaced air handler
t_{OCC}	Hrs	Occupied Bin Hours in respective temperature bin

*Inputs are blue

Building	Qty (Refurbished)	Qty (Replaced)	Total Supply (CFM)	Total OA (CFM)	
Glenfield Middle School	2	0	5,000	1,500	
Glenfield Middle School	1	0	9,914	2,974	gym AHU
Totals		**0**	**14,914**	**4,474**	

	Glenfield Middle School	Glenfield Middle School
No. of Units to be Refurbished	2	1
No. of Units to be Replaced	-	-
Total Supply Air CFM	5,000	9,914
Total Outdoor Air CFM	1,500	2,974
Total Return Air CFM	3,500	6,940
Efficiency Gain w/ Refurbished and Replaced Units	2.5%	2.5%
Return Air Temperature	**70.0**	**70.0**
Supply Air Temperature	**85.0**	**85.0**
Boiler Efficiency	91.0%	91.0%
Annual Energy Savings	24	47
Safety Factor	**0%**	**0%**
Annual Energy Savings	24	47

Montclair Board of Education
Exhibit D
ECM 2K Air Handling Unit Refurbishment
Replace/Refurbished Air Handling Units

CALCULATIONS

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin deg. F	Avg Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Mixed air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp	Heat Provided by Units	Input Heat to Units	Heat Savings by Refurb/Replace
HEATING											BTU	BTU	Therms
55 to 60	57.5	86	144	97	327	98	66.3	18.8	101,250	56%	5,494,420	6,037,824	1.5
50 to 55	52.5	109	182	172	463	123	64.8	20.3	109,350	60%	8,101,663	8,902,927	2.2
45 to 50	47.5	105	119	142	366	84	63.3	21.8	117,450	64%	6,339,038	6,965,975	1.7
40 to 45	42.5	185	155	177	517	113	61.8	23.3	125,550	69%	9,807,348	10,777,306	2.7
35 to 40	37.5	236	200	241	677	146	60.3	24.8	133,650	73%	14,316,461	15,732,374	3.9
30 to 35	32.5	237	202	198	637	147	58.8	26.3	141,750	78%	16,252,031	17,859,375	4.5
25 to 30	27.5	121	115	113	349	83	57.3	27.8	149,850	82%	10,186,827	11,194,315	2.8
20 to 25	22.5	149	68	97	314	56	55.8	29.3	157,950	87%	7,638,951	8,394,452	2.1
15 to 20	17.5	95	40	46	181	33	54.3	30.8	166,050	91%	5,065,513	5,566,498	1.4
10 to 15	12.5	39	9	28	76	9	52.8	32.3	174,150	96%	1,515,520	1,665,406	0.4
5 to 10	7.5	21	5	5	31	5	51.3	33.8	182,250	100%	911,250	1,001,374	0.3
0 to 5	2.5	4	2	-	6	2	49.8	35.3	190,350	104%	319,516	351,117	0.1
-5 to 0	-2.5	4	-	-	4	0	48.3	36.8	198,450	109%	77,175	84,808	0.0
-10 to -5	-7.5	-	-	-	-	-	46.8	38.3	206,550	113%	-	-	-
-15 to -10	-12.5	-	-	-	-	-	45.3	39.8	214,650	118%	-	-	-
Total		**1,391**	**1,241**	**1,316**	**3,948**	**900**					**86,025,713**		**24**

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin deg. F	Avg Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Mixed air Temp	Temp rise across coil	Heat Load on the unit	Load % at bin O/A temp	Heat Provided by Units	Input Heat to Units	Heat Savings by Refurb/Replace
HEATING											BTU	BTU	Therms
55 to 60	57.5	86	144	97	327	98	66.3	18.8	200,759	56%	10,894,335	11,971,797	3.0
50 to 55	52.5	109	182	172	463	123	64.8	20.3	216,819	60%	16,063,978	17,652,723	4.4
45 to 50	47.5	105	119	142	366	84	63.3	21.8	232,880	64%	12,569,044	13,812,136	3.5
40 to 45	42.5	185	155	177	517	113	61.8	23.3	248,941	69%	19,446,010	21,369,242	5.3
35 to 40	37.5	236	200	241	677	146	60.3	24.8	265,001	73%	28,386,678	31,194,152	7.8
30 to 35	32.5	237	202	198	637	147	58.8	26.3	281,062	78%	32,224,528	35,411,569	8.9
25 to 30	27.5	121	115	113	349	83	57.3	27.8	297,123	82%	20,198,440	22,196,088	5.5
20 to 25	22.5	149	68	97	314	56	55.8	29.3	313,183	87%	15,146,512	16,644,518	4.2
15 to 20	17.5	95	40	46	181	33	54.3	30.8	329,244	91%	10,043,900	11,037,253	2.8
10 to 15	12.5	39	9	28	76	9	52.8	32.3	345,305	96%	3,004,972	3,302,167	0.8
5 to 10	7.5	21	5	5	31	5	51.3	33.8	361,365	100%	1,806,827	1,985,524	0.5
0 to 5	2.5	4	2	-	6	2	49.8	35.3	377,426	100%	606,577	666,569	0.2
-5 to 0	-2.5	4	-	-	4	0	48.3	36.8	393,487	100%	140,531	154,430	0.0
-10 to -5	-7.5	-	-	-	-	-	46.8	38.3	409,547	100%	-	-	-
-15 to -10	-12.5	-	-	-	-	-	45.3	39.8	425,608	100%	-	-	-
Total		**1,391**	**1,241**	**1,316**	**3,948**	**900**					**170,532,332**		**47**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

ECM DESCRIPTION

The building managament system for the school district will be upgraded. Where the DDC system exists it will be incorporated into a web-based system. The pnaumatic control system in some buildings will be replaced with new DDC controls. The new DDC system will be a web based type that allows remote access to a personnel from any computer using a security password.

DATA / ASSUMPTIONS

Heating Hours	3,948 Hours
Cooling electrical use	5%

*Schedules and temperatures are based on data logging trends performed throughout the building

MEASUREMENT AND VERIFICATION

Option A (Electric) - Direct kW and savings measurements before and after installation conducted. A report is generated showing the reduction in kW
Option C (Fuel) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify functions of all installed controllers. Verify that control loops work properly. Verify function of all alarms installed in the system. Verify that all installed control variables and set points can be set and managed remotely

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of percent is used for this ECM due to the uncertainty of variables. The heating fuel savings calculations are based upon information provided by the equipment vendor.

FORMULAE

$$Q_{SAVINGS} = (HD_{EXISTING} - HD_{PROPOSED} / HD_{EXISTING}) \cdot Fuel_{ADJUSTED}$$

$$HD_{EXISTING} = \sum_{-5}^{60} (T_{OCC} - T_{BIN}) \cdot t_{OCC} + (T_{UNOCC} - T_{BIN}) \cdot t_{UNOCC}$$

$$HD_{PROPOSED} = \sum_{-5}^{60} (T_{OCC} - T_{BIN}) \cdot t_{OCC} + (T_{UNOCC} - T_{BIN}) \cdot t_{UNOCC}$$

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
$\sum_{-5}^{60}$	-	Summation of all bins from -5°F to 60°F
T_{BIN}	°F	Temperature of respective bin
t_{OCC}	Hrs	Existing occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Existing unoccupied Bin Hours in respective temperature bin
t_{OCC}	Hrs	Proposed occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Proposed unoccupied Bin Hours in respective temperature bin
T_{OCC}	°F	Existing temperature of space during occupied hours
T_{UNOCC}	°F	Existing temperature of space during unoccupied hours
T_{OCC}	°F	Proposed temperature of space during occupied hours
T_{UNOCC}	°F	Proposed temperature of space during unoccupied hours
$HD_{EXISTING}$	Hrs	Existing heating degree hours in space
$HD_{PROPOSED}$	Hrs	Proposed heating degree hours in space
$Fuel_{ADJUSTED}$	Therms	Adjusted Boiler Fuel Usage

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

* Inputs for Section 1 and Section 2 are in blue

		EXISTING				PROPOSED			
Building	Percentage of Building	Occupied Heating Temperature (°F)	Unoccupied Heating Temperature (°F)	Occupied Cooling Temperature (°F)	Unoccupied Cooling Temperature (°F)	Occupied Heating Temperature (°F)	Unoccupied Heating Temperature (°F)	Occupied Cooling Temperature (°F)	Unoccupied Cooling Temperature (°F)
Bradford Elementary School	100%	72.0	65.0	72.0	72.0	72.0	60.0	72.0	74.0
Bullock Elementary School	100%	73.0	68.0	72.0	80.0	72.0	60.0	72.0	80.0
Buzz Aldrin Middle School	100%	79.0	66.0	72.0	72.0	72.0	60.0	72.0	72.0
Edgemont Elementary School	100%	81.0	66.0	72.0	72.0	72.0	60.0	72.0	72.0
Glenfield Middle School	100%	76.0	65.0	72.0	72.0	72.0	60.0	72.0	72.0
Valley Road Complex	100%	74.0	66.0	72.0	72.0	72.0	60.0	72.0	72.0
Montclair High School	100%	75.0	66.0	72.0	72.0	72.0	60.0	72.0	74.0
George Inness Annex (HS-9th), At	100%	76.0	64.0	72.0	72.0	72.0	60.0	72.0	74.0
Nishuane K-2	100%	77.0	72.0	72.0	72.0	72.0	60.0	72.0	72.0
Northeast Elementary School	100%	78.0	72.0	72.0	72.0	72.0	60.0	72.0	74.0
Renaissance Middle School	100%	77.0	65.0	72.0	72.0	72.0	60.0	72.0	72.0
Watchung Elementary School	100%	78.0	69.0	72.0	72.0	72.0	60.0	72.0	72.0
Woodman Field	100%	72.0	72.0	72.0	72.0	72.0	60.0	72.0	74.0

THERMAL NIGHT SETBACK SAVINGS CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Occupied Bin Hours	900	1,128	1,128	900	900	1,024	1,135	1,024	1,011	1,246	1,011	1,011	3,784
Occupied HD-hrs	29,352	37,944	44,712	37,451	32,952	35,962	40,860	38,010	37,947	48,211	37,947	38,958	129,191
Annual Fuel Usage	24,536	-	56,597	24,189	39,779	69,998	71,619	42,171	37,325	21,146	18,400	27,343	20,406
Annual Boiler Usage	2,773	(5,240)	14,932	2,971	15,663	2,770	20,652	3,339	6,358	(52)	(408)	5,204	14,535
Existing Heating Degree-Hrs	113,344	124,530	125,659	124,490	116,943	119,185	121,206	115,385	139,734	142,155	119,173	131,933	134,681
Proposed Heating Degree-Hrs	98,103	100,843	98,103	98,103	98,103	99,593	99,593	99,593	99,433	98,103	98,103	98,103	114,266
Safety Factor	0%	100%	0%	0%	0%	0%	0%	20%	0%	20%	10%	0%	0%
Thermal Savings	13.4%	0.0%	21.9%	21.2%	16.1%	16.4%	17.8%	10.9%	28.8%	24.8%	15.9%	25.6%	15.2%
Thermal Savings	4,109	-	14,370	5,198	4,827	14,090	19,145	15,467	9,819	7,133	7,119	6,161	645

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

ELECTRIC NIGHT SETBACK SAVINGS CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Annual kWh Usage	316,377	478,514	620,172	94,680	787,484	657,410	948,990	552,617	221,790	267,450	154,890	219,090	217,120
Annual Cooling kWh Baseline	15,819	23,926	31,009	4,734	39,374	32,871	47,450	27,631	11,090	13,373	7,745	10,955	10,856
Existing Cooling Degree-Hrs	14,451	8,368	14,451	14,451	14,451	14,451	14,451	14,451	14,451	14,451	14,451	14,451	14,451
Proposed Cooling Degree-Hrs	12,212	8,368	14,451	14,451	14,451	14,451	12,261	12,261	14,451	12,212	14,451	14,451	13,467
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	15.5%	0.0%	0.0%	0.0%	0.0%	0.0%	15.2%	15.2%	0.0%	15.5%	0.0%	0.0%	6.8%
Electrical Savings	5,045	-	-	-	-	-	25,518	23,352	-	4,554	-	-	4,866
NJ BPU Protocol Calculations													
Cooling Savings (kWh/yr)	**5,045**	**-**	**-**	**-**	**-**	**-**	**25,518**	**23,352**	**-**	**4,554**	**-**	**-**	**4,866**
Tc (cool setpt)	72	72	72	72	72	72	72	72	72	72	72	72	72
H (weekly hours)	70	70	70	70	70	70	70	70	70	70	70	70	70
Sc	77	77	77	77	77	77	77	77	77	77	77	77	77
Pc	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Caphp (tons)	64.25	-	-	-	-	-	106.00	97.00	-	58.00	-	-	36.50
EFLHc	394	394	466	394	466	394	1,208	1,208	394	394	466	394	669
EERhp	10.0						10.0	10.0		10.0			10.0
Heating Savings (Therms)	**4,109**	**3,321**	**14,370**	**5,198**	**4,827**	**14,090**	**19,145**	**19,333**	**9,819**	**8,916**	**7,910**	**6,161**	**645**
Th	72	72	72	72	72	72	72	72	72	72	72	72	72
H	70	70	70	70	70	70	70	70	70	70	70	70	70
Sh	67	67	67	67	67	67	67	67	67	67	67	67	67
Ph	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Caph (Btu/h)	4,890,000	4,000,000	15,308,000	6,186,000	6,000,000	16,160,000	15,526,000	14,662,000	10,558,000	9,587,000	8,564,000	7,022,000	1,044,000
EFLHh	840	840	901	840	901	840	1,191	1,191	840	840	901	840	603
AFUEh	83.0%	84.0%	79.7%	83.0%	93.0%	80.0%	80.2%	75.0%	75.0%	75.0%	81.0%	79.5%	81.0%

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

BRADFORD ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
BRADFORD E	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	19	11	31	1	0	72.0	74.0	19	11	30
BRADFORD E	95 to 100	97.5	-	19	2	21	12	9	72.0	72.0	303	233	536	12	9	72.0	74.0	303	214	517
BRADFORD E	90 to 95	92.5	-	44	13	57	28	30	72.0	72.0	564	605	1,169	28	30	72.0	74.0	564	546	1,110
BRADFORD E	85 to 90	87.5	1	167	60	228	104	124	72.0	72.0	1,619	1,915	3,534	104	124	72.0	74.0	1,619	1,668	3,287
BRADFORD E	80 to 85	82.5	31	283	162	476	180	296	72.0	72.0	1,886	3,112	4,998	180	296	72.0	74.0	1,886	2,519	4,405
BRADFORD E	75 to 80	77.5	191	235	280	706	164	542	72.0	72.0	902	2,981	3,883	164	542	72.0	74.0	902	1,897	2,799
BRADFORD E	70 to 75	72.5	203	177	222	602	129	473	72.0	72.0	64	237	301	129	473	72.0	74.0	64	-	64
BRADFORD E	65 to 70	67.5	325	165	204	694	132	562	72.0	72.0	-	-	-	132	562	72.0	74.0	-	-	-
BRADFORD E	60 to 65	62.5	180	152	195	527	111	416	72.0	72.0	-	-	-	111	416	72.0	74.0	-	-	-
													14,451							**12,212**
	HEATING																			
BRADFORD E	55 to 60	57.5	86	144	97	327	98	229	72.0	65.0	1,416	1,720	3,136	98	229	72	60	1,416	573	1,990
BRADFORD E	50 to 55	52.5	109	182	172	463	123	340	72.0	65.0	2,408	4,244	6,652	123	340	72	60	2,408	2,546	4,954
BRADFORD E	45 to 50	47.5	105	119	142	366	84	282	72.0	65.0	2,052	4,939	6,991	84	282	72	60	2,052	3,528	5,580
BRADFORD E	40 to 45	42.5	185	155	177	517	113	404	72.0	65.0	3,345	9,081	12,426	113	404	72	60	3,345	7,063	10,408
BRADFORD E	35 to 40	37.5	236	200	241	677	146	531	72.0	65.0	5,039	14,601	19,640	146	531	72	60	5,039	11,946	16,985
BRADFORD E	30 to 35	32.5	237	202	198	637	147	490	72.0	65.0	5,823	15,912	21,734	147	490	72	60	5,823	13,464	19,286
BRADFORD E	25 to 30	27.5	121	115	113	349	83	266	72.0	65.0	3,679	9,987	13,666	83	266	72	60	3,679	8,655	12,335
BRADFORD E	20 to 25	22.5	149	68	97	314	56	258	72.0	65.0	2,762	10,973	13,736	56	258	72	60	2,762	9,682	12,445
BRADFORD E	15 to 20	17.5	95	40	46	181	33	148	72.0	65.0	1,825	7,007	8,832	33	148	72	60	1,825	6,270	8,094
BRADFORD E	10 to 15	12.5	39	9	28	76	9	67	72.0	65.0	542	3,512	4,054	9	67	72	60	542	3,177	3,719
BRADFORD E	5 to 10	7.5	21	5	5	31	5	26	72.0	65.0	323	1,495	1,818	5	26	72	60	323	1,365	1,688
BRADFORD E	0 to 5	2.5	4	2	-	6	2	4	72.0	65.0	112	275	386	2	4	72	60	112	253	364
BRADFORD E	-5 to 0	(2.5)	4	-	-	4	0	4	72.0	65.0	27	246	273	0	4	72	60	27	228	254
BRADFORD E	-10 to -5	(7.5)	-	-	-	-	-	-	72.0	65.0	-	-	-	-	-	72	60	-	-	-
BRADFORD E	-15 to -10	(12.5)	-	-	-	-	-	-	72.0	65.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	900	3,048			29,352	83,991	113,344	900	3,048			29,352	68,751	**98,103**

BULLOCK ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
BULLOCK ELE	100 to 105	102.5	-	1	-	1	1	0	72.0	80.0	22	6	28	1	0	72.0	80.0	22	6	28
BULLOCK ELE	95 to 100	97.5	-	19	2	21	14	7	72.0	80.0	351	127	478	14	7	72.0	80.0	351	127	478
BULLOCK ELE	90 to 95	92.5	-	44	13	57	33	24	72.0	80.0	668	305	973	33	24	72.0	80.0	668	305	973
BULLOCK ELE	85 to 90	87.5	1	167	60	228	125	103	72.0	80.0	1,933	775	2,708	125	103	72.0	80.0	1,933	775	2,708
BULLOCK ELE	80 to 85	82.5	31	283	162	476	219	257	72.0	80.0	2,303	642	2,945	219	257	72.0	80.0	2,303	642	2,945
BULLOCK ELE	75 to 80	77.5	191	235	280	706	210	496	72.0	80.0	1,155	-	1,155	210	496	72.0	80.0	1,155	-	1,155
BULLOCK ELE	70 to 75	72.5	203	177	222	602	164	438	72.0	80.0	82	-	82	164	438	72.0	80.0	82	-	82
BULLOCK ELE	65 to 70	67.5	325	165	204	694	165	529	72.0	80.0	-	-	-	165	529	72.0	80.0	-	-	-
BULLOCK ELE	60 to 65	62.5	180	152	195	527	142	385	72.0	80.0	-	-	-	142	385	72.0	80.0	-	-	-
													8,368							**8,368**
	HEATING																			
BULLOCK ELE	55 to 60	57.5	86	144	97	327	119	208	73.0	68.0	1,848	2,182	4,029	119	208	72	60	1,728	520	2,248
BULLOCK ELE	50 to 55	52.5	109	182	172	463	155	308	73.0	68.0	3,179	4,773	7,952	155	308	72	60	3,024	2,309	5,334
BULLOCK ELE	45 to 50	47.5	105	119	142	366	107	259	73.0	68.0	2,730	5,308	8,038	107	259	72	60	2,623	3,237	5,860
BULLOCK ELE	40 to 45	42.5	185	155	177	517	143	374	73.0	68.0	4,363	9,536	13,899	143	374	72	60	4,220	6,544	10,764
BULLOCK ELE	35 to 40	37.5	236	200	241	677	185	492	73.0	68.0	6,583	14,992	21,576	185	492	72	60	6,398	11,060	17,458
BULLOCK ELE	30 to 35	32.5	237	202	198	637	183	454	73.0	68.0	7,417	16,113	23,529	183	454	72	60	7,233	12,482	19,715
BULLOCK ELE	25 to 30	27.5	121	115	113	349	103	246	73.0	68.0	4,688	9,962	14,650	103	246	72	60	4,585	7,994	12,579
BULLOCK ELE	20 to 25	22.5	149	68	97	314	71	243	73.0	68.0	3,562	11,078	14,640	71	243	72	60	3,492	9,130	12,621
BULLOCK ELE	15 to 20	17.5	95	40	46	181	41	140	73.0	68.0	2,284	7,062	9,346	41	140	72	60	2,243	5,943	8,186
BULLOCK ELE	10 to 15	12.5	39	9	28	76	12	64	73.0	68.0	751	3,529	4,280	12	64	72	60	738	3,020	3,759
BULLOCK ELE	5 to 10	7.5	21	5	5	31	6	25	73.0	68.0	386	1,519	1,905	6	25	72	60	380	1,318	1,698
BULLOCK ELE	0 to 5	2.5	4	2	-	6	2	4	73.0	68.0	126	276	402	2	4	72	60	124	242	366
BULLOCK ELE	-5 to 0	(2.5)	4	-	-	4	0	4	73.0	68.0	27	257	284	0	4	72	60	27	228	254
BULLOCK ELE	-10 to -5	(7.5)	-	-	-	-	-	-	73.0	68.0	-	-	-	-	-	72	60	-	-	-
BULLOCK ELE	-15 to -10	(12.5)	-	-	-	-	-	-	73.0	68.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,128	2,820			37,944	86,586	124,530	1,128	2,820			36,815	64,027	**100,843**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

BUZZ ALDRIN MIDDLE SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
BUZZ ALDRIN	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	72.0	19	11	31
BUZZ ALDRIN	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	351	185	536	12	9	72.0	72.0	303	233	536
BUZZ ALDRIN	90 to 95	92.5	-	44	13	57	33	24	72.0	72.0	668	500	1,169	28	30	72.0	72.0	564	605	1,169
BUZZ ALDRIN	85 to 90	87.5	1	167	60	228	125	103	72.0	72.0	1,933	1,601	3,534	104	124	72.0	72.0	1,619	1,915	3,534
BUZZ ALDRIN	80 to 85	82.5	31	283	162	476	219	257	72.0	72.0	2,303	2,695	4,998	180	296	72.0	72.0	1,886	3,112	4,998
BUZZ ALDRIN	75 to 80	77.5	191	235	280	706	210	496	72.0	72.0	1,155	2,728	3,883	164	542	72.0	72.0	902	2,981	3,883
BUZZ ALDRIN	70 to 75	72.5	203	177	222	602	164	438	72.0	72.0	82	219	301	129	473	72.0	72.0	64	237	301
BUZZ ALDRIN	65 to 70	67.5	325	165	204	694	165	529	72.0	72.0	-	-	-	132	562	72.0	72.0	-	-	-
BUZZ ALDRIN	60 to 65	62.5	180	152	195	527	142	385	72.0	72.0	-	-	-	111	416	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
BUZZ ALDRIN	55 to 60	57.5	86	144	97	327	119	208	79.0	66.0	2,563	1,766	4,329	98	229	72	60	1,416	573	1,990
BUZZ ALDRIN	50 to 55	52.5	109	182	172	463	155	308	79.0	66.0	4,110	4,157	8,267	123	340	72	60	2,408	2,546	4,954
BUZZ ALDRIN	45 to 50	47.5	105	119	142	366	107	259	79.0	66.0	3,372	4,791	8,163	84	282	72	60	2,052	3,528	5,580
BUZZ ALDRIN	40 to 45	42.5	185	155	177	517	143	374	79.0	66.0	5,221	8,788	14,009	113	404	72	60	3,345	7,063	10,408
BUZZ ALDRIN	35 to 40	37.5	236	200	241	677	185	492	79.0	66.0	7,696	14,009	21,705	146	531	72	60	5,039	11,946	16,985
BUZZ ALDRIN	30 to 35	32.5	237	202	198	637	183	454	79.0	66.0	8,515	15,205	23,720	147	490	72	60	5,823	13,464	19,286
BUZZ ALDRIN	25 to 30	27.5	121	115	113	349	103	246	79.0	66.0	5,306	9,470	14,776	83	266	72	60	3,679	8,655	12,335
BUZZ ALDRIN	20 to 25	22.5	149	68	97	314	71	243	79.0	66.0	3,985	10,591	14,576	56	258	72	60	2,762	9,682	12,445
BUZZ ALDRIN	15 to 20	17.5	95	40	46	181	41	140	79.0	66.0	2,531	6,782	9,314	33	148	72	60	1,825	6,270	8,094
BUZZ ALDRIN	10 to 15	12.5	39	9	28	76	12	64	79.0	66.0	825	3,402	4,227	9	67	72	60	542	3,177	3,719
BUZZ ALDRIN	5 to 10	7.5	21	5	5	31	6	25	79.0	66.0	421	1,469	1,890	5	26	72	60	323	1,365	1,688
BUZZ ALDRIN	0 to 5	2.5	4	2	-	6	2	4	79.0	66.0	137	268	404	2	4	72	60	112	253	364
BUZZ ALDRIN	-5 to 0	(2.5)	4	-	-	4	0	4	79.0	66.0	29	250	279	0	4	72	60	27	228	254
BUZZ ALDRIN	-10 to -5	(7.5)	-	-	-	-	-	-	79.0	66.0	-	-	-	-	-	72	60	-	-	-
BUZZ ALDRIN	-15 to -10	(12.5)	-	-	-	-	-	-	79.0	66.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,128	2,820			44,712	80,946	125,659	900	3,048			29,352	68,751	**98,103**

EDGEMONT ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
EDGEMONT	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	19	11	31	1	0	72.0	72.0	19	11	31
EDGEMONT	95 to 100	97.5	-	19	2	21	12	9	72.0	72.0	303	233	536	12	9	72.0	72.0	303	233	536
EDGEMONT	90 to 95	92.5	-	44	13	57	28	30	72.0	72.0	564	605	1,169	28	30	72.0	72.0	564	605	1,169
EDGEMONT	85 to 90	87.5	1	167	60	228	104	124	72.0	72.0	1,619	1,915	3,534	104	124	72.0	72.0	1,619	1,915	3,534
EDGEMONT	80 to 85	82.5	31	283	162	476	180	296	72.0	72.0	1,886	3,112	4,998	180	296	72.0	72.0	1,886	3,112	4,998
EDGEMONT	75 to 80	77.5	191	235	280	706	164	542	72.0	72.0	902	2,981	3,883	164	542	72.0	72.0	902	2,981	3,883
EDGEMONT	70 to 75	72.5	203	177	222	602	129	473	72.0	72.0	64	237	301	129	473	72.0	72.0	64	237	301
EDGEMONT	65 to 70	67.5	325	165	204	694	132	562	72.0	72.0	-	-	-	132	562	72.0	72.0	-	-	-
EDGEMONT	60 to 65	62.5	180	152	195	527	111	416	72.0	72.0	-	-	-	111	416	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
EDGEMONT	55 to 60	57.5	86	144	97	327	98	229	81.0	66.0	2,295	1,949	4,245	98	229	72	60	1,416	573	1,990
EDGEMONT	50 to 55	52.5	109	182	172	463	123	340	81.0	66.0	3,519	4,583	8,103	123	340	72	60	2,408	2,546	4,954
EDGEMONT	45 to 50	47.5	105	119	142	366	84	282	81.0	66.0	2,806	5,222	8,027	84	282	72	60	2,052	3,528	5,580
EDGEMONT	40 to 45	42.5	185	155	177	517	113	404	81.0	66.0	4,366	9,485	13,850	113	404	72	60	3,345	7,063	10,408
EDGEMONT	35 to 40	37.5	236	200	241	677	146	531	81.0	66.0	6,354	15,131	21,486	146	531	72	60	5,039	11,946	16,985
EDGEMONT	30 to 35	32.5	237	202	198	637	147	490	81.0	66.0	7,149	16,401	23,551	147	490	72	60	5,823	13,464	19,286
EDGEMONT	25 to 30	27.5	121	115	113	349	83	266	81.0	66.0	4,423	10,253	14,677	83	266	72	60	3,679	8,655	12,335
EDGEMONT	20 to 25	22.5	149	68	97	314	56	258	81.0	66.0	3,265	11,232	14,496	56	258	72	60	2,762	9,682	12,445
EDGEMONT	15 to 20	17.5	95	40	46	181	33	148	81.0	66.0	2,126	7,155	9,281	33	148	72	60	1,825	6,270	8,094
EDGEMONT	10 to 15	12.5	39	9	28	76	9	67	81.0	66.0	624	3,579	4,203	9	67	72	60	542	3,177	3,719
EDGEMONT	5 to 10	7.5	21	5	5	31	5	26	81.0	66.0	368	1,521	1,889	5	26	72	60	323	1,365	1,688
EDGEMONT	0 to 5	2.5	4	2	-	6	2	4	81.0	66.0	126	279	405	2	4	72	60	112	253	364
EDGEMONT	-5 to 0	(2.5)	4	-	-	4	0	4	81.0	66.0	30	250	279	0	4	72	60	27	228	254
EDGEMONT	-10 to -5	(7.5)	-	-	-	-	-	-	81.0	66.0	-	-	-	-	-	72	60	-	-	-
EDGEMONT	-15 to -10	(12.5)	-	-	-	-	-	-	81.0	66.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	900	3,048			37,451	87,040	124,490	900	3,048			29,352	68,751	**98,103**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

GLENFIELD MIDDLE SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
GLENFIELD M	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	19	11	31	1	0	72.0	72.0	19	11	31
GLENFIELD M	95 to 100	97.5	-	19	2	21	12	9	72.0	72.0	303	233	536	12	9	72.0	72.0	303	233	536
GLENFIELD M	90 to 95	92.5	-	44	13	57	28	30	72.0	72.0	564	605	1,169	28	30	72.0	72.0	564	605	1,169
GLENFIELD M	85 to 90	87.5	1	167	60	228	104	124	72.0	72.0	1,619	1,915	3,534	104	124	72.0	72.0	1,619	1,915	3,534
GLENFIELD M	80 to 85	82.5	31	283	162	476	180	296	72.0	72.0	1,886	3,112	4,998	180	296	72.0	72.0	1,886	3,112	4,998
GLENFIELD M	75 to 80	77.5	191	235	280	706	164	542	72.0	72.0	902	2,981	3,883	164	542	72.0	72.0	902	2,981	3,883
GLENFIELD M	70 to 75	72.5	203	177	222	602	129	473	72.0	72.0	64	237	301	129	473	72.0	72.0	64	237	301
GLENFIELD M	65 to 70	67.5	325	165	204	694	132	562	72.0	72.0	-	-	-	132	562	72.0	72.0	-	-	-
GLENFIELD M	60 to 65	62.5	180	152	195	527	111	416	72.0	72.0	-	-	-	111	416	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
GLENFIELD M	55 to 60	57.5	86	144	97	327	98	229	76.0	65.0	1,807	1,720	3,527	98	229	72	60	1,416	573	1,990
GLENFIELD M	50 to 55	52.5	109	182	172	463	123	340	76.0	65.0	2,902	4,244	7,146	123	340	72	60	2,408	2,546	4,954
GLENFIELD M	45 to 50	47.5	105	119	142	366	84	282	76.0	65.0	2,387	4,939	7,326	84	282	72	60	2,052	3,528	5,580
GLENFIELD M	40 to 45	42.5	185	155	177	517	113	404	76.0	65.0	3,799	9,081	12,880	113	404	72	60	3,345	7,063	10,408
GLENFIELD M	35 to 40	37.5	236	200	241	677	146	531	76.0	65.0	5,624	14,601	20,224	146	531	72	60	5,039	11,946	16,985
GLENFIELD M	30 to 35	32.5	237	202	198	637	147	490	76.0	65.0	6,412	15,912	22,324	147	490	72	60	5,823	13,464	19,286
GLENFIELD M	25 to 30	27.5	121	115	113	349	83	266	76.0	65.0	4,010	9,987	13,997	83	266	72	60	3,679	8,655	12,335
GLENFIELD M	20 to 25	22.5	149	68	97	314	56	258	76.0	65.0	2,985	10,973	13,959	56	258	72	60	2,762	9,682	12,445
GLENFIELD M	15 to 20	17.5	95	40	46	181	33	148	76.0	65.0	1,959	7,007	8,966	33	148	72	60	1,825	6,270	8,094
GLENFIELD M	10 to 15	12.5	39	9	28	76	9	67	76.0	65.0	578	3,512	4,090	9	67	72	60	542	3,177	3,719
GLENFIELD M	5 to 10	7.5	21	5	5	31	5	26	76.0	65.0	343	1,495	1,838	5	26	72	60	323	1,365	1,688
GLENFIELD M	0 to 5	2.5	4	2	-	6	2	4	76.0	65.0	118	275	393	2	4	72	60	112	253	364
GLENFIELD M	-5 to 0	(2.5)	4	-	-	4	0	4	76.0	65.0	28	246	274	0	4	72	60	27	228	254
GLENFIELD M	-10 to -5	(7.5)	-	-	-	-	-	-	76.0	65.0	-	-	-	-	-	72	60	-	-	-
GLENFIELD M	-15 to -10	(12.5)	-	-	-	-	-	-	76.0	65.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	900	3,048			32,952	83,991	116,943	900	3,048			29,352	68,751	**98,103**

VALLEY ROAD COMPLEX

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
VALLEY ROAD	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	19	11	31	1	0	72.0	72.0	19	11	31
VALLEY ROAD	95 to 100	97.5	-	19	2	21	12	9	72.0	72.0	303	233	536	12	9	72.0	72.0	303	233	536
VALLEY ROAD	90 to 95	92.5	-	44	13	57	28	30	72.0	72.0	564	605	1,169	28	30	72.0	72.0	564	605	1,169
VALLEY ROAD	85 to 90	87.5	1	167	60	228	105	123	72.0	72.0	1,621	1,913	3,534	105	123	72.0	72.0	1,621	1,913	3,534
VALLEY ROAD	80 to 85	82.5	31	283	162	476	182	294	72.0	72.0	1,915	3,083	4,998	182	294	72.0	72.0	1,915	3,083	4,998
VALLEY ROAD	75 to 80	77.5	191	235	280	706	181	525	72.0	72.0	995	2,888	3,883	181	525	72.0	72.0	995	2,888	3,883
VALLEY ROAD	70 to 75	72.5	203	177	222	602	147	455	72.0	72.0	73	228	301	147	455	72.0	72.0	73	228	301
VALLEY ROAD	65 to 70	67.5	325	165	204	694	161	533	72.0	72.0	-	-	-	161	533	72.0	72.0	-	-	-
VALLEY ROAD	60 to 65	62.5	180	152	195	527	127	400	72.0	72.0	-	-	-	127	400	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
VALLEY ROAD	55 to 60	57.5	86	144	97	327	105	222	74.0	66.0	1,738	1,884	3,622	105	222	72	60	1,528	554	2,082
VALLEY ROAD	50 to 55	52.5	109	182	172	463	133	330	74.0	66.0	2,864	4,452	7,316	133	330	72	60	2,598	2,473	5,071
VALLEY ROAD	45 to 50	47.5	105	119	142	366	93	273	74.0	66.0	2,468	5,048	7,516	93	273	72	60	2,282	3,411	5,693
VALLEY ROAD	40 to 45	42.5	185	155	177	517	130	387	74.0	66.0	4,092	9,097	13,189	130	387	72	60	3,832	6,774	10,606
VALLEY ROAD	35 to 40	37.5	236	200	241	677	167	510	74.0	66.0	6,101	14,531	20,632	167	510	72	60	5,766	11,472	17,238
VALLEY ROAD	30 to 35	32.5	237	202	198	637	169	468	74.0	66.0	6,996	15,692	22,688	169	468	72	60	6,659	12,882	19,540
VALLEY ROAD	25 to 30	27.5	121	115	113	349	93	256	74.0	66.0	4,347	9,837	14,184	93	256	72	60	4,160	8,304	12,464
VALLEY ROAD	20 to 25	22.5	149	68	97	314	69	245	74.0	66.0	3,559	10,653	14,212	69	245	72	60	3,421	9,183	12,604
VALLEY ROAD	15 to 20	17.5	95	40	46	181	42	139	74.0	66.0	2,371	6,743	9,114	42	139	72	60	2,287	5,909	8,196
VALLEY ROAD	10 to 15	12.5	39	9	28	76	13	63	74.0	66.0	774	3,392	4,167	13	63	72	60	749	3,012	3,761
VALLEY ROAD	5 to 10	7.5	21	5	5	31	7	24	74.0	66.0	457	1,411	1,869	7	24	72	60	443	1,267	1,710
VALLEY ROAD	0 to 5	2.5	4	2	-	6	2	4	74.0	66.0	140	256	397	2	4	72	60	137	232	369
VALLEY ROAD	-5 to 0	(2.5)	4	-	-	4	1	3	74.0	66.0	55	225	280	1	3	72	60	53	205	259
VALLEY ROAD	-10 to -5	(7.5)	-	-	-	-	-	-	74.0	66.0	-	-	-	-	-	72	60	-	-	-
VALLEY ROAD	-15 to -10	(12.5)	-	-	-	-	-	-	74.0	66.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,024	2,924			35,962	83,223	119,185	1,024	2,924			33,914	65,679	**99,593**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

MONTCLAIR HIGH SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
MONTCLAIR	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	74.0	19	11	30
MONTCLAIR	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	346	189	536	12	9	72.0	74.0	303	214	517
MONTCLAIR	90 to 95	92.5	-	44	13	57	31	26	72.0	72.0	644	524	1,169	28	30	72.0	74.0	564	546	1,110
MONTCLAIR	85 to 90	87.5	1	167	60	228	119	109	72.0	72.0	1,852	1,682	3,534	105	123	72.0	74.0	1,621	1,667	3,287
MONTCLAIR	80 to 85	82.5	31	283	162	476	208	268	72.0	72.0	2,181	2,817	4,998	182	294	72.0	74.0	1,915	2,496	4,411
MONTCLAIR	75 to 80	77.5	191	235	280	706	202	504	72.0	72.0	1,111	2,772	3,883	181	525	72.0	74.0	995	1,838	2,833
MONTCLAIR	70 to 75	72.5	203	177	222	602	163	439	72.0	72.0	81	220	301	147	455	72.0	74.0	73	-	73
MONTCLAIR	65 to 70	67.5	325	165	204	694	176	518	72.0	72.0	-	-	-	161	533	72.0	74.0	-	-	-
MONTCLAIR	60 to 65	62.5	180	152	195	527	141	386	72.0	72.0	-	-	-	127	400	72.0	74.0	-	-	-
													14,451							**12,261**
	HEATING																			
MONTCLAIR	55 to 60	57.5	86	144	97	327	118	209	75.0	66.0	2,069	1,775	3,843	105	222	72	60	1,528	554	2,082
MONTCLAIR	50 to 55	52.5	109	182	172	463	149	314	75.0	66.0	3,363	4,233	7,596	133	330	72	60	2,598	2,473	5,071
MONTCLAIR	45 to 50	47.5	105	119	142	366	104	262	75.0	66.0	2,853	4,852	7,705	93	273	72	60	2,282	3,411	5,693
MONTCLAIR	40 to 45	42.5	185	155	177	517	144	373	75.0	66.0	4,672	8,771	13,443	130	387	72	60	3,832	6,774	10,606
MONTCLAIR	35 to 40	37.5	236	200	241	677	185	492	75.0	66.0	6,938	14,022	20,960	167	510	72	60	5,766	11,472	17,238
MONTCLAIR	30 to 35	32.5	237	202	198	637	187	450	75.0	66.0	7,931	15,088	23,019	169	468	72	60	6,659	12,882	19,540
MONTCLAIR	25 to 30	27.5	121	115	113	349	104	245	75.0	66.0	4,928	9,442	14,370	93	256	72	60	4,160	8,304	12,464
MONTCLAIR	20 to 25	22.5	149	68	97	314	75	239	75.0	66.0	3,947	10,389	14,336	69	245	72	60	3,421	9,183	12,604
MONTCLAIR	15 to 20	17.5	95	40	46	181	46	135	75.0	66.0	2,618	6,570	9,188	42	139	72	60	2,287	5,909	8,196
MONTCLAIR	10 to 15	12.5	39	9	28	76	13	63	75.0	66.0	837	3,349	4,187	13	63	72	60	749	3,012	3,761
MONTCLAIR	5 to 10	7.5	21	5	5	31	7	24	75.0	66.0	494	1,385	1,879	7	24	72	60	443	1,267	1,710
MONTCLAIR	0 to 5	2.5	4	2	-	6	2	4	75.0	66.0	155	245	400	2	4	72	60	137	232	369
MONTCLAIR	-5 to 0	(2.5)	4	-	-	4	1	3	75.0	66.0	55	225	280	1	3	72	60	53	205	259
MONTCLAIR	-10 to -5	(7.5)	-	-	-	-	-	-	75.0	66.0	-	-	-	-	-	72	60	-	-	-
MONTCLAIR	-15 to -10	(12.5)	-	-	-	-	-	-	75.0	66.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,135	2,813			40,860	80,346	121,206	1,024	2,924			33,914	65,679	**99,593**

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
GEORGE INN	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	19	11	31	1	0	72.0	74.0	19	11	30
GEORGE INN	95 to 100	97.5	-	19	2	21	12	9	72.0	72.0	303	233	536	12	9	72.0	74.0	303	214	517
GEORGE INN	90 to 95	92.5	-	44	13	57	28	30	72.0	72.0	564	605	1,169	28	30	72.0	74.0	564	546	1,110
GEORGE INN	85 to 90	87.5	1	167	60	228	105	123	72.0	72.0	1,621	1,913	3,534	105	123	72.0	74.0	1,621	1,667	3,287
GEORGE INN	80 to 85	82.5	31	283	162	476	182	294	72.0	72.0	1,915	3,083	4,998	182	294	72.0	74.0	1,915	2,496	4,411
GEORGE INN	75 to 80	77.5	191	235	280	706	181	525	72.0	72.0	995	2,888	3,883	181	525	72.0	74.0	995	1,838	2,833
GEORGE INN	70 to 75	72.5	203	177	222	602	147	455	72.0	72.0	73	228	301	147	455	72.0	74.0	73	-	73
GEORGE INN	65 to 70	67.5	325	165	204	694	161	533	72.0	72.0	-	-	-	161	533	72.0	74.0	-	-	-
GEORGE INN	60 to 65	62.5	180	152	195	527	127	400	72.0	72.0	-	-	-	127	400	72.0	74.0	-	-	-
													14,451							**12,261**
	HEATING																			
GEORGE INN	55 to 60	57.5	86	144	97	327	105	222	76.0	64.0	1,949	1,441	3,390	105	222	72	60	1,528	554	2,082
GEORGE INN	50 to 55	52.5	109	182	172	463	133	330	76.0	64.0	3,131	3,793	6,923	133	330	72	60	2,598	2,473	5,071
GEORGE INN	45 to 50	47.5	105	119	142	366	93	273	76.0	64.0	2,654	4,502	7,157	93	273	72	60	2,282	3,411	5,693
GEORGE INN	40 to 45	42.5	185	155	177	517	130	387	76.0	64.0	4,352	8,322	12,674	130	387	72	60	3,832	6,774	10,606
GEORGE INN	35 to 40	37.5	236	200	241	677	167	510	76.0	64.0	6,435	13,511	19,946	167	510	72	60	5,766	11,472	17,238
GEORGE INN	30 to 35	32.5	237	202	198	637	169	468	76.0	64.0	7,333	14,756	22,088	169	468	72	60	6,659	12,882	19,540
GEORGE INN	25 to 30	27.5	121	115	113	349	93	256	76.0	64.0	4,534	9,326	13,860	93	256	72	60	4,160	8,304	12,464
GEORGE INN	20 to 25	22.5	149	68	97	314	69	245	76.0	64.0	3,697	10,163	13,860	69	245	72	60	3,421	9,183	12,604
GEORGE INN	15 to 20	17.5	95	40	46	181	42	139	76.0	64.0	2,455	6,465	8,920	42	139	72	60	2,287	5,909	8,196
GEORGE INN	10 to 15	12.5	39	9	28	76	13	63	76.0	64.0	799	3,266	4,065	13	63	72	60	749	3,012	3,761
GEORGE INN	5 to 10	7.5	21	5	5	31	7	24	76.0	64.0	471	1,363	1,834	7	24	72	60	443	1,267	1,710
GEORGE INN	0 to 5	2.5	4	2	-	6	2	4	76.0	64.0	144	248	393	2	4	72	60	137	232	369
GEORGE INN	-5 to 0	(2.5)	4	-	-	4	1	3	76.0	64.0	56	219	275	1	3	72	60	53	205	259
GEORGE INN	-10 to -5	(7.5)	-	-	-	-	-	-	76.0	64.0	-	-	-	-	-	72	60	-	-	-
GEORGE INN	-15 to -10	(12.5)	-	-	-	-	-	-	76.0	64.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,024	2,924			38,010	77,375	115,385	1,024	2,924			33,914	65,679	**99,593**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

NISHUANE K-2

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
NISHUANE K	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	72.0	22	9	31
NISHUANE K	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	346	189	536	14	7	72.0	72.0	346	189	536
NISHUANE K	90 to 95	92.5	-	44	13	57	31	26	72.0	72.0	644	524	1,169	31	26	72.0	72.0	644	524	1,169
NISHUANE K	85 to 90	87.5	1	167	60	228	119	109	72.0	72.0	1,850	1,684	3,534	119	109	72.0	72.0	1,850	1,684	3,534
NISHUANE K	80 to 85	82.5	31	283	162	476	205	271	72.0	72.0	2,152	2,846	4,998	205	271	72.0	72.0	2,152	2,846	4,998
NISHUANE K	75 to 80	77.5	191	235	280	706	185	521	72.0	72.0	1,017	2,866	3,883	185	521	72.0	72.0	1,017	2,866	3,883
NISHUANE K	70 to 75	72.5	203	177	222	602	145	457	72.0	72.0	72	229	301	145	457	72.0	72.0	72	229	301
NISHUANE K	65 to 70	67.5	325	165	204	694	147	547	72.0	72.0	-	-	-	147	547	72.0	72.0	-	-	-
NISHUANE K	60 to 65	62.5	180	152	195	527	125	402	72.0	72.0	-	-	-	125	402	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
NISHUANE K	55 to 60	57.5	86	144	97	327	111	216	77.0	72.0	2,155	3,139	5,294	111	216	72	60	1,603	541	2,144
NISHUANE K	50 to 55	52.5	109	182	172	463	140	323	77.0	72.0	3,423	6,304	9,727	140	323	72	60	2,725	2,425	5,149
NISHUANE K	45 to 50	47.5	105	119	142	366	94	272	77.0	72.0	2,784	6,655	9,439	94	272	72	60	2,312	3,395	5,708
NISHUANE K	40 to 45	42.5	185	155	177	517	127	390	77.0	72.0	4,390	11,498	15,888	127	390	72	60	3,753	6,821	10,574
NISHUANE K	35 to 40	37.5	236	200	241	677	164	513	77.0	72.0	6,475	17,701	24,176	164	513	72	60	5,656	11,544	17,200
NISHUANE K	30 to 35	32.5	237	202	198	637	165	472	77.0	72.0	7,362	18,626	25,989	165	472	72	60	6,535	12,968	19,503
NISHUANE K	25 to 30	27.5	121	115	113	349	93	256	77.0	72.0	4,601	11,394	15,995	93	256	72	60	4,136	8,322	12,458
NISHUANE K	20 to 25	22.5	149	68	97	314	62	252	77.0	72.0	3,372	12,480	15,852	62	252	72	60	3,063	9,455	12,518
NISHUANE K	15 to 20	17.5	95	40	46	181	37	144	77.0	72.0	2,205	7,845	10,050	37	144	72	60	2,019	6,118	8,137
NISHUANE K	10 to 15	12.5	39	9	28	76	10	66	77.0	72.0	639	3,932	4,572	10	66	72	60	590	3,139	3,729
NISHUANE K	5 to 10	7.5	21	5	5	31	5	26	77.0	72.0	379	1,648	2,027	5	26	72	60	351	1,342	1,693
NISHUANE K	0 to 5	2.5	4	2	-	6	2	4	77.0	72.0	133	293	426	2	4	72	60	124	242	366
NISHUANE K	-5 to 0	(2.5)	4	-	-	4	0	4	77.0	72.0	28	271	300	0	4	72	60	27	228	254
NISHUANE K	-10 to -5	(7.5)	-	-	-	-	-	-	77.0	72.0	-	-	-	-	-	72	60	-	-	-
NISHUANE K	-15 to -10	(12.5)	-	-	-	-	-	-	77.0	72.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,011	2,937			37,947	101,787	139,734	1,011	2,937			32,894	66,539	**99,433**

NORTHEAST ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
NORTHEAST	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	74.0	19	11	30
NORTHEAST	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	355	180	536	12	9	72.0	74.0	303	214	517
NORTHEAST	90 to 95	92.5	-	44	13	57	34	23	72.0	72.0	692	477	1,169	28	30	72.0	74.0	564	546	1,110
NORTHEAST	85 to 90	87.5	1	167	60	228	130	98	72.0	72.0	2,016	1,518	3,534	104	124	72.0	74.0	1,619	1,668	3,287
NORTHEAST	80 to 85	82.5	31	283	162	476	234	242	72.0	72.0	2,455	2,543	4,998	180	296	72.0	74.0	1,886	2,519	4,405
NORTHEAST	75 to 80	77.5	191	235	280	706	235	471	72.0	72.0	1,292	2,591	3,883	164	542	72.0	74.0	902	1,897	2,799
NORTHEAST	70 to 75	72.5	203	177	222	602	184	418	72.0	72.0	92	209	301	129	473	72.0	74.0	64	-	64
NORTHEAST	65 to 70	67.5	325	165	204	694	183	511	72.0	72.0	-	-	-	132	562	72.0	74.0	-	-	-
NORTHEAST	60 to 65	62.5	180	152	195	527	159	368	72.0	72.0	-	-	-	111	416	72.0	74.0	-	-	-
													14,451							**12,212**
	HEATING																			
NORTHEAST	55 to 60	57.5	86	144	97	327	128	199	78.0	72.0	2,621	2,888	5,509	98	229	72	60	1,416	573	1,990
NORTHEAST	50 to 55	52.5	109	182	172	463	170	293	78.0	72.0	4,346	5,705	10,051	123	340	72	60	2,408	2,546	4,954
NORTHEAST	45 to 50	47.5	105	119	142	366	120	246	78.0	72.0	3,652	6,034	9,685	84	282	72	60	2,052	3,528	5,580
NORTHEAST	40 to 45	42.5	185	155	177	517	159	358	78.0	72.0	5,639	10,566	16,205	113	404	72	60	3,345	7,063	10,408
NORTHEAST	35 to 40	37.5	236	200	241	677	207	470	78.0	72.0	8,382	16,216	24,598	146	531	72	60	5,039	11,946	16,985
NORTHEAST	30 to 35	32.5	237	202	198	637	201	436	78.0	72.0	9,137	17,230	26,366	147	490	72	60	5,823	13,464	19,286
NORTHEAST	25 to 30	27.5	121	115	113	349	113	236	78.0	72.0	5,713	10,496	16,209	83	266	72	60	3,679	8,655	12,335
NORTHEAST	20 to 25	22.5	149	68	97	314	79	235	78.0	72.0	4,395	11,623	16,018	56	258	72	60	2,762	9,682	12,445
NORTHEAST	15 to 20	17.5	95	40	46	181	45	136	78.0	72.0	2,739	7,397	10,136	33	148	72	60	1,825	6,270	8,094
NORTHEAST	10 to 15	12.5	39	9	28	76	15	61	78.0	72.0	977	3,635	4,611	9	67	72	60	542	3,177	3,719
NORTHEAST	5 to 10	7.5	21	5	5	31	6	25	78.0	72.0	447	1,591	2,038	5	26	72	60	323	1,365	1,688
NORTHEAST	0 to 5	2.5	4	2	-	6	2	4	78.0	72.0	135	293	428	2	4	72	60	112	253	364
NORTHEAST	-5 to 0	(2.5)	4	-	-	4	0	4	78.0	72.0	29	271	300	0	4	72	60	27	228	254
NORTHEAST	-10 to -5	(7.5)	-	-	-	-	-	-	78.0	72.0	-	-	-	-	-	72	60	-	-	-
NORTHEAST	-15 to -10	(12.5)	-	-	-	-	-	-	78.0	72.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,246	2,702			48,211	93,944	142,155	900	3,048			29,352	68,751	**98,103**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

RENAISSANCE MIDDLE SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
RENAISSANC	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	72.0	19	11	31
RENAISSANC	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	346	189	536	12	9	72.0	72.0	303	233	536
RENAISSANC	90 to 95	92.5	-	44	13	57	31	26	72.0	72.0	644	524	1,169	28	30	72.0	72.0	564	605	1,169
RENAISSANC	85 to 90	87.5	1	167	60	228	119	109	72.0	72.0	1,850	1,684	3,534	104	124	72.0	72.0	1,619	1,915	3,534
RENAISSANC	80 to 85	82.5	31	283	162	476	205	271	72.0	72.0	2,152	2,846	4,998	180	296	72.0	72.0	1,886	3,112	4,998
RENAISSANC	75 to 80	77.5	191	235	280	706	185	521	72.0	72.0	1,017	2,866	3,883	164	542	72.0	72.0	902	2,981	3,883
RENAISSANC	70 to 75	72.5	203	177	222	602	145	457	72.0	72.0	72	229	301	129	473	72.0	72.0	64	237	301
RENAISSANC	65 to 70	67.5	325	165	204	694	147	547	72.0	72.0	-	-	-	132	562	72.0	72.0	-	-	-
RENAISSANC	60 to 65	62.5	180	152	195	527	125	402	72.0	72.0	-	-	-	111	416	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
RENAISSANC	55 to 60	57.5	86	144	97	327	111	216	77.0	65.0	2,155	1,623	3,779	98	229	72	60	1,416	573	1,990
RENAISSANC	50 to 55	52.5	109	182	172	463	140	323	77.0	65.0	3,423	4,041	7,464	123	340	72	60	2,408	2,546	4,954
RENAISSANC	45 to 50	47.5	105	119	142	366	94	272	77.0	65.0	2,784	4,753	7,538	84	282	72	60	2,052	3,528	5,580
RENAISSANC	40 to 45	42.5	185	155	177	517	127	390	77.0	65.0	4,390	8,770	13,159	113	404	72	60	3,345	7,063	10,408
RENAISSANC	35 to 40	37.5	236	200	241	677	164	513	77.0	65.0	6,475	14,109	20,585	146	531	72	60	5,039	11,946	16,985
RENAISSANC	30 to 35	32.5	237	202	198	637	165	472	77.0	65.0	7,362	15,325	22,688	147	490	72	60	5,823	13,464	19,286
RENAISSANC	25 to 30	27.5	121	115	113	349	93	256	77.0	65.0	4,601	9,602	14,203	83	266	72	60	3,679	8,655	12,335
RENAISSANC	20 to 25	22.5	149	68	97	314	62	252	77.0	65.0	3,372	10,715	14,088	56	258	72	60	2,762	9,682	12,445
RENAISSANC	15 to 20	17.5	95	40	46	181	37	144	77.0	65.0	2,205	6,837	9,042	33	148	72	60	1,825	6,270	8,094
RENAISSANC	10 to 15	12.5	39	9	28	76	10	66	77.0	65.0	639	3,470	4,109	9	67	72	60	542	3,177	3,719
RENAISSANC	5 to 10	7.5	21	5	5	31	5	26	77.0	65.0	379	1,469	1,848	5	26	72	60	323	1,365	1,688
RENAISSANC	0 to 5	2.5	4	2	-	6	2	4	77.0	65.0	133	263	396	2	4	72	60	112	253	364
RENAISSANC	-5 to 0	(2.5)	4	-	-	4	0	4	77.0	65.0	28	246	274	0	4	72	60	27	228	254
RENAISSANC	-10 to -5	(7.5)	-	-	-	-	-	-	77.0	65.0	-	-	-	-	-	72	60	-	-	-
RENAISSANC	-15 to -10	(12.5)	-	-	-	-	-	-	77.0	65.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,011	2,937			37,947	81,226	119,173	900	3,048			29,352	68,751	**98,103**

WATCHUNG ELEMENTARY SCHOOL

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
WATCHUNG	100 to 105	102.5	-	1	-	1	1	0	72.0	72.0	22	9	31	1	0	72.0	72.0	19	11	31
WATCHUNG	95 to 100	97.5	-	19	2	21	14	7	72.0	72.0	346	189	536	12	9	72.0	72.0	303	233	536
WATCHUNG	90 to 95	92.5	-	44	13	57	31	26	72.0	72.0	644	524	1,169	28	30	72.0	72.0	564	605	1,169
WATCHUNG	85 to 90	87.5	1	167	60	228	119	109	72.0	72.0	1,850	1,684	3,534	104	124	72.0	72.0	1,619	1,915	3,534
WATCHUNG	80 to 85	82.5	31	283	162	476	205	271	72.0	72.0	2,152	2,846	4,998	180	296	72.0	72.0	1,886	3,112	4,998
WATCHUNG	75 to 80	77.5	191	235	280	706	185	521	72.0	72.0	1,017	2,866	3,883	164	542	72.0	72.0	902	2,981	3,883
WATCHUNG	70 to 75	72.5	203	177	222	602	145	457	72.0	72.0	72	229	301	129	473	72.0	72.0	64	237	301
WATCHUNG	65 to 70	67.5	325	165	204	694	147	547	72.0	72.0	-	-	-	132	562	72.0	72.0	-	-	-
WATCHUNG	60 to 65	62.5	180	152	195	527	125	402	72.0	72.0	-	-	-	111	416	72.0	72.0	-	-	-
													14,451							**14,451**
	HEATING																			
WATCHUNG	55 to 60	57.5	86	144	97	327	111	216	78.0	69.0	2,266	2,489	4,755	98	229	72	60	1,416	573	1,990
WATCHUNG	50 to 55	52.5	109	182	172	463	140	323	78.0	69.0	3,563	5,334	8,897	123	340	72	60	2,408	2,546	4,954
WATCHUNG	45 to 50	47.5	105	119	142	366	94	272	78.0	69.0	2,878	5,840	8,718	84	282	72	60	2,052	3,528	5,580
WATCHUNG	40 to 45	42.5	185	155	177	517	127	390	78.0	69.0	4,517	10,329	14,846	113	404	72	60	3,345	7,063	10,408
WATCHUNG	35 to 40	37.5	236	200	241	677	164	513	78.0	69.0	6,639	16,162	22,801	146	531	72	60	5,039	11,946	16,985
WATCHUNG	30 to 35	32.5	237	202	198	637	165	472	78.0	69.0	7,528	17,212	24,740	147	490	72	60	5,823	13,464	19,286
WATCHUNG	25 to 30	27.5	121	115	113	349	93	256	78.0	69.0	4,694	10,626	15,320	83	266	72	60	3,679	8,655	12,335
WATCHUNG	20 to 25	22.5	149	68	97	314	62	252	78.0	69.0	3,434	11,724	15,158	56	258	72	60	2,762	9,682	12,445
WATCHUNG	15 to 20	17.5	95	40	46	181	37	144	78.0	69.0	2,242	7,413	9,655	33	148	72	60	1,825	6,270	8,094
WATCHUNG	10 to 15	12.5	39	9	28	76	10	66	78.0	69.0	649	3,734	4,383	9	67	72	60	542	3,177	3,719
WATCHUNG	5 to 10	7.5	21	5	5	31	5	26	78.0	69.0	384	1,572	1,956	5	26	72	60	323	1,365	1,688
WATCHUNG	0 to 5	2.5	4	2	-	6	2	4	78.0	69.0	135	280	415	2	4	72	60	112	253	364
WATCHUNG	-5 to 0	(2.5)	4	-	-	4	0	4	78.0	69.0	29	260	289	0	4	72	60	27	228	254
WATCHUNG	-10 to -5	(7.5)	-	-	-	-	-	-	78.0	69.0	-	-	-	-	-	72	60	-	-	-
WATCHUNG	-15 to -10	(12.5)	-	-	-	-	-	-	78.0	69.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	1,011	2,937			38,958	92,975	131,933	900	3,048			29,352	68,751	**98,103**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

WOODMAN FIELD

							Current Operating Schedule							Proposed Operating Schedule						
	Amb. Temp Bin deg. F	Ave Temp deg. F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours	Occup.Bin Hours	Unocc. Bin Hours	Occup. Indoor temp	Unocc. Indoor temp	Occup. Deg-hours	Unocc. Deg-hours	Total Deg-hours
	COOLING																			
WOODMAN	100 to 105	102.5	-	1	-	1	1	-	72.0	72.0	31	-	31	1	-	72.0	74.0	31	-	31
WOODMAN	95 to 100	97.5	-	19	2	21	21	0	72.0	72.0	529	6	536	20	1	72.0	74.0	510	24	534
WOODMAN	90 to 95	92.5	-	44	13	57	55	2	72.0	72.0	1,135	33	1,169	51	7	72.0	74.0	1,035	120	1,156
WOODMAN	85 to 90	87.5	1	167	60	228	221	8	72.0	72.0	3,418	116	3,534	197	31	72.0	74.0	3,057	415	3,473
WOODMAN	80 to 85	82.5	31	283	162	476	456	20	72.0	72.0	4,785	213	4,998	372	104	72.0	74.0	3,903	886	4,790
WOODMAN	75 to 80	77.5	191	235	280	706	671	35	72.0	72.0	3,691	193	3,883	423	283	72.0	74.0	2,325	991	3,317
WOODMAN	70 to 75	72.5	203	177	222	602	574	28	72.0	72.0	287	14	301	339	263	72.0	74.0	169	-	169
WOODMAN	65 to 70	67.5	325	165	204	694	669	26	72.0	72.0	-	-	-	348	346	72.0	74.0	-	-	-
WOODMAN	60 to 65	62.5	180	152	195	527	503	24	72.0	72.0	-	-	-	295	233	72.0	74.0	-	-	-
													14,451							**13,467**
	HEATING																			
WOODMAN	55 to 60	57.5	86	144	97	327	315	12	72.0	72.0	4,566	176	4,742	214	113	72	60	3,103	283	3,386
WOODMAN	50 to 55	52.5	109	182	172	463	442	22	72.0	72.0	8,609	419	9,029	295	168	72	60	5,757	1,258	7,016
WOODMAN	45 to 50	47.5	105	119	142	366	348	18	72.0	72.0	8,532	435	8,967	216	150	72	60	5,298	1,872	7,170
WOODMAN	40 to 45	42.5	185	155	177	517	495	22	72.0	72.0	14,599	653	15,252	290	227	72	60	8,548	3,977	12,525
WOODMAN	35 to 40	37.5	236	200	241	677	647	30	72.0	72.0	22,317	1,039	23,357	380	298	72	60	13,093	6,694	19,787
WOODMAN	30 to 35	32.5	237	202	198	637	612	25	72.0	72.0	24,184	978	25,162	360	277	72	60	14,230	7,611	21,841
WOODMAN	25 to 30	27.5	121	115	113	349	335	14	72.0	72.0	14,902	629	15,531	202	147	72	60	8,978	4,786	13,764
WOODMAN	20 to 25	22.5	149	68	97	314	302	12	72.0	72.0	14,943	600	15,543	154	160	72	60	7,611	6,009	13,620
WOODMAN	15 to 20	17.5	95	40	46	181	175	6	72.0	72.0	9,551	313	9,865	87	94	72	60	4,728	4,006	8,734
WOODMAN	10 to 15	12.5	39	9	28	76	73	4	72.0	72.0	4,314	208	4,522	33	43	72	60	1,949	2,054	4,003
WOODMAN	5 to 10	7.5	21	5	5	31	30	1	72.0	72.0	1,959	40	2,000	13	18	72	60	822	958	1,781
WOODMAN	0 to 5	2.5	4	2	-	6	6	-	72.0	72.0	417	-	417	3	3	72	60	209	173	381
WOODMAN	-5 to 0	(2.5)	4	-	-	4	4	-	72.0	72.0	298	-	298	1	3	72	60	75	188	262
WOODMAN	-10 to -5	(7.5)	-	-	-	-	-	-	72.0	72.0	-	-	-	-	-	72	60	-	-	-
WOODMAN	-15 to -10	(12.5)	-	-	-	-	-	-	72.0	72.0	-	-	-	-						
	Total		1,391	1,241	1,316	3,948	3,784	165			129,191	5,490	134,681	2,247	1,701			74,399	39,867	**114,266**

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

Occupancy Controlled Thermostats

The program has received a large amount of custom electric applications for the installation of Occupancy Controlled Thermostats in hotels, motels, and, most recently, university dormitories.

Standard practice today is thermostats which are manually controlled by occupants to regulate temperature within a facility. An occupancy controlled thermostat is a thermostat paired with a sensor and/or door detector to identify movement and determine if a room is occupied or unoccupied. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e., programmed setpoint). If a pre-programmed time frame elapses (i.e., 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback setpoint or off) until occupancy is sensed again. This type of thermostat is often used in hotels to conserve energy.

The occupancy controlled thermostat reduces the consumption of electricity and/or gas by requiring less heating and/or cooling when a room or a facility is vacant or unoccupied.

Algorithms

Cooling Energy Savings (kWh/yr) = $(((T_c * (H+5) + S_c * (168 - (H+5)))/168) - T_c) * (P_c * Cap_{hp} * 12 * EFLH_c/EER_{hp})$

Heating Energy Savings (kWh/yr) = $(T_h - ((T_h * (H+5) + S_h * (168 - (H+5)))/168)) * (P_h * Cap_{hp} * 12 * EFLH_h/EER_{hp})$

Heating Energy Savings (Therms/yr) = $(T_h - ((T_h * (H+5) + S_h * (168 - (H+5)))/168) * (P_h * Cap_h * EFLH_h/AFUE_h/100{,}000)$

Definition of Variables

T_h = Heating Season Facility Temp. (°F)
T_c = Cooling Season Facility Temp. (°F)
S_h = Heating Season Setback Temp. (°F)
S_c = Cooling Season Setup Temp. (°F)
H = Weekly Occupied Hours
Cap_{hp} = Connected load capacity of heat pump/AC (Tons) – Provided on Application.
Cap_h = Connected heating load capacity (Btu/hr) – Provided on Application.
$EFLH_c$ = Equivalent full load cooling hours
$EFLH_h$ = Equivalent full load heating hours
P_h = Heating season percent savings per degree setback
P_c = Cooling season percent savings per degree setup
$AFUE_h$ = Heating equipment efficiency – Provided on Application.
EER_{hp} = Heat pump/AC equipment efficiency – Provided on Application

12 = Conversion factor from Tons to kBtu/hr to acquire consumption in kWh.
168 = Hours per week.
7 = Assumed weekly hours for setback/setup adjustment period (based on 1 setback/setup per day, 7 days per week).

Summary of Inputs

Occupancy Controlled Thermostats

Component	Type	Value	Source
T_h	Variable		Application
T_c	Variable		Application
S_h	Fixed	T_h-5°	
S_c	Fixed	T_c+5°	
H	Variable		Application; Default of 84 hrs/week
Cap_{hp}	Variable		Application

Montclair Board of Education
Exhibit D
ECM 3A Building Management Control System
BMS Upgrades

Cap_h	Variable		Application
$EFLH_{c,h}$	Variable	See Table Below	1
P_h	Fixed	3%	2
P_c	Fixed	6%	2
$AFUE_h$	Variable		Application
EER_{hp}	Variable		Application

EFLH Table

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Assembly	603	669
Auto repair	1910	426
Dormitory	465	800
Hospital	3366	1424
Light industrial	714	549
Lodging – Hotel	1077	2918
Lodging – Motel	619	1233
Office – large	2034	720
Office – small	431	955
Other	681	736
Religious worship	722	279
Restaurant – fast food	813	645
Restaurant – full service	821	574
Retail – big box	191	1279
Retail – Grocery	191	1279
Retail – small	545	882
Retail – large	2101	1068
School – Community college	1431	846
School – postsecondary	1191	1208
School – primary	840	394
School – secondary	901	466
Warehouse	452	400

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Cooling	507	550	562
Low-rise, Heating	757	723	503
High-rise, Cooling	793	843	954
High-rise, Heating	526	395	219

Montclair Board of Education
Exhibit D
ECM 3B Demand Control Ventilation (in BMS scope)
Demand Control Ventilation

ECM DESCRIPTION

Install CO2 sensors in large areas to control fresh air intake

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

*Schedules and temperatures are based on data logging trends performed throughout the building
* Proposed setpoints are used as to not capture thermal savings twice

MEASUREMENT AND VERIFICATION

Option A (Electric) -
Option C (Thermal) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Simulate function of CO2 control signal. Test all equipment involved in DCV, which will include but not limited to testing function of fresh air damper response to the CO2 sensor signal and sequence of operation per design (Override CO2 signal during the building warm up, etc.).

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of 0 percent is used for this ECM due to the uncertainty of variables.

FORMULAE

$$W_{SAVINGS} = \sum_{-5}^{60} [(kW_{FAN} \cdot t_{OCC}) - (kW_{FAN} \cdot (1 - RPM_{-\%})^{2.8}) \cdot t_{OCC}]$$

$$Q_{SAVINGS} = \sum_{-5}^{60} \{ [Q_{LOAD} \cdot t_{OCC} \cdot (1 - OA_{\%OCC})] + [Q_{LOAD} \cdot t_{UNOCC} \cdot (1 - OA_{\%UNOCC})] \} / \eta_{BOILER}$$

$$Q_{LOAD} = 1.08 \cdot CFM_{OA} \cdot (T_{OCC} - T_{BIN}) / 1000$$

Variable	Units	Description
$W_{SAVINGS}$	kWh	Annual kWh Savings
$Q_{SAVINGS}$	Therms	Annual Thermal Savings
Q_{LOAD}	Mmbtu	Thermal Load of unit at respective temperature bin
kW_{FAN}	kW	Total kW of Fan
$\sum_{-5}^{60}$	-	Summation of all bins from -5°F to 60°F
T_{BIN}	°F	Temperature of respective bin
t_{OCC}	Hrs	Proposed occupied Bin Hours in respective temperature bin
t_{UNOCC}	Hrs	Proposed unoccupied Bin Hours in respective temperature bin
$RPM_{-\%}$	%	Percentage of RPM fan will be reduced due to VFD
$OA_{\%OCC}$	%	Percentage Fresh Air Reduction during occupied hours
$OA_{\%UNOCC}$	%	Percentage Fresh Air Reduction during unoccupied hours
CFM_{SUPPLY}	CFM	Total supply CFM of units
CFM_{OA}	CFM	Total outside air CFM of units
T_{OCC}	°F	Proposed occupied Temperature
T_{UNOCC}	°F	Proposed unoccupied Temperature
$T_{OCC/UNOCC}$	°F	Proposed occupied/unoccupied Mode Temperature for controlled unit
η_{BOILER}	%	Boiler Efficiency

Montclair Board of Education
Exhibit D
ECM 3B Demand Control Ventilation (in BMS scope)
Demand Control Ventilation

* Inputs are in blue

Building	Area Served	Qty	HP (Each)	Supply CFM (Each)	OA CFM (Each)
Glenfield Middle School	Gym	1	15.0	9,912	2,974
Northeast Elementary School	Cafetorium	1	3.0	9,000	2,700
Renaissance Middle School	Gym	2	5.0	3,304	991
Valley Road Complex	Hillside Gym Supply	1	7.5	5,000	1,500
Valley Road Complex	illside Auditorium Supp	1	5.0	3,000	900
Totals		6	35.5	30,216	9,065

		Glenfield Middle School	Northeast Elementary School	Renaissance Middle School	Valley Road Complex	Valley Road Complex
	Location	Gym	Cafetorium	Gym	Hillside Gym Supply	Hillside Auditorium Supply
	Quantity	1	1	2	1	1
	HP Motor Total	15	3	10	7.5	5
	Motor Load Factor	0.65	0.65	0.65	0.65	0.65
	kW Motor Total	7.27	1.45	2.42	3.64	2.42
	CFM Total	9,912	9,000	6,608	5,000	3,000
	Outside Air Total	2,974	2,700	1,982	1,500	900
	**Proposed Occupied Heating Setpoint	72.0	72	72	72	72
	**Proposed Unoccup. Heating Setpoint	60.0	60	60	60	60
	**Proposed Occupied Cooling Setpoint	72.0	72	72	72	72
	**Proposed Unoccup. Cooling Setpoint	72.0	74	72	72	72
	Existing Boiler Efficiency	91.0%	64.8%	72.5%	69.6%	69.6%
30	Average Fan Speed Reduction	0%	0%	0%	0%	0%
20	Average Occupied Heating Reduction	20%	20%	20%	20%	20%
20	Average Unoccupied Heating Reduction	0%	0%	0%	0%	0%
0	Safety Factor	0%	0%	0%	0%	0%
	Electrical Savings	-	-	-	-	-
	Thermal Savings	131	232	123	101	60

Montclair Board of Education
Exhibit D
ECM 3B Demand Control Ventilation (in BMS scope)
Demand Control Ventilation

CALCULATIONS

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	98	229	2,974	8	0	0.2	0.0	2
50 to 55	52.5	109	182	172	463	123	340	2,974	24	0	0.6	0.0	7
45 to 50	47.5	105	119	142	366	84	282	2,974	40	0	0.7	0.0	7
40 to 45	42.5	185	155	177	517	113	404	2,974	56	0	1.3	0.0	14
35 to 40	37.5	236	200	241	677	146	531	2,974	72	0	2.1	0.0	23
30 to 35	32.5	237	202	198	637	147	490	2,974	88	0	2.6	0.0	29
25 to 30	27.5	121	115	113	349	83	266	2,974	104	0	1.7	0.0	19
20 to 25	22.5	149	68	97	314	56	258	2,974	120	0	1.3	0.0	15
15 to 20	17.5	95	40	46	181	33	148	2,974	136	0	0.9	0.0	10
10 to 15	12.5	39	9	28	76	9	67	2,974	153	0	0.3	0.0	3
5 to 10	7.5	21	5	5	31	5	26	2,974	169	0	0.2	0.0	2
0 to 5	2.5	4	2	-	6	2	4	2,974	185	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	0	4	2,974	201	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	2,974	217	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	2,974	233	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	900	3,048			-	12		131

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	128	199	2,700	7	0	0.2	0.0	3
50 to 55	52.5	109	182	172	463	170	293	2,700	22	0	0.7	0.0	12
45 to 50	47.5	105	119	142	366	120	246	2,700	36	0	0.9	0.0	13
40 to 45	42.5	185	155	177	517	159	358	2,700	51	0	1.6	0.0	25
35 to 40	37.5	236	200	241	677	207	470	2,700	66	0	2.7	0.0	42
30 to 35	32.5	237	202	198	637	201	436	2,700	80	0	3.2	0.0	50
25 to 30	27.5	121	115	113	349	113	236	2,700	95	0	2.1	0.0	33
20 to 25	22.5	149	68	97	314	79	235	2,700	109	0	1.7	0.0	27
15 to 20	17.5	95	40	46	181	45	136	2,700	124	0	1.1	0.0	17
10 to 15	12.5	39	9	28	76	15	61	2,700	139	0	0.4	0.0	6
5 to 10	7.5	21	5	5	31	6	25	2,700	153	0	0.2	0.0	3
0 to 5	2.5	4	2	-	6	2	4	2,700	168	0	0.1	0.0	1
-5 to 0	-2.5	4	-	-	4	0	4	2,700	182	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	2,700	197	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	2,700	211	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	1,246	2,702			-	15		232

Montclair Board of Education
Exhibit D
ECM 3B Demand Control Ventilation (in BMS scope)
Demand Control Ventilation

RENAISSANCE MIDDLE SCHOOL

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	111	216	1,982	5	0	0.1	0.0	2
50 to 55	52.5	109	182	172	463	140	323	1,982	16	0	0.4	0.0	6
45 to 50	47.5	105	119	142	366	94	272	1,982	27	0	0.5	0.0	7
40 to 45	42.5	185	155	177	517	127	390	1,982	37	0	1.0	0.0	13
35 to 40	37.5	236	200	241	677	164	513	1,982	48	0	1.6	0.0	22
30 to 35	32.5	237	202	198	637	165	472	1,982	59	0	1.9	0.0	27
25 to 30	27.5	121	115	113	349	93	256	1,982	70	0	1.3	0.0	18
20 to 25	22.5	149	68	97	314	62	252	1,982	80	0	1.0	0.0	14
15 to 20	17.5	95	40	46	181	37	144	1,982	91	0	0.7	0.0	9
10 to 15	12.5	39	9	28	76	10	66	1,982	102	0	0.2	0.0	3
5 to 10	7.5	21	5	5	31	5	26	1,982	112	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	2	4	1,982	123	0	0.0	0.0	1
-5 to 0	-2.5	4	-	-	4	0	4	1,982	134	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	1,982	145	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	1,982	155	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	1,011	2,937			-	9		123

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	105	222	1,500	4	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	133	330	1,500	12	0	0.3	0.0	5
45 to 50	47.5	105	119	142	366	93	273	1,500	20	0	0.4	0.0	5
40 to 45	42.5	185	155	177	517	130	387	1,500	28	0	0.7	0.0	11
35 to 40	37.5	236	200	241	677	167	510	1,500	36	0	1.2	0.0	18
30 to 35	32.5	237	202	198	637	169	468	1,500	45	0	1.5	0.0	22
25 to 30	27.5	121	115	113	349	93	256	1,500	53	0	1.0	0.0	14
20 to 25	22.5	149	68	97	314	69	245	1,500	61	0	0.8	0.0	12
15 to 20	17.5	95	40	46	181	42	139	1,500	69	0	0.6	0.0	8
10 to 15	12.5	39	9	28	76	13	63	1,500	77	0	0.2	0.0	3
5 to 10	7.5	21	5	5	31	7	24	1,500	85	0	0.1	0.0	2
0 to 5	2.5	4	2	-	6	2	4	1,500	93	0	0.0	0.0	1
-5 to 0	-2.5	4	-	-	4	1	3	1,500	101	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	1,500	109	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	1,500	117	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	1,024	2,924			-	7		101

Montclair Board of Education
Exhibit D
ECM 3B Demand Control Ventilation (in BMS scope)
Demand Control Ventilation

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Ave Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Bin Hours	Unoccupied Bin Hours	Outside Air Flowrate CFM	OA Air Load MBH	Annual Fan Electrical Savings	Annual Occupied Heating Savings	Annual Unoccupied Heating Savings	Total Savings Therms
HEATING													
55 to 60	57.5	86	144	97	327	105	222	900	2	0	0.1	0.0	1
50 to 55	52.5	109	182	172	463	133	330	900	7	0	0.2	0.0	3
45 to 50	47.5	105	119	142	366	93	273	900	12	0	0.2	0.0	3
40 to 45	42.5	185	155	177	517	130	387	900	17	0	0.4	0.0	6
35 to 40	37.5	236	200	241	677	167	510	900	22	0	0.7	0.0	11
30 to 35	32.5	237	202	198	637	169	468	900	27	0	0.9	0.0	13
25 to 30	27.5	121	115	113	349	93	256	900	32	0	0.6	0.0	8
20 to 25	22.5	149	68	97	314	69	245	900	36	0	0.5	0.0	7
15 to 20	17.5	95	40	46	181	42	139	900	41	0	0.3	0.0	5
10 to 15	12.5	39	9	28	76	13	63	900	46	0	0.1	0.0	2
5 to 10	7.5	21	5	5	31	7	24	900	51	0	0.1	0.0	1
0 to 5	2.5	4	2	-	6	2	4	900	56	0	0.0	0.0	0
-5 to 0	-2.5	4	-	-	4	1	3	900	61	0	0.0	0.0	0
-10 to -5	-7.5	-	-	-	-	-	-	900	66	0	0.0	0.0	0
-15 to -10	-12.5	-	-	-	-	-	-	900	70	0	0.0	0.0	0
Total		1,391	1,241	1,316	3,948	1,024	2,924			-	4		60

Montclair Board of Education
Exhibit D
ECM 3C Exhaust Fan Controls (in BMS scope)
Exhaust Fan Replacement

ECM DESCRIPTION

Replacement of exhaust fans. New exhaust fans will be integrated into the existing / proposed building management syste. The tie in will allow control of the fans to run only when spaces or occupied or needed. Code exhaust requirements will be met.

DATA / ASSUMPTIONS

* Current run hours are based upon interview with staff and site survey observations
* Proposed run hours are based upon either on occupancy of the spaces or to meet code requirements
* Some motor efficiencies have been verified and an average motor efficiency is used

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and installed motors and operating hours. All existing motors will be measured before removal and new motors after the installation. Equipment operating hours are based on the audit, logging and operating personnel input.

COMMISSIONING

Review installation documents for alignments and vibrations. Verify functional control of fans and their response to the control signals issued by the building management system.

SAFETY FACTOR

Safety Factor (Electric) = **0%**

FORMULAE

$W_{SAVINGS} = W_{EXISTING} - W_{PROPOSED}$

$W_{EXISTING} = Hp \cdot Lf \cdot \eta \cdot t$
$W_{PROPOSED} = Hp \cdot Lf \cdot \eta \cdot t$

Montclair Board of Education
Exhibit D
ECM 3C Exhaust Fan Controls (in BMS scope)
Exhaust Fan Replacement

Variable	Units	Description
$W_{savings}$	kWh	Electrical Savings for Motor Replacement
Hp	HP	Horsepower of motor
t	Hrs	Existing Run Hours
t	Hrs	Proposed Run Hours
Lf	-	Load Factor of motor
η	-	Existing efficiency of motor
η	-	Proposed efficiency of motor
$W_{EXISTING}$	kWh	Existing electrical consumption of motor
$W_{PROPOSED}$	kWh	Proposed electrical consumption of motor

* Inputs are in blue

Building	Total Exhaust Fan HP	Quantity	Type of Exhaust Fan	Current Run Hours	Proposed Run Hours	Current Motor Efficiency (Average)	Proposed Motor Efficiency (Average)
Bradford Elementary School	2.5	10	General Exhaust	8,760	2,000	90.0%	90.0%
Bullock Elementary School	4.5	18	General Exhaust	8,760	2,000	90.0%	90.0%
Buzz Aldrin Middle School	1.0	4	General Exhaust	8,760	2,000	90.0%	90.0%
Glenfield Middle School	2.5	10	General Exhaust	8,760	2,000	90.0%	90.0%
Valley Road Complex	0.3	1	General Exhaust	8,760	2,000	90.0%	90.0%
Montclair High School	1.0	4	General Exhaust	8,760	2,000	90.0%	90.0%
Northeast Elementary School	1.3	5	General Exhaust	8,760	2,000	90.0%	90.0%
Watchung Elementary School	1.3	5	General Exhaust	8,760	2,000	90.0%	90.0%
Woodman Field	0.5	2	General Exhaust	8,760	2,000	90.0%	90.0%
Totals	14.8	59	-	78,840	18,000	8	8.1

General Exhaust
House Exhaust
Toilet Exhaust
Kitchen Exhaust

Montclair Board of Education
Exhibit D
ECM 3C Exhaust Fan Controls (in BMS scope)
Exhaust Fan Replacement

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Glenfield Middle School	Valley Road Complex	Montclair High School	Northeast Elementary School	Watchung Elementary School	Woodman Field
Total Exhaust Fan Hp	2.50	4.50	1.00	2.50	0.25	1.00	1.25	1.25	0.50
Quantity of Fans	10	18	4	10	1	4	5	5	2
Current Run Hours	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Proposed Run Hours	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Current Motor Efficiency (Average)	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
Proposed Motor Efficiency (Average)	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
Load Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Current Electrical Consumption	11,799	21,239	4,720	11,799	1,180	4,720	5,900	5,900	2,360
Proposed Electrical Consumption	2,694	4,849	1,078	2,694	269	1,078	1,347	1,347	539
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	9,105	16,390	3,642	9,105	911	3,642	4,553	4,553	1,821

Montclair Board of Education
Exhibit D
ECM 4A Building Envelope Improvements
Building Envelope Improvements

ECM DESCRIPTION

Reduce building infiltration by weather stripping doors, sealing roof & wall joints, duct & piping penetrations, skylight perimeters and window corners.

DATA / ASSUMPTIONS

*Crack area determined by survey team

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Visual inspection per scope of work from subcontractor. Inspection might include smoke test.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	0%
Safety Factor (Thermal) =	0%

Recovery factor taken at 10% due to the uncertainty of variables incorporated in the savings calculations

FORMULAE

$H = (K * Q_{INF} * (dp)^n * HDD * 10) / 28,900$ where 28,900 = Heating efficiency factor = (1,000,000 Btu per MMBtu / (1.08 * 24 hr/day)) * 75% std htg efficiency

$C = T * C2 * CDD$ where $T = C1 * Q_{INF} * h$

$Q_{INF} = K * dp^n * A_{CRACK}$

$dp^n = 5.16$

$A_{CRACK} = A_{VENTS} + A_{WIN} + A_{RTU} + A_{DOORS} + A_{BULK} + A_{ROOF/WALL}$

Variable	Units	Description
H	therms	Thermal Savings associated with air infiltration reduction
C	kWh	Electrical Savings associated with air infiltration reduction
Q_{INF}	cfm	Infiltration air flow savings
A_{CRACK}	ft^2	Total square feet of infiltration area
K	(ft^3 / min) / (Pa * ft^2)	Flow Factor
dp^n	Pa	Pressure difference across building envelope raised to nth power
CDD	(^oF-Day)/Yr	Cooling degree days
T	tons	Cooling load
h	Btu/lb	Avg. enthalpy of air
HDD	(°F-Day)/Yr	Annual heating degree days
C1	lb/ft^3 * min/hr	Cooling Constant = std air density 0.075 lb/ft^3 * 60 min/hr
C2	kW/ton	Cooling system characteristic power consumption
A_{VENTS}	ft^2	Total square feet of infiltration spaces with regards to vents
A_{WIN}	ft^2	Total square feet of infiltration spaces with regards to windows
A_{RTU}	ft^2	Total square feet of infiltration spaces with regards to RTU's
A_{DOORS}	ft^2	Total square feet of infiltration spaces with regards to doors
A_{BULK}	ft^2	Total square feet of infiltration spaces with regards to bulkheads
$A_{ROOF/WALL}$	ft^2	Total square feet of infiltration spaces with regards to the wall roof joint

Source: Public Works Canada Standards & Guidelines,: EC128 April 30, 1980

Very Good
Good
Average
Poor
Loose

Montclair Board of Education
Exhibit D
ECM 4A Building Envelope Improvements
Building Envelope Improvements

ASSUMPTIONS / DATA

Subcontractor Calculations N * If Yes - Please Refer to tab 'Sub BEI Calculation' for details

Building	Building Envelope Improvements (Y/N)	Envelope Tightness	Cooling Savings Applicable (Y/N)
Bradford Elementary School	Y	Poor	Y
Bullock Elementary School	Y	Good	Y
Buzz Aldrin Middle School	Y	Poor	Y
Edgemont Elementary School	Y	Poor	Y
Glenfield Middle School	Y	Poor	N
Valley Road Complex	Y	Poor	Y
Montclair High School	Y	Poor	Y
George Inness Annex (HS-9th), Athletics	Y	Poor	Y
Nishuane K-2	Y	Poor	Y
Northeast Elementary School	Y	Poor	Y
Renaissance Middle School	Y	Poor	Y
Watchung Elementary School	Y	Poor	Y
Woodman Field	Y	Average	Y

Montclair Board of Education
Exhibit D
ECM 4A Building Envelope Improvements
Building Envelope Improvements

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Building Envelope Improvements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Envelope Tightness	Poor	Good	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Average
Tightness Multiplier	0.0004	0.00014	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.00028
Cooling Savings Applicable	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Heating Savings Diversity Factor	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Flow Factor	20	20	20	20	20	20	20	20	20	20	20	20	20
(AP)^n	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16
Crack Area	36.7	12.2	44.9	32.6	84.2	55.1	61.1	69.8	24.2	26.8	18.6	21.4	17.1
Air Leakage (CFM)	3,785	1,263	4,630	3,360	8,691	5,686	6,305	7,201	2,500	2,768	1,917	2,210	1,768
Heating Degree Days	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843
Heating Efficiency Factor	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900	28,900
Cooling Savings Diversity Factor	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%
Constant	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.5
CFM	3,785	1,263	4,630	3,360	8,691	5,686	6,305	7,201	2,500	2,768	1,917	2,210	1,768
Enthalpy	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Tons	13.9	4.6	17.0	12.3	-	20.9	23.2	26.5	9.2	10.2	7.0	8.1	7.9
Constant	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
CDD	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242	1,242
kWh	11,402	3,804	13,948	10,121	-	17,129	18,992	21,693	7,530	8,339	5,775	6,658	6,509
Therms	5,074	1,693	6,207	4,504	11,651	7,623	8,452	9,654	3,351	3,711	2,570	2,963	2,370
Electric Safety Factor	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Thermal Safety Factor	0%	0%	0%	0%	0%	0%	0%	20%	0%	10%	0%	0%	0%
kWh Savings	11,402	3,804	13,948	5,060	-	17,129	18,992	21,693	7,530	8,339	5,775	6,658	6,509
Thermal Savings	5,074	1,693	6,207	4,504	11,651	7,623	8,452	7,723	3,351	3,340	2,570	2,963	2,370

Montclair Board of Education
Exhibit D
ECM 5A Computer Power Management
Computer Power Management

ECM DESCRIPTION

Install a centralized personal computer power management system to control computers and monitors.

DATA / ASSUMPTIONS

* Annual Savings for Student Computers	120	kWh/Yr
* Annual Savings for Administrative Computers	110	kWh/Yr

	On		Sleep Mode	
* CRT wattage (Average)	70	W	15	W
* LCD wattage	18	W	5	W

Annual Savings for Administrative Computers and Student Computers are based on previous logging results for computers with similar usage types

MEASUREMENT AND VERIFICATION

Option A - The engineering calculations are based on direct kW measurements of the existing and post software installation computers. All existing computers will be measured before the installation of the computer management software.

COMMISSIONING

Review installation documents for alignments and vibrations. Start up equipment and measure vibration through the load range along with motor kW. Verify that VFDs are capable of operating in full design range upon the control signal demand.

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

The safety factor for this ECM is taken at 0 due to some variability in schedule and load changes.

FORMULAE

$$W_{TOTAL} = (W_{CPU} \cdot CPU_{\#}) + (W_{LCD} \cdot CRT_{\#})$$

$$W_{LCD} = (CRT_{\#} \cdot Monitor_{hrs\text{-}SLEEP} \cdot (W_{CRT\text{-}SLEEP} - W_{LCD\text{-}SLEEP}) \cdot Monitor_{\%OFF}) + (CRT_{\#} \cdot Monitor_{hrs\text{-}ON} \cdot (W_{CRT\text{-}ON} - W_{LCD\text{-}ON}))$$

Variable	Units	Description
W_{TOTAL}	kWh	Total Electrical Savings associated with this measure
W_{CPU}	kWh	Electrical Savings associated with computer control
W_{LCD}	kWh	Electrical Savings associated with Monitor Replacement
$CPU_{\#}$	-	Numbers of Computers
$CRT_{\#}$	-	Numbers of CRTs
$W_{CRT\text{-}ON}$	kWh	Wattage of CRT Monitor when ON
$W_{CRT\text{-}SLEEP}$	kWh	Wattage of CRT Monitor when in sleep mode
$W_{LCD\text{-}ON}$	kWh	Wattage of LCD Monitor when ON
$W_{LCD\text{-}SLEEP}$	kWh	Wattage of LCD Monitor when in sleep mode
$Monitor_{hrs\text{-}ON}$	hrs	Annual hours monitor is ON
$Monitor_{hrs\text{-}SLEEP}$	hrs	Annual hours monitor is in sleep mode
$Monitor_{\%OFF}$	%	Percentage that monitor is off during sleep mode hours

Montclair Board of Education
Exhibit D
ECM 5A Computer Power Management
Computer Power Management

* Inputs are in blue

Building	# of Student Computers	# of Administrative Computers	# of CRTs to be Replaced
Bradford Elementary School	0	80	
Bullock Elementary School	40	33	
Buzz Aldrin Middle School	93	94	
Edgemont Elementary School	0	35	
Glenfield Middle School	0	81	
Valley Road Complex	0	27	
Montclair High School	200	110	
George Inness Annex (HS-9th), Athletics	0	105	
Nishuane K-2	0	68	
Northeast Elementary School	0	48	
Renaissance Middle School	0	100	
Watchung Elementary School	0	52	
Woodman Field	0	2	
Totals	333	835	0

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Number of Student Computers	-	40	93	-	-	-	200	-	-	-	-	-	-
Number of Administrative Computers	80	33	94	35	81	27	110	105	68	48	100	52	2
Total Number of Computers	80	73	187	35	81	27	310	105	68	48	100	52	2
Number of CRTs to be Replaced	-	-	-	-	-	-	-	-	-	-	-	-	-
Monitor On Run Hours	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080
Monitor Sleep Mode Run Hours	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240
Percentage of Monitors Turned off during Unoccupied Hours	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%
kWh Savings (Monitor)	-	-	-	-	-	-	-	-	-	-	-	-	-
kWh Savings (Computers)	8,800	8,430	21,500	3,850	8,910	2,970	36,100	11,550	7,480	5,280	11,000	5,720	220
kWh Savings	8,800	8,430	21,500	3,850	8,910	2,970	36,100	11,550	7,480	5,280	11,000	5,720	220
Recovery Factor	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
kWh Savings	7,920	7,587	19,350	3,465	8,019	2,673	32,490	10,395	6,732	4,752	9,900	5,148	198

Montclair Board of Education
Exhibit D
ECM 6A Permanent Load Reduction
Permanent Load Reduction

ECM DESCRIPTION

PJM Demand Response Program based on Shedable Load on Peak Demand Curtailment Day

DATA / ASSUMPTIONS

Demand Response Revenue	$ 15,000	/ MW
Permanent Load Reduction	$ 27,750	/ MW
Customer Share (Typically between 60-70%)	100%	

Year	All Other $/kW	PSEG $/kW
2019/2020	$22.00	$22.00
2020/2021	$34.00	$34.00
2021/2022	$30.00	$25.00
2022/2023	$25.00	$30.00
	$27.75	$27.75

*Demand Response Savings = Assumed between 1 - 4% Annual Electrical Load
*Assume 2% of Total District Load as Shedable
*Savings is not Guaranteed any savings from program will be considered operational savings only

MEASUREMENT AND VERIFICATION

None - Operational Savings

COMMISSIONING

N/A

RECOVERY/SAFETY FACTOR

N/A

FORMULAE

$$\$_{savings} = kWh_{ADJ} \cdot Cust_{\%} \cdot DM_{\%}$$

Variable	Units	Description
$\$_{savings}$	Dollars	Dollar Savings from Demand Response
$DM_{\%}$	%	Demand Response Savings as a percentage of electric baseline
$Cust_{\%}$	%	Customer Percentage of Savings
kWh_{BASE}	kWh	Adjusted Boiler Fuel Usage

* Inputs are in blue

Building	Demand Response/Permanent Load Reduction Participation (Y/N)
Bradford Elementary School	Y
Bullock Elementary School	Y
Buzz Aldrin Middle School	Y
Edgemont Elementary School	Y
Glenfield Middle School	Y
Valley Road Complex	Y
Montclair High School	Y
George Inness Annex (HS-9th), Athletics	Y
Nishuane K-2	Y
Northeast Elementary School	Y
Renaissance Middle School	Y
Watchung Elementary School	Y
Woodman Field	Y

Montclair Board of Education
Exhibit D
ECM 6A Permanent Load Reduction
Permanent Load Reduction

CALCULATIONS

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Demand Response Participation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Average Monthly kW	125	210	187	41	208	236	257	171	98	100	62	72	68
Permanent Load Shed Reduction (kW)	**24.1**	**74.2**	**61.6**	**18.7**	**58.4**	**134.7**	**109.4**	**23.7**	**33.8**	**24.8**	**24.6**	**15.8**	**6.5**
Sheddable Load (kW)	-	-	-	-	-	-	-	-	-	-	-	-	-
Percentage of Baseline Demand	**19.2%**	**35.2%**	**32.9%**	**45.7%**	**28.1%**	**57.1%**	**42.6%**	**13.8%**	**34.4%**	**24.7%**	**39.4%**	**22.0%**	**9.5%**
Demand Response $ / MW	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Permanent Load Shed Reduction $ / MW	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750	$ 27,750
Demand Hours / Year	100	$ -											
Cost to Run Generator / hr	$ -	$ -											
Cost to Run Generator / yr	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Safety Factor	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**

Montclair Board of Education
Exhibit D
ECM 7A Transformer Replacement
Transformer Replacement

ECM DESCRIPTION

Replace dry transformers with new custom designed high efficiency transformers. New transformers will save electricity and avoid the future replacements due to failure.

DATA / ASSUMPTIONS
*Input Measured kW losses (If kW losses are not none calculation will calculate efficiency using past results)
* Existing loads were obtained by data logging
* Existing efficiencies were obtained by data logging or manufacturer specifications

MEASUREMENT AND VERIFICATION

Option A - Direct kW and savings measurements before and after installation conducted. A report is generated showing the reduction in kW

COMMISSIONING

Test all transformers after installation

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) = 0%

Recovery factor is set at 10% due to unknown flucuations in transformer loads

FORMULAE

$W_{SAVINGS} = \varepsilon_T - \varepsilon_T$

$\varepsilon_T = \varepsilon_{OCC} \cdot t_{OCC} + \varepsilon_{UNOCC} \cdot t_{UNOCC}$
$\varepsilon_T = \varepsilon_{OCC} \cdot t_{OCC} + \varepsilon_{UNOCC} \cdot t_{UNOCC}$

$\varepsilon_{OCC} = [(Lf_{OCC} \cdot KVA) / \eta_L^{OCC}] - (KVA \cdot Lf_{OCC})$
$\varepsilon_{OCC} = [(Lf_{OCC} \cdot KVA) / \eta_L^{OCC}] - (KVA \cdot Lf_{OCC})$

$\varepsilon_{UNOCC} = [(Lf_{OCC} \cdot KVA) / \eta_L^{UNOCC}] - (KVA \cdot Lf_{OCC})$
$\varepsilon_{UNOCC} = [(Lf_{OCC} \cdot KVA) / \eta_L^{UNOCC}] - (KVA \cdot Lf_{OCC})$

$\eta_L^{OCC} = Lf_{OCC} \cdot kVA \cdot \eta_T$
$\eta_L^{OCC} = Lf_{OCC} \cdot kVA \cdot \eta_T$

$\eta_L^{UNOCC} = Lf_{UNOCC} \cdot kVA \cdot \eta_T$
$\eta_L^{UNOCC} = Lf_{UNOCC} \cdot kVA \cdot \eta_T$

Variable	Units	Description
$W_{savings}$	kWh	Electrical Savings
ε_T	kW	Existing annual transformer losses
ε_T	kW	Proposed annual transformer losses
t_{OCC}	Hrs	Existing Run Hours
t_{UNOCC}	Hrs	Proposed Run Hours
ε_{OCC}	kW	Existing transformer losses during occupied hours
ε_{OCC}	kW	Proposed transformer losses during occupied hours
ε_{UNOCC}	kW	Existing transformer losses during unoccupied hours
ε_{UNOCC}	kW	Proposed transformer losses during unoccupied hours
kVA	kVA	kVA of existing transformer
Lf_{OCC}	-	Load Factor of transformer during occupied hours
Lf_{UNOCC}	-	Load Factor of transformer during unoccupied hours
η_L^{OCC}	%	Existing efficiency of transformer during occupied hours
η_L^{OCC}	%	Proposed efficiency of transformer during occupied hours
η_L^{UNOCC}	%	Existing efficiency of transformer during unoccupied hours
η_L^{UNOCC}	%	Proposed efficiency of transformer during unoccupied hours
η_T	%	Existing weighted efficiency of transformer at various loads
η_T	%	Proposed weighted efficiency of transformer at various loads

* Inputs are in blue
Calculation is automatic. If Efficiencies are known override automatically generated efficiencies in Columns G through M when necessary

Montclair Board of Education
Exhibit D
ECM 7A Transformer Replacement
Transformer Replacement

							EXISTING					PROPOSED			
Building	Replace	Tag Number	Location ID	Transormer Designation	Qty	kVA	% Load During Occupied Hours	% Load During Unoccupied Hours	Baseline kW Losses (Normal Operation)	Baseline kW Losses (Outside Op. hrs)	Efficiency at Occupied Loads	Efficiency at Unoccupied Loads	New Transformer kW Losses (Normal Operation)	New Transformer kW Losses (Outside Op. hrs)	Efficiency Occupied Loads	Efficiency Unoccupied Loads
Bradford Elementary School	y	BES-T-1	Electric Rm 3	0	1.00	112.5	5.9%	2.0%	1.269	1.259	92.50%	90.52%	0.175	0.165	98.20%	97.80%
Bradford Elementary School	y	BES-T-2	Boiler Rm	0	1.00	150.0	30.8%	26.0%	1.269	1.159	92.99%	92.99%	0.558	0.456	98.39%	97.85%
Bradford Elementary School	y	BES-T-3	Boiler Rm	0	1.00	15.0	24.6%	19.0%	0.314	0.292	86.88%	81.90%	0.080	0.062	96.75%	95.75%
George Inness Annex (HS-9th), Athletics	y	GIA-T-1	Main Electric	0	1.00	300.0	20.0%	15.0%	4.260	4.154	94.48%	91.57%	0.604	0.503	98.45%	98.12%
George Inness Annex (HS-9th), Athletics	y	GIA-T-2	Electric Rm 2	0	1.00	225.0	16.7%	11.0%	3.061	2.963	93.49%	90.74%	0.431	0.367	98.40%	97.90%
Totals					5	803										

Montclair Board of Education
Exhibit D
ECM 7A Transformer Replacement
Transformer Replacement

CALCULATIONS

	Bradford Elementary School	Bradford Elementary School	Bradford Elementary School	George Inness Annex (HS-9th), Athletics	George Inness Annex (HS-9th), Athletics
Replace Transformer	y	y	y	y	y
kVa	112.5	150.0	15.0	300.0	225.0
Quantity	1	1	1	1	1
% Load at Occupied Hours	6%	31%	25%	20%	17%
% Load at Unoccupied Hours	2%	26%	19%	15%	11%
Estimated Efficiences					
Existing Efficiency at Occupied Loads	92.5%	93.0%	86.9%	94.5%	93.5%
Existing Efficiency at Unoccupied Loads	90.5%	93.0%	81.9%	91.6%	90.7%
Proposed Efficiency at Occupied Loads	98.2%	98.4%	96.8%	98.5%	98.4%
Proposed Efficiency at Unoccupied Loads	97.8%	97.9%	95.8%	98.1%	97.9%
Measured Baseline Losses					
Existing Losses at Occupied Loads	1.269	1.269	0.314	4.260	3.061
Existing Losses at Unoccupied Loads	1.259	1.159	0.292	4.154	2.963
Proposed Losses at Occupied Loads	0.175	0.558	0.080	0.604	0.431
Proposed Losses at Unoccupied Loads	0.165	0.456	0.062	0.503	0.367
Measured kW Losses					
Existing kW Losses Occupied Hours	1.094	0.711	0.234	3.656	2.630
Existing kW Losses Unoccupied Hours	1.094	0.703	0.230	3.651	2.596
Estimated kW Losses based on Efficiences					
Existing kW Losses Occupied Hours Calculated	0.538	3.4807	0.5574	3.5055	2.6175
Existing kW Losses Unoccupied Hours Calculated	0.695	3.4807	0.8157	5.5229	3.8325
Occupancy					
Occupied Hours per Day	**12**	**12**	**12**	**13**	**13**
Occupied Days per Year	**200**	**200**	**200**	**200**	**200**
Estimated kWh Losses based on Efficiences					
Existing Annual kWh Losses	5,713	30,491	6,526	43,136	30,414
Proposed kW and kWh Losses based on Efficiences					
Proposed kW Losses Occupied Hours	0.1217	0.7547	0.1240	0.9446	0.6110
Proposed kW Losses Unoccupied Hours	0.0506	0.8551	0.1265	0.8622	0.5309
Proposed Annual kWh Losses	614	7,250	1,102	7,767	4,859
Safety Factor	**0%**	**0%**	**0%**	**0%**	**0%**
Total kW and kWh Savings					
kW Savings	1.094	0.711	0.234	3.656	2.630
kWh Savings	9,583	6,177	2,024	31,996	22,829

Montclair Board of Education
Exhibit D
ECM 8A Cogeneration
Combined Heat and Power Plant

ECM DESCRIPTION

Installation of a Combined Heat and Power Plant (CHP). Recoverable heat from the CHP will be used to subsidize heating requirements.

DATA / ASSUMPTIONS

*Annual run hours are agreed upon by facility staff
*Annual waste dump hours are taken at 10% of run time
*CHP Natural Gas Consumption and Recoverable Heat Rate provided by the CHP Manufacturer.
* Parasitic load during normal operation 1%

MEASUREMENT AND VERIFICATION

Option A (Electric) - The engineering calculations are based on direct kW measurements of the electrical output feed.
Option C (Thermal) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify electrical and natural gas interconnects, as well as, electrical production by multimeter spot measurements. Verify proper exhaust ventilation.

A safety factor of 0.5 is conservative

RECOVERY/SAFETY FACTOR

Safety Factor (Electric) =	50%
Safety Factor (Thermal) =	0%

Montclair Board of Education
Exhibit D
ECM 8A Cogeneration
Combined Heat and Power Plant

FORMULAE

$W_{PRODUCTION} = (kW_{CHP} - KW_{PARA}) \cdot t_{CHP}$

$Q_{NET} = (Q_{CHP} - Q_{DISPLACED})$

$Q_{CHP} = Q_D$

$Q_{DISPLACED} = CHP_{NG\text{-}RATE} \cdot (t_{CHP} + t_{DUMP})$

$Q_D = CHP_{NG\text{-}USEABLE} \cdot (CHP_{RECOVERY} \ / \ CHP_{NG\text{-}RATE}) \cdot HEATEXG$

$CHP_{NG\text{-}USEABLE} = CHP_{NG\text{-}RATE} \cdot t_{CHP}$

Variable	Units	Description
$W_{PRODUCTION}$	kWh/yr	Annual Electrical Production of CHP
Q_{NET}	Therms/yr	Net Annual Natural Gas Consumption of CHP
$Q_{DISPLACED}$	Therms/yr	Avoided Boiler Natural Gas Consumption due to CHP Recoverable Heat
Q_D	Therms/yr	Annual CHP Recoverable Heat
kW_{CHP}	kW	CHP kW
kW_{PARA}	kW	CHP Parasitic Load
t_{CHP}	hrs	Annual CHP run time
t_{DUMP}	hrs	Annual CHP waste heat dump
Q_{CHP}	therms/yr	Annual Natural Gas Consumption of CHP
$CHP_{NG\text{-}USEABLE}$	therms/yr	Annual useable Natural Gas available for heating purposes
$CHP_{NG\text{-}RATE}$	therms/hr	Natural Gas Consumption rate for the CHP
$CHP_{RECOVERY}$	therms/hr	Recoverable heat from CHP
HEATEXG	%	Heat Exchanger Efficiency
η_{BOILER}	%	Boiler Efficiency

*Parastic Load, Natural Gas Consumption Rate, and Recoverable Heat Rate based off of Tecogen Literature. If using another manufacturer input fields manually

CHP	Building	CHP Plant Electric Output (kW)	Annual Run Hours of Plant	Heat Recovery Efficiency through Heat Exchanger	Parasitic Load* (kW)	Natural Gas Consumption Rate* (therm/hr)	Recoverable Heat Rate* (therm/hr)
N	Glenfield Middle School	35.0	8,322	80%	0.35	4.07	2.04
	Total	**35.0**			0.4		

Montclair Board of Education
Exhibit D
ECM 8A Cogeneration
Combined Heat and Power Plant

	Glenfield Middle School
CHP Plant Electric Output	35.0
Parasitic Load	0.4
Proposed Facility Electric Demand	34.7
Annual hours for CHP Plant	8,322
Annual Waste Heat Dump Hours	**3,743**
Annual CHP Plant Electric Output	288,357
Natural Gas Consumption Rate	4.1
Annual CHP Plant Natural Gas Consumption	33,880
Recoverable Heat Rate	2.0
Heat Recovery Efficiency through Heat Exchanger	80%
Recoverable CHP Heat Output	7,474
Boiler Efficiency	91.0%
Annual Displaced Natural Gas Consumption	8,214
kW Safety Factor	**50%**
Safety Factor	**0%**
kW Savings / Month	17.3
Annual kWh Production	288,357
Annual Net Thermal Consumption	(25,666)

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

ECM DESCRIPTION

Furnish and install a PVC roofing system as manufactured by Sika Samafil or equal.

DATA / ASSUMPTIONS

Heating Hours 3,948 Hours

Building Existing Roof is in satisfactory condition and can be overlayed with little or no repairs
-15%+ loss in thermal resistance due to thermal shorts of steel fasteners
-10% increase in thermal transmittance when using single layer of insulation board
-R-value & Air permeability of a deck, insulation & membrane has a major impact on System R-value

*U Factors for the new roof was obtained by manufacturer and product data. U Factors for the existing roof is based on construction type and material

MEASUREMENT AND VERIFICATION

Option A - Electrical Savings based on Engineering Calculations
Option C - Thermal Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify area of new roof installed.

RECOVERY/SAFETY FACTOR

Recovery/Safety Factor (Electric) =	0%
Recovery/Safety Factor (Thermal) =	0%

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of 0 percent is used for this ECM due to the uncertainty of variables. The heating fuel savings calculations are based upon information provided by the equipment vendor.

FORMULAE

$$Q_{SAVINGS} = (Q_C - Q_C) + Q_{INF}$$

$$Q_{INF} = \sum_{-5}^{100} (1.08 \cdot (i_{ROOF} - i_{ROOF}) \cdot (T_{W/S} - T_{BIN}) \cdot I_R \cdot t_{BIN}) / 100{,}000$$

$$Q_C = \sum_{-5}^{100} ((T_{W/S} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{BIN}) / 100{,}000$$
$$Q_C = \sum_{-5}^{100} ((T_{W/S} - T_{BIN}) \cdot A_{ROOF} \cdot U_{ROOF} \cdot t_{BIN}) / 100{,}000$$

*Note W/S designates use of either winter building setpoint or summer building setpoint with the appropiate bin

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
Q_C	Therms	Conductive/convective cooling gain and heating loss with existing windows
Q_C	Therms	Conductive/convective cooling gain and heating loss with proposed windows
Q_{INF}	Therms	Infiltration savings with proposed windows
$\sum_{-5}^{100}$	-	Summation of all bins from -5°F to 100°F
T_W	°F	Winter building setpoint
T_S	°F	Summer building setpoint
T_{BIN}	°F	Temperature of respective bin
t_{BIN}	Hrs	Hrs in respective bin
A_{ROOF}	ft^2	Existing unoccupied Bin Hours in respective temperature bin
U_{ROOF}	btu / ft^2 / °F	Existing U-factor of roof
U_{ROOF}	btu / ft^2 / °F	Proposed U-factor of roof
i_{ROOF}	Cfm/ft	Infiltration constant for existing windows
i_{ROOF}	Cfm/ft	Infiltration constant for proposed windows
I_R	ft	Linear feet of curtain wall

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

* Inputs are in blue

Building	Roof ft^2 Audited	Air permability Factor of Deck. Insulation, membrane (-100%-0)	Thermal Transmittance Increase (20-0%)	Thermal Shorts due to Steel Fastners (-15%-0)	R - Value of Existing Roofing Materials	R - Value of Existing Roof	U Factor of Existing Roof	R - Value of Proposed Roof	U Factor of Proposed Roof	Infiltration of Existing Roof (0-100%)	Infiltration of Proposed Roof ((0-100%)	EER of Cooling System (Average)
Bradford Elementary School	10,687	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Buzz Aldrin Middle School	7,210	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Edgemont Elementary School	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Glenfield Middle School	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Valley Road Complex	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Montclair High School	80,251	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
George Inness Annex (HS-9th), Athletics	6,293	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Nishuane K-2	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Northeast Elementary School	6,156	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Renaissance Middle School	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Watchung Elementary School	0	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Woodman Field	3,615	-50%	-10%	-15%	18.00	4.50	0.22	4.50	0.22	50%	45%	11.0
Totals	114,212											

	Bradford Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Roof ft^2 Audited	10,687	7,210	0	0	0	80,251	6,293	0	6,156	0	0	3,615
U of Existing Roof	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
U of Proposed Roof	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Infiltration of Existing Roofs	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Infiltration of Proposed Roofs	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Total Linear Ft of Perimeter	761	366	-	-	-	3,315	363	-	522	-	-	270
EER of Cooling System (Average)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Existing Occupied Heating Setpoint	72.0	79.0	81.0	76.0	74.0	75.0	76.0	77.0	78.0	77.0	78.0	72.0
Existing Unoccup. Heating Setpoint	65.0	66.0	66.0	65.0	66.0	66.0	64.0	72.0	72.0	65.0	69.0	72.0
Existing Occupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Existing Unoccup. Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Boiler Efficiency	72.5%	69.4%	72.5%	91.0%	69.6%	69.6%	64.8%	64.8%	64.8%	72.5%	73.5%	70.6%
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Electrical Savings	167	80	-	-	-	728	80	-	115	-	-	59
Thermal Savings	61	32	-	-	-	285	31	-	58	-	-	30

CALCULATIONS

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

BRADFORD ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	10,687	0.0	0.0	0.0	0.0	-	0.0	0.0	0%	0	
95 to 100	97.5	-	19	2	21	12	9	10,687	0.8	0.6	0.8	0.6	-	0.0	0.0	0%	6	
90 to 95	92.5	-	44	13	57	28	30	10,687	1.5	1.6	1.5	1.6	-	0.0	0.0	0%	14	
85 to 90	87.5	1	167	60	228	104	124	10,687	4.2	5.0	4.2	5.0	-	0.1	0.1	0%	43	
80 to 85	82.5	31	283	162	476	180	296	10,687	4.9	8.1	4.9	8.1	-	0.2	0.2	0%	60	
75 to 80	77.5	191	235	280	706	164	542	10,687	2.3	7.7	2.3	7.7	-	0.2	0.2	0%	47	
70 to 75	72.5	203	177	222	602	129	473	10,687	0.2	0.6	0.2	0.6	-	0.0	0.0	0%	4	
65 to 70	67.5	325	165	204	694	132	562	10,687	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	10,687	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	10,687	3.4	0.5	3.4	4.1	-	0.1	0.1	0%		1
50 to 55	52.5	109	182	172	463	123	340	10,687	5.7	0.8	5.7	10.1	-	0.2	0.2	0%		3
45 to 50	47.5	105	119	142	366	84	282	10,687	4.9	0.7	4.9	11.7	-	0.3	0.3	0%		4
40 to 45	42.5	185	155	177	517	113	404	10,687	7.9	1.0	7.9	21.6	-	0.5	0.5	0%		7
35 to 40	37.5	236	200	241	677	146	531	10,687	12.0	1.3	12.0	34.7	-	0.8	0.8	0%		11
30 to 35	32.5	237	202	198	637	147	490	10,687	13.8	1.2	13.8	37.8	-	0.9	0.9	0%		12
25 to 30	27.5	121	115	113	349	83	266	10,687	8.7	0.6	8.7	23.7	-	0.5	0.5	0%		7
20 to 25	22.5	149	68	97	314	56	258	10,687	6.6	0.6	6.6	26.1	-	0.5	0.5	0%		8
15 to 20	17.5	95	40	46	181	33	148	10,687	4.3	0.4	4.3	16.6	-	0.4	0.4	0%		5
10 to 15	12.5	39	9	28	76	9	67	10,687	1.3	0.2	1.3	8.3	-	0.2	0.2	0%		2
5 to 10	7.5	21	5	5	31	5	26	10,687	0.8	0.1	0.8	3.6	-	0.1	0.1	0%		1
0 to 5	2.5	4	2	-	6	2	4	10,687	0.3	0.0	0.3	0.7	-	0.0	0.0	0%		0
-5 to 0	-2.5	4	-	-	4	0	4	10,687	0.1	0.0	0.1	0.6	-	0.0	0.0	0%		0
-10 to -5	-7.5																	
-15 to -10	-12.5																	
Total		2,322	2,484	2,454	7,260	1,760	5,500										167	61

BUZZ ALDRIN MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	7,210	0.0	0.0	0.0	0.0	-	0.0	0.0	0%	0	
95 to 100	97.5	-	19	2	21	14	7	7,210	0.6	0.3	0.6	0.3	-	0.0	0.0	0%	3	
90 to 95	92.5	-	44	13	57	33	24	7,210	1.2	0.9	1.2	0.9	-	0.0	0.0	0%	7	
85 to 90	87.5	1	167	60	228	125	103	7,210	3.4	2.8	3.4	2.8	-	0.1	0.1	0%	20	
80 to 85	82.5	31	283	162	476	219	257	7,210	4.0	4.7	4.0	4.7	-	0.1	0.1	0%	29	
75 to 80	77.5	191	235	280	706	210	496	7,210	2.0	4.8	2.0	4.8	-	0.1	0.1	0%	22	
70 to 75	72.5	203	177	222	602	164	438	7,210	0.1	0.4	0.1	0.4	-	0.0	0.0	0%	2	
65 to 70	67.5	325	165	204	694	165	529	7,210	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	142	385	7,210	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	119	208	7,210	4.1	0.7	4.1	2.8	-	0.1	0.1	0%		1
50 to 55	52.5	109	182	172	463	155	308	7,210	6.6	1.0	6.6	6.7	-	0.1	0.1	0%		2
45 to 50	47.5	105	119	142	366	107	259	7,210	5.4	0.8	5.4	7.7	-	0.1	0.1	0%		2
40 to 45	42.5	185	155	177	517	143	374	7,210	8.4	1.2	8.4	14.1	-	0.2	0.2	0%		3
35 to 40	37.5	236	200	241	677	185	492	7,210	12.3	1.6	12.3	22.4	-	0.4	0.4	0%		5
30 to 35	32.5	237	202	198	637	183	454	7,210	13.6	1.5	13.6	24.4	-	0.4	0.4	0%		6
25 to 30	27.5	121	115	113	349	103	246	7,210	8.5	0.8	8.5	15.2	-	0.3	0.3	0%		4
20 to 25	22.5	149	68	97	314	71	243	7,210	6.4	0.8	6.4	17.0	-	0.3	0.3	0%		4
15 to 20	17.5	95	40	46	181	41	140	7,210	4.1	0.4	4.1	10.9	-	0.2	0.2	0%		3
10 to 15	12.5	39	9	28	76	12	64	7,210	1.3	0.2	1.3	5.5	-	0.1	0.1	0%		1
5 to 10	7.5	21	5	5	31	6	25	7,210	0.7	0.1	0.7	2.4	-	0.0	0.0	0%		1
0 to 5	2.5	4	2	-	6	2	4	7,210	0.2	0.0	0.2	0.4	-	0.0	0.0	0%		0
-5 to 0	-2.5	4	-	-	4	0	4	7,210	0.0	0.0	0.0	0.4	-	0.0	0.0	0%		0
-10 to -5	-7.5																	
-15 to -10	-12.5																	
Total		2,322	2,484	2,454	7,260	2,201	5,059										80	32

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

EDGEMONT ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	12	9	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	28	30	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	104	124	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	180	296	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	164	542	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	129	473	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	132	562	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	123	340	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	84	282	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	113	404	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	146	531	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	147	490	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	83	266	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	56	258	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	33	148	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	9	67	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	5	26	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5	4	-	-	4	0	4	-	-	-	-	-	-	-	-	0%		-
-10 to -5	-7.5																	
-15 to -10	-12.5																	
Total		2,322	2,484	2,454	7,260	1,760	5,500										-	-

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	12	9	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	28	30	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	104	124	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	180	296	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	164	542	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	129	473	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	132	562	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	123	340	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	84	282	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	113	404	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	146	531	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	147	490	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	83	266	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	56	258	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	33	148	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	9	67	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	5	26	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5	4	-	-	4	0	4	-	-	-	-	-	-	-	-	0%		-
-10 to -5	-7.5																	
-15 to -10	-12.5																	
Total		2,322	2,484	2,454	7,260	1,760	5,500										-	-

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	12	9	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	28	30	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	105	123	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	182	294	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	181	525	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	147	455	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	161	533	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	127	400	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	105	222	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	133	330	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	93	273	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	130	387	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	167	510	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	169	468	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	93	256	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	69	245	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	42	139	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	13	63	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	7	24	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5	4	-	-	4	1	3	-	-	-	-	-	-	-	-	0%		-
-10 to -5	-7.5																	
-15 to -10	-12.5																	
Total		2,322	2,484	2,454	7,260	1,967	5,293										-	-

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	80,251	0.4	0.2	0.4	0.2	-	0.0	0.0	0%	2	
95 to 100	97.5	-	19	2	21	14	7	80,251	6.7	3.7	6.7	3.7	-	0.1	0.1	0%	28	
90 to 95	92.5	-	44	13	57	31	26	80,251	12.5	10.2	12.5	10.2	-	0.2	0.2	0%	61	
85 to 90	87.5	1	167	60	228	119	109	80,251	36.0	32.7	36.0	32.7	-	0.6	0.6	0%	185	
80 to 85	82.5	31	283	162	476	208	268	80,251	42.4	54.8	42.4	54.8	-	0.9	0.9	0%	262	
75 to 80	77.5	191	235	280	706	202	504	80,251	21.6	53.9	21.6	53.9	-	0.7	0.7	0%	204	
70 to 75	72.5	203	177	222	602	163	439	80,251	1.6	4.3	1.6	4.3	-	0.1	0.1	0%	16	
65 to 70	67.5	325	165	204	694	176	518	80,251	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	141	386	80,251	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	118	209	80,251	36.9	7.4	36.9	31.6	-	0.5	0.5	0%		7
50 to 55	52.5	109	182	172	463	149	314	80,251	60.0	11.2	60.0	75.5	-	1.1	1.1	0%		16
45 to 50	47.5	105	119	142	366	104	262	80,251	50.9	9.4	50.9	86.5	-	1.2	1.2	0%		17
40 to 45	42.5	185	155	177	517	144	373	80,251	83.3	13.3	83.3	156.4	-	2.2	2.2	0%		31
35 to 40	37.5	236	200	241	677	185	492	80,251	123.7	17.5	123.7	250.1	-	3.5	3.5	0%		50
30 to 35	32.5	237	202	198	637	187	450	80,251	141.4	16.1	141.4	269.1	-	3.8	3.8	0%		55
25 to 30	27.5	121	115	113	349	104	245	80,251	87.9	8.7	87.9	168.4	-	2.4	2.4	0%		35
20 to 25	22.5	149	68	97	314	75	239	80,251	70.4	8.5	70.4	185.3	-	2.4	2.4	0%		35
15 to 20	17.5	95	40	46	181	46	135	80,251	46.7	4.8	46.7	117.2	-	1.6	1.6	0%		23
10 to 15	12.5	39	9	28	76	13	63	80,251	14.9	2.2	14.9	59.7	-	0.7	0.7	0%		10
5 to 10	7.5	21	5	5	31	7	24	80,251	8.8	0.8	8.8	24.7	-	0.3	0.3	0%		5
0 to 5	2.5	4	2	-	6	2	4	80,251	2.8	0.1	2.8	4.4	-	0.1	0.1	0%		1
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	2,188	5,068										728	285

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	6,293	0.0	0.0	0.0	0.0	-	0.0	0.0	0%	0	
95 to 100	97.5	-	19	2	21	12	9	6,293	0.5	0.4	0.5	0.4	-	0.0	0.0	0%	3	
90 to 95	92.5	-	44	13	57	28	30	6,293	0.9	0.9	0.9	0.9	-	0.0	0.0	0%	7	
85 to 90	87.5	1	167	60	228	105	123	6,293	2.5	2.9	2.5	2.9	-	0.1	0.1	0%	20	
80 to 85	82.5	31	283	162	476	182	294	6,293	2.9	4.7	2.9	4.7	-	0.1	0.1	0%	29	
75 to 80	77.5	191	235	280	706	181	525	6,293	1.5	4.4	1.5	4.4	-	0.1	0.1	0%	22	
70 to 75	72.5	203	177	222	602	147	455	6,293	0.1	0.3	0.1	0.3	-	0.0	0.0	0%	2	
65 to 70	67.5	325	165	204	694	161	533	6,293	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	127	400	6,293	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	105	222	6,293	2.7	-	2.7	2.0	-	0.0	0.0	0%		1
50 to 55	52.5	109	182	172	463	133	330	6,293	4.4	-	4.4	5.3	-	0.1	0.1	0%		2
45 to 50	47.5	105	119	142	366	93	273	6,293	3.7	-	3.7	6.3	-	0.1	0.1	0%		2
40 to 45	42.5	185	155	177	517	130	387	6,293	6.1	-	6.1	11.6	-	0.2	0.2	0%		3
35 to 40	37.5	236	200	241	677	167	510	6,293	9.0	-	9.0	18.9	-	0.4	0.4	0%		5
30 to 35	32.5	237	202	198	637	169	468	6,293	10.3	-	10.3	20.6	-	0.4	0.4	0%		6
25 to 30	27.5	121	115	113	349	93	256	6,293	6.3	-	6.3	13.0	-	0.2	0.2	0%		4
20 to 25	22.5	149	68	97	314	69	245	6,293	5.2	-	5.2	14.2	-	0.3	0.3	0%		4
15 to 20	17.5	95	40	46	181	42	139	6,293	3.4	-	3.4	9.0	-	0.2	0.2	0%		3
10 to 15	12.5	39	9	28	76	13	63	6,293	1.1	-	1.1	4.6	-	0.1	0.1	0%		1
5 to 10	7.5	21	5	5	31	7	24	6,293	0.7	-	0.7	1.9	-	0.0	0.0	0%		1
0 to 5	2.5	4	2	-	6	2	4	6,293	0.2	-	0.2	0.3	-	0.0	0.0	0%		0
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	1,966	5,290										80	31

NISHUANE K-2

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	14	7	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	31	26	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	119	109	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	205	271	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	185	521	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	145	457	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	147	547	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	125	402	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	111	216	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	140	323	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	94	272	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	127	390	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	164	513	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	165	472	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	93	256	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	62	252	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	37	144	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	10	66	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	5	26	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	1,981	5,275										-	-

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	6,156	0.0	0.0	0.0	0.0	-	0.0	0.0	0%	0	
95 to 100	97.5	-	19	2	21	14	7	6,156	0.5	0.3	0.5	0.3	-	0.0	0.0	0%	4	
90 to 95	92.5	-	44	13	57	34	23	6,156	1.0	0.7	1.0	0.7	-	0.0	0.0	0%	10	
85 to 90	87.5	1	167	60	228	130	98	6,156	3.0	2.3	3.0	2.3	-	0.1	0.1	0%	29	
80 to 85	82.5	31	283	162	476	234	242	6,156	3.7	3.8	3.7	3.8	-	0.1	0.1	0%	41	
75 to 80	77.5	191	235	280	706	235	471	6,156	1.9	3.9	1.9	3.9	-	0.1	0.1	0%	32	
70 to 75	72.5	203	177	222	602	184	418	6,156	0.1	0.3	0.1	0.3	-	0.0	0.0	0%	2	
65 to 70	67.5	325	165	204	694	183	511	6,156	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	159	368	6,156	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	128	199	6,156	3.4	2.2	3.4	4.0	-	0.1	0.1	0%		2
50 to 55	52.5	109	182	172	463	170	293	6,156	5.7	3.2	5.7	7.8	-	0.3	0.3	0%		4
45 to 50	47.5	105	119	142	366	120	246	6,156	4.8	2.7	4.8	8.3	-	0.3	0.3	0%		4
40 to 45	42.5	185	155	177	517	159	358	6,156	7.5	3.9	7.5	14.5	-	0.4	0.4	0%		7
35 to 40	37.5	236	200	241	677	207	470	6,156	11.2	5.1	11.2	22.2	-	0.7	0.7	0%		10
30 to 35	32.5	237	202	198	637	201	436	6,156	12.2	4.8	12.2	23.6	-	0.7	0.7	0%		11
25 to 30	27.5	121	115	113	349	113	236	6,156	7.7	2.6	7.7	14.4	-	0.4	0.4	0%		7
20 to 25	22.5	149	68	97	314	79	235	6,156	5.9	2.6	5.9	15.9	-	0.4	0.4	0%		7
15 to 20	17.5	95	40	46	181	45	136	6,156	3.7	1.5	3.7	10.1	-	0.3	0.3	0%		4
10 to 15	12.5	39	9	28	76	15	61	6,156	1.3	0.7	1.3	5.0	-	0.1	0.1	0%		2
5 to 10	7.5	21	5	5	31	6	25	6,156	0.6	0.3	0.6	2.2	-	0.1	0.1	0%		1
0 to 5	2.5	4	2	-	6	2	4	6,156	0.2	0.0	0.2	0.4	-	0.0	0.0	0%		0
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	2,419	4,837										115	58

RENAISSANCE MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	14	7	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	31	26	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	119	109	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	205	271	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	185	521	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	145	457	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	147	547	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	125	402	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	111	216	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	140	323	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	94	272	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	127	390	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	164	513	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	165	472	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	93	256	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	62	252	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	37	144	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	10	66	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	5	26	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	1,981	5,275										-	-

Montclair Board of Education
Exhibit D
ECM 9A Roof Re-sealing
Roof Replacement

WATCHUNG ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	-	-	-	-	-	-	-	-	0%	-	
95 to 100	97.5	-	19	2	21	14	7	-	-	-	-	-	-	-	-	0%	-	
90 to 95	92.5	-	44	13	57	31	26	-	-	-	-	-	-	-	-	0%	-	
85 to 90	87.5	1	167	60	228	119	109	-	-	-	-	-	-	-	-	0%	-	
80 to 85	82.5	31	283	162	476	205	271	-	-	-	-	-	-	-	-	0%	-	
75 to 80	77.5	191	235	280	706	185	521	-	-	-	-	-	-	-	-	0%	-	
70 to 75	72.5	203	177	222	602	145	457	-	-	-	-	-	-	-	-	0%	-	
65 to 70	67.5	325	165	204	694	147	547	-	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	125	402	-	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	111	216	-	-	-	-	-	-	-	-	0%		-
50 to 55	52.5	109	182	172	463	140	323	-	-	-	-	-	-	-	-	0%		-
45 to 50	47.5	105	119	142	366	94	272	-	-	-	-	-	-	-	-	0%		-
40 to 45	42.5	185	155	177	517	127	390	-	-	-	-	-	-	-	-	0%		-
35 to 40	37.5	236	200	241	677	164	513	-	-	-	-	-	-	-	-	0%		-
30 to 35	32.5	237	202	198	637	165	472	-	-	-	-	-	-	-	-	0%		-
25 to 30	27.5	121	115	113	349	93	256	-	-	-	-	-	-	-	-	0%		-
20 to 25	22.5	149	68	97	314	62	252	-	-	-	-	-	-	-	-	0%		-
15 to 20	17.5	95	40	46	181	37	144	-	-	-	-	-	-	-	-	0%		-
10 to 15	12.5	39	9	28	76	10	66	-	-	-	-	-	-	-	-	0%		-
5 to 10	7.5	21	5	5	31	5	26	-	-	-	-	-	-	-	-	0%		-
0 to 5	2.5	4	2	-	6	2	4	-	-	-	-	-	-	-	-	0%		-
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	1,981	5,275										-	-

WOODMAN FIELD

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	-	3,615	0.0	-	0.0	-	-	0.0	0.0	0%	0	
95 to 100	97.5	-	19	2	21	21	0	3,615	0.5	0.0	0.5	0.0	-	0.0	0.0	0%	2	
90 to 95	92.5	-	44	13	57	55	2	3,615	1.0	0.0	1.0	0.0	-	0.0	0.0	0%	5	
85 to 90	87.5	1	167	60	228	221	8	3,615	3.0	0.1	3.0	0.1	-	0.1	0.1	0%	15	
80 to 85	82.5	31	283	162	476	456	20	3,615	4.2	0.2	4.2	0.2	-	0.1	0.1	0%	21	
75 to 80	77.5	191	235	280	706	671	35	3,615	3.2	0.2	3.2	0.2	-	0.1	0.1	0%	17	
70 to 75	72.5	203	177	222	602	574	28	3,615	0.3	0.0	0.3	0.0	-	0.0	0.0	0%	1	
65 to 70	67.5	325	165	204	694	669	26	3,615	-	-	-	-	-	-	-	0%	-	
60 to 65	62.5	180	152	195	527	503	24	3,615	-	-	-	-	-	-	-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	315	12	3,615	4.9	0.1	4.9	0.1	-	0.1	0.1	0%		1
50 to 55	52.5	109	182	172	463	442	22	3,615	8.7	0.1	8.7	0.3	-	0.1	0.1	0%		2
45 to 50	47.5	105	119	142	366	348	18	3,615	8.3	0.1	8.3	0.3	-	0.1	0.1	0%		2
40 to 45	42.5	185	155	177	517	495	22	3,615	13.7	0.1	13.7	0.5	-	0.2	0.2	0%		3
35 to 40	37.5	236	200	241	677	647	30	3,615	20.5	0.2	20.5	0.8	-	0.3	0.3	0%		5
30 to 35	32.5	237	202	198	637	612	25	3,615	21.9	0.2	21.9	0.8	-	0.4	0.4	0%		6
25 to 30	27.5	121	115	113	349	335	14	3,615	13.3	0.1	13.3	0.5	-	0.2	0.2	0%		3
20 to 25	22.5	149	68	97	314	302	12	3,615	13.2	0.1	13.2	0.5	-	0.2	0.2	0%		3
15 to 20	17.5	95	40	46	181	175	6	3,615	8.4	0.0	8.4	0.3	-	0.1	0.1	0%		2
10 to 15	12.5	39	9	28	76	73	4	3,615	3.8	0.0	3.8	0.2	-	0.1	0.1	0%		1
5 to 10	7.5	21	5	5	31	30	1	3,615	1.7	0.0	1.7	0.0	-	0.0	0.0	0%		0
0 to 5	2.5	4	2	-	6	6	-	3,615	0.4	-	0.4	-	-	0.0	0.0	0%		0
-5 to 0	-2.5																	-
-10 to -5	-7.5																	-
-15 to -10	-12.5																	-
Total		2,318	2,484	2,454	7,256	6,949	307										59	30

Montclair Board of Education
Exhibit D
Kitchen Appliance Replacement Spreadsheet

EXISTING								
Building	Equipment Label	Qty	Replace (Y/N)	Manufacturer	Model No.	Type	kW	MBH
Bradford Elementary School	BES-CO-1	1	Y	Vulcan	-	ctric Double Convection Ov	24.0	-
Buzz Aldrin Middle School	BUZ-CO-1	1	Y	-	-	ctric Double Convection Ov	24.0	-
Valley Road Complex	HES-CO-1	1	Y	Hobart	-	ctric Double Convection Ov	24.0	-
Edgemont Elementary Schoo	EE-CO-1	1	Y	-	-	ctric Double Convection Ov	24.0	-
Glenfield Middle School	GMS-CO-1	1	Y	-	-	ctric Double Convection Ov	24.0	-
Nishuane K-2	NK-CO-1	1	Y	Hobart	-	ctric Double Convection Ov	24.0	-
Northeast Elementary Schoo	NE-CO-1	1	Y	-	-	ectric Single Convection Ov	12.0	-
Totals		**7**					**156**	

PROPOSED				
Manufacturer	Model No.	Qty	MBH	Qty
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	90.0	0.0
Blodgett	BDO-100-G-ES	1	45.0	0.0
		7	**585.0**	

EXISTING CONDENSING UNIT SPECIFICATIONS

Building	Bradford Elementary School	Buzz Aldrin Middle School	Valley Road Complex	Edgemont Elementary School	Glenfield Middle School	Nishuane K-2	Northeast Elementary School
Label	BES-CO-1	BUZ-CO-1	HES-CO-1	EE-CO-1	GMS-CO-1	NK-CO-1	NE-CO-1
Area Serving	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Single Convection Oven
Quantity	1	1	1	1	1	1	1
kW	24.0	24.0	24.0	24.0	24.0	24.0	12.0
MBH	0.0	0.0	0.0	0.0	0.0	0.0	0.0

PROPOSED CONDENSING UNIT SPECIFICATIONS

	Bradford Elementary School	Buzz Aldrin Middle School	Valley Road Complex	Edgemont Elementary School	Glenfield Middle School	Nishuane K-2	Northeast Elementary School
Kitchen Equipment Replace	Y	Y	Y	Y	Y	Y	Y
Label	BES-CO-1	BUZ-CO-1	HES-CO-1	EE-CO-1	GMS-CO-1	NK-CO-1	NE-CO-1
Type	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Double Convection Oven	Electric Single Convection Oven
Quantity	1	1	1	1	1	1	1
MBH	90.0	90.0	90.0	90.0	90.0	90.0	45.0
kW	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Montclair Board of Education
Exhibit D
ECM 10A Kitchen Equipment Conversion
Kitchen Equipment Upgrades

ECM DESCRIPTION

Convert Kitchen Appliances from Electric to Gas

DATA / ASSUMPTIONS

Savings achieved by converting electric kitchen appliances to gas appliances

Demand Load Factor	25%
Consumption Load Factor	25%
Relative Appliance Efficiency	90%

MEASUREMENT AND VERIFICATION

OPTION A - Stipulated Savings - Electric
OPTION C - Utility Bill Analysis. - Thermal

COMMISSIONING

Ensure all equipment is installed and working properly

RECOVERY/SAFETY FACTOR

Safety Factor (Electrical) =	0%
Safety Factor (Thermal) =	0%

FORMULAE

UsageFUEL = (EkWh · 3,412 / 100,000) / APP
EkWh = EkW · LFCons
EkW = APPkW · LFDemand

Variable	Units	Description
EkWh	kWh	Electric consumption savings
EkW	kW	Electric demand savings
UsageFUEL	Therms	Proposed fuel consumption
LFCons	%	Consumption load factor
LFDemand	%	Demand load factor
APP	%	Appliance thermal efficiency
APPkW	kW	Electrical appliance kW load
Op. Hrs	Hrs	Operating hours

Montclair Board of Education
Exhibit D
ECM 10A Kitchen Equipment Conversion
Kitchen Equipment Upgrades

*Inputs are blue

Building	Label	kW	MBH	Qty	Type
Bradford Elementary School	BES-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Buzz Aldrin Middle School	BUZ-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Valley Road Complex	HES-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Edgemont Elementary School	EE-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Glenfield Middle School	GMS-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Nishuane K-2	NK-CO-1	24.0	0.0	1.0	ic Double Convection Oven
Northeast Elementary School	NE-CO-1	12.0	0.0	1.0	ric Single Convection Oven
Totals		**156.0**			

CALCULATIONS

	Bradford Elementary School	Buzz Aldrin Middle School	Valley Road Complex	Edgemont Elementary School	Glenfield Middle School	Nishuane K-2	Northeast Elementary School
Appliance Label	BES-CO-1	BUZ-CO-1	HES-CO-1	EE-CO-1	GMS-CO-1	NK-CO-1	NE-CO-1
Qty	1	1	1	1	1	1	1
Total kW	24.0	24.0	24.0	24.0	24.0	24.0	12.0
Demand Load Factor	25%	25%	25%	25%	25%	25%	25%
Consumption Load Factor	25%	25%	25%	25%	25%	25%	25%
Operating Months Per Year	9	9	9	9	9	9	9
Operating Days Per Year	**160**	**160**	**160**	**160**	**160**	**160**	**160**
Operating Hours Per Day	1	1	1	1	1	1	1
Annual Operating Hours	160	160	160	160	160	160	160
Monthly Demand Savings (kW)	6.0	6.0	6.0	6.0	6.0	6.0	3.0
Annual Demand Savings (kW)	54.0	54.0	54.0	54.0	54.0	54.0	27.0
Consumption Savings (kWh)	240	240	240	240	240	240	120
Relative Appliance Efficiency	90%	90%	90%	90%	90%	90%	90%
Safety Factor - Electric	0%	0%	0%	0%	0%	0%	0%
Safety Factor - Thermal	0%	0%	0%	0%	0%	0%	0%
Therms	(9)	(9)	(9)	(9)	(9)	(9)	(5)
kWh Savings	240	240	240	240	240	240	120
kW Savings	6.0	6.0	6.0	6.0	6.0	6.0	3.0

Montclair Board of Education
Exhibit D
ECM 11A Solar PPA
Solar PPA Photovoltaic System

ECM DESCRIPTION

Installation of a photovoltaic array utilizing Solar Power Purchase Agreement (PPA) - reducing grid electricity with a reduction of greenhouse gas emissions.

DATA / ASSUMPTIONS

PPA Cost per kWH	**$0.020**	typically around $0.05, Carlisle roof membrane adds another $0.04
*1-Axis Tracking System Collection Improvement:	**18.6%**	

*Emperical studies show an that annual output increases 18.6% with use of one-axis sun tracking
**Assume two weeks of downtime for PV maintenance

Solar radiation at ground level was obtained using the data collected by the National Renewable Energy Laboratory (NREL) via the software Pvwatts.
Proposed technology is only able to convert 77% of the direct current produced at the panel to a usable alternative current for building consumption

MEASUREMENT AND VERIFICATION

Option C - Verification by dedicated electric meter.

COMMISSIONING

Test installed system - measuring the output and verify with calculations for weather conditions. Verify all electrical connections and tie-ins to the grid and the building power.

RECOVERY/SAFETY FACTOR

Safety Factor (Electrical) =	**0%**

FORMULAE

$$W_{PV} = \sum_{Jan}^{Dec} (Q_{RAD} \cdot A_{PV} \cdot t_{MONTH}) \cdot t_{\%}$$

Variable	Units	Description
W_{PV}	kWh	Electrical energy produced by PV array
$\sum_{Jan}^{Dec}$	-	Summation of months
Q_{RAD}	$kWh/m^2/day$	Solar radiation (averaged by month) capable of being collected with the proposed PV technology
A_{PV}	ft^2	Area of proposed system
t_{MONTH}	Days	Days in the month
$t_{\%}$	%	Percentage of operational time

Montclair Board of Education
Exhibit D
ECM 11A Solar PPA
Solar PPA Photovoltaic System

*Inputs are blue

Building	DC Rating of System	Install 1-Axis Tracking System (Y/N)
Bradford Elementary School	177.1	N
Buzz Aldrin Middle School	156.4	N
Edgemont Elementary School	373.9	N
Glenfield Middle School	361.2	N
Valley Road Complex	302.1	N
Montclair High School	843.7	N
George Inness Annex (HS-9th), Athletics	161.1	N
Nishuane K-2	319.3	N
Northeast Elementary School	182.1	N
Renaissance Middle School	52.7	N
Watchung Elementary School	250.7	N
Woodman Field	409.8	N
Totals	**3,590.0**	

Cell ID	Newark		
State	New Jersey		
Latitude	40.7 N		
Longitude	74.17 W		
Month	Days in Month	**Solar Radiation (kWh/day)	Solar Radiation per 1-kW (kWh)
Jan	31	2.39	74.1
Feb	28	3.17	88.8
Mar	31	4.07	126.2
Apr	30	4.83	144.9
May	31	5.7	176.7
Jun	30	5.94	178.2
Jul	31	5.77	178.9
Aug	31	5.38	166.8
Sep	30	4.65	139.5
Oct	31	3.61	111.9
Nov	30	2.35	70.5
Dec	31	2.01	62.3
Total		4.16	**1,518.7**

Montclair Board of Education
Exhibit D
ECM 11A Solar PPA
Solar PPA Photovoltaic System

CALCULATIONS

	5%	0%	95%	0%	30%	35%	0%	70%	25%	0%	50%	65%
	Bradford Elementary School	**Buzz Aldrin Middle School**	**Edgemont Elementary School**	**Glenfield Middle School**	**Valley Road Complex**	**Montclair High School**	**George Inness Annex (HS-9th), Athletics**	**Nishuane K-2**	**Northeast Elementary School**	**Renaissance Middle School**	**Watchung Elementary School**	**Woodman Field**
DC Rating of System	177.1	156.4	373.9	361.2	302.1	843.7	161.1	319.3	182.1	52.7	250.7	409.8
Safety Factor	**5%**	**0%**	**100%**	**100%**	**100%**	**35%**	**0%**	**100%**	**25%**	**100%**	**100%**	**65%**
Maximum DC Rating	168.3	156.4	0.0	0.0	0.0	548.4	161.1	0.0	136.6	0.0	0.0	143.4
Install 1-Axis Tracking System	N	N	N	N	N	N	N	N	N	N	N	N
**Annual Operational Hours	8,424	8,424	8,424	8,424	8,424	8,424	8,424	8,424	8,424	8,424	8,424	8,424
DC to AC Safety Factor	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**	**0.82**
*Efficiency gain with 1-Axis Tracking	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total kWh AC per year Generated	200,408	186,267	-	-	-	653,109	191,877	-	162,683	-	-	170,808
Solar Factor	81%	74%	76%	70%	78%	81%	72%	74%	74%	73%	72%	72%
kWh Savings	161,982	136,988	-	-	-	527,626	138,599	-	120,439	-	-	122,763

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

ECM DESCRIPTION

Reduce water consumption by replacing older less-efficient toilets, urinals, faucets, sinks and showerheads with more water efficient fixtures.

DATA / ASSUMPTIONS

* Existing flow rates were determined by flushometers during walk-throughs
*Proposed flow rates were determined by manufacturer data

MEASUREMENT AND VERIFICATION

Option C (Thermal)- Savings Calculations are based on regression analysis of utility billing meter data
Option C (Water) - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Ensure installation by testing for leaks and proper functionality.

RECOVERY/SAFETY FACTOR

Safety Factor (Thermal) =	0%
Safety Factor (Water) =	0%

Recovery factor taken at 10% due to the variability of fixture usage

FORMULAE

$$Q_{SAVINGS} = [(h_{SAVINGS} \cdot 8.34) \cdot (1000 / 100000)] / \eta_{BOILER}$$

$$h_{SAVINGS} = (h_{Toilet} - h_{Toilet}) + (h_{Urinal} - h_{Urinal}) + (h_{Sink} - h_{Sink}) + (h_{Shower} - h_{Shower})$$

$$h_{Toilet} = (Toilet_{RATE} \cdot Toilet_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Toilet} = (Toilet_{RATE} \cdot Toilet_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Urinal} = (Urinal_{RATE} \cdot Urinal_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Urinal} = (Urinal_{RATE} \cdot Urinal_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Sink} = (Sink_{RATE} \cdot Sink_{USAGE} \cdot Occ_{\%}) / 1{,}000$$
$$h_{Sink} = (Sink_{RATE} \cdot Sink_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

$$h_{Shower} = (Shower_{RATE} \cdot Shower_{USAGE} \cdot Occ_{\%}) / 1{,}000$$

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

$h_{Shower} = (Shower_{RATE} \cdot Shower_{USAGE} \cdot Occ_{\%}) / 1{,}000$

Variable	Units	Description
$Q_{SAVINGS}$	Therms	Annual Thermal Savings
$h_{SAVINGS}$	kGal	Annual Water Savings
n_{BOILER}	%	Efficiency of Boiler
T_{SINK}	°F	Temperature of Sink Water
T_{SHOWER}	°F	Temperature of Shower Water
T_{CITY}	°F	Temperature of incoming city water
h_{TOILET}	kGal	Existing Toilet Water Usage
h_{TOILET}	kGal	Proposed Toilet Water Usage
h_{Urinal}	kGal	Existing Urinal Water Usage
h_{Urinal}	kGal	Proposed Urinal Water Usage
h_{Sink}	kGal	Existing Sink Water Usage
h_{Sink}	kGal	Proposed Sink Water Usage
h_{Shower}	kGal	Existing Shower Water Usage
h_{Shower}	kGal	Proposed Shower Water Usage
Occ_{DAYS}	-	Equivalent Days of occupied use
$Occ_{\%}$	%	Percentage of occupants that occupy the building daily
Ppl	-	Number of building occupants
$Ur_{\%}$	%	Urinal Usage Factor
$Toilet_{USAGE}$	-	Toilet Usage per day per occupant
$Urinal_{USAGE}$		Urinal Usage per day per occupant
$Sink_{USAGE}$		Sink Usage per day per occupant
$Shower_{USAGE}$		Shower Usage per day per occupant
$Toilet_{RATE}$	Gallons	Existing Gallons per Usage
$Toilet_{RATE}$	Gallons	Proposed Gallons per Usage
$Urinal_{RATE}$	Gallons	Existing Gallons per Usage
$Urinal_{RATE}$	Gallons	Proposed Gallons per Usage
$Sink_{RATE}$	Gallons	Existing Gallons per Usage
$Sink_{RATE}$	Gallons	Proposed Gallons per Usage
$Shower_{RATE}$	Gallons	Existing Gallons per Usage
$Shower_{RATE}$	Gallons	Proposed Gallons per Usage

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

* Inputs are in blue
*Checks against baseline are in purple

Subcontractor Calculations N * If Yes - Please Refer to tab 'Sub Water Conservation' for details

Building	Water Conservation	Daily Occupants	Occupied Days
Bradford Elementary School	Y	458	180
Bullock Elementary School	N	470	180
Buzz Aldrin Middle School	Y	700	180
Edgemont Elementary School	Y	294	180
Glenfield Middle School	N	709	180
Valley Road Complex	N	614	180
Montclair High School	N	1,639	180
George Inness Annex (HS-9th), Athletics	Y	546	180
Nishuane K-2	Y	438	180
Northeast Elementary School	Y	432	180
Renaissance Middle School	Y	269	180
Watchung Elementary School	Y	446	180
Woodman Field	Y	109	180
Totals		7,124	2,340

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

CALCULATIONS

	Bradford Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field
Water Conservation	Y	Y	Y	Y	Y	Y	Y	Y	Y
Item									
Daily Occupants	458	700	294	546	438	432	269	446	109
Area of Occupied Facilities	58,129	58,128	34,638	89,261	87,440	56,549	37,167	52,109	13,184
Occupancy Factor	85%	65%	80%	85%	75%	65%	70%	80%	65%
Occupied Days	180	180	180	180	180	180	180	180	180
Occupant Days	70,043	81,941	42,336	83,578	59,110	50,491	33,869	64,260	12,783
Toilet Consumption									
Toilet Usage Rate	1.5	2.5	2.5	2	3.5	3	3.5	3	1
Existing Toilet Flow Rate	2.87	2.95	2.62	2.86	3.09	3.04	3.03	2.64	2.29
Existing Annual Toilet Flow	302	604	277	478	639	460	359	509	29
Proposed Toilet Flow Rate	2.87	2.95	2.62	2.86	3.09	3.04	3.03	2.64	2.29
Proposed Annual Toilet Flow	302	604	277	478	639	460	359	509	29
Urinal Consumption									
Urinal Usage Rate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Urinal Usage Factor	50%	50%	50%	50%	50%	50%	50%	50%	50%
Existing Urinal Flow Rate	0.96	1.29	0.63	1.02	1.18	1.08	1.14	1.25	1.07
Existing Annual Urinal Flow	17	26	7	21	17	14	10	20	3
Proposed Urinal Flow Rate	0.96	1.29	0.63	1.02	1.18	1.08	1.14	1.25	1.07
Proposed Annual Urinal Flow	17	26	7	21	17	14	10	20	3
Lavatory/Sink Consumption									
Sink Usage Factor	75%	75%	75%	75%	75%	75%	75%	75%	75%
Existing Sink Flow Rate	1.28	1.37	1.32	1.16	1.58	1.41	1.31	1.07	1.16
Existing Annual Sink Flow	67	84	42	73	70	53	33	52	11
Proposed Sink Flow Rate	0.74	0.93	0.80	0.93	0.68	0.73	0.80	0.71	0.93
Proposed Annual Sink Flow	39	57	25	58	30	28	20	34	9
Shower Consumption									
Shower Usage Factor	-	-	-	-	-	-	-	-	1.00
Existing Shower Flow Rate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Existing Annual Shower Flow	-	-	-	-	-	-	-	-	19
Proposed Shower Flow Rate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Proposed Annual Shower Flow	-	-	-	-	-	-	-	-	19

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

Kitchen Consumption									
% Persons Eat Breakfast	0%	0%	0%	0%	0%	0%	0%	0%	0%
% Persons Eat Lunch	100%	100%	100%	100%	100%	100%	100%	100%	0%
% Persons Eat Dinner	0%	0%	0%	0%	0%	0%	0%	0%	0%
Breakfast Consumption	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650
Lunch Consumption	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Dinner Consumption	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total Meal Consumption	66.54	77.84	40.22	79.40	56.15	47.97	32.18	61.05	-
Miscellaneous									
Drinking Water	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Cleaning	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Campus Area	0	0	0	0	0	0	0	0	0
Garden Area	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total Irrigation	0	0	0	0	0	0	0	0	1000
Vehicle Washing	0	0	0	0	0	0	0	0	0
Lab Equipment testing	0	0	0	0	0	0	0	0	0
Annual Cooling Load to tower		-	-	-	-	-	-	-	0
Cooling Tower M/U	-	-	-	-	-	-	-	-	0
Boiler Make-up	-	-	-	-	-	-	-	-	-
Total Misc. uses	87	131	55	103	82	81	50	84	1,020
Laundry									
Load person	0	0	0	0	0	0	0	0	0
% Occupant Laundry Done	0	0	0	0	0	0	0	0	0
Gal/Load	0	0	0	0	0	0	0	0	0
Annual Use	-	-	-	-	-	-	-	-	-
Leaks									
% Total Water Use	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total Loss	4.89	9.10	3.93	6.85	7.88	6.20	4.41	6.94	10.53
% of Loss Repaired During Retrofit	0%	0%	0%	0%	0%	0%	0%	0%	0%
Retrofit Water Consumption	5	9	4	7	8	6	4	7	11
Baseline Water Consumption (from bills)	489	910	393	685	788	620	441	694	1,053
Calculated Existing Water Usage	544	933	425	762	873	662	489	733	1,094
Water Usage Accounted for (Must be 70% to 100%)	**90.0%**	**97.5%**	**92.4%**	**89.9%**	**90.2%**	**93.6%**	**90.2%**	**94.7%**	**96.3%**
Calculated Proposed Water Usage	515	906	409	747	833	637	476	715	1,092
Water Savings	28	27	17	14	40	26	13	17	2

Montclair Board of Education
Exhibit D
ECM 12A Water Conservation (DI)
Water Conservation

Thermal Savings									
City Water Temperature	60	60	60	60	60	60	60	60	60
Sink Water temperature	120	120	120	120	120	120	120	120	120
Shower Water Temperature	110	110	110	110	110	110	110	110	110
Boiler Efficiency	72.5%	69.4%	72.5%	64.8%	64.8%	64.8%	72.5%	73.5%	70.6%
Thermal Savings	142	135	83	72	199	129	65	87	11
Actual Thermal Savings	196	195	114	111	308	199	89	118	16
Safety Factor Water	**80%**	**92%**	**90%**	**0%**	**85%**	**49%**	**62%**	**62%**	**16%**
Safety Factor Thermal	**80%**	**92%**	**90%**	**0%**	**85%**	**49%**	**62%**	**62%**	**16%**
Water Savings	6	2	2	14	6	13	5	7	2
Thermal Savings	39	16	11	111	46	101	34	45	13

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

ECM DESCRIPTION

Replacement of windows with double-pane, low-e, metal frame windows.

DATA / ASSUMPTIONS

Recovery/Safety Factor (Electric) =	0%	
Recovery/Safety Factor (Thermal) =	0%	
Heating Hours	3,948	Hours

*U Factors for the new windows are obtained by manufacturer data. U Factors for the existing windows are based on type, material, and thickness

MEASUREMENT AND VERIFICATION

Option C - Savings Calculations are based on regression analysis of utility billing meter data

COMMISSIONING

Verify quantities installed and total square feet.

RECOVERY/SAFETY FACTOR

Savings calculations are based on weather bin data, fresh air flows and temperature setpoints. A more conservative of 0 percent is used for this ECM due to the uncertainty of variables. The heating fuel savings calculations are based upon information provided by the equipment vendor.

FORMULAE

$$Q_{SAVINGS} = (Q_C - Q_C) + Q_{INF}$$

$$Q_{INF} = \sum_{-5}^{100} (1.08 \cdot (I_{WIN} - i_{WIN}) \cdot (T_{W/S} - T_{BIN}) \cdot I_W \cdot t_{BIN}) / 100{,}000$$

$$Q_C = \sum_{-5}^{100} ((T_{W/S} - T_{BIN}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{BIN}) / 100{,}000$$
$$Q_C = \sum_{-5}^{100} ((T_{W/S} - T_{BIN}) \cdot A_{WIN} \cdot U_{WIN} \cdot t_{BIN}) / 100{,}000$$

*Note W/S designates use of either winter building setpoint or summer building setpoint with the appropiate bin

Variable	Units	Description
$Q_{savings}$	Therms	Thermal Savings
Q_C	Therms	Conductive/convective cooling gain and heating loss with existing windows
Q_C	Therms	Conductive/convective cooling gain and heating loss with proposed windows
Q_{INF}	Therms	Infiltration savings with proposed windows
$\sum_{-5}^{100}$	-	Summation of all bins from -5°F to 100°F
T_W	°F	Winter building setpoint
T_S	°F	Summer building setpoint
T_{BIN}	°F	Temperature of respective bin
t_{BIN}	Hrs	Hrs in respective bin
A_{WIN}	ft^2	Existing unoccupied Bin Hours in respective temperature bin
U_{WIN}	btu / ft^2 / °F	Existing U-factor of roof
U_{WIN}	btu / ft^2 / °F	Proposed U-factor of roof
i_{WIN}	Cfm/ft	Infiltration constant for existing windows
i_{WIN}	Cfm/ft	Infiltration constant for proposed windows
I_W	ft	Linear feet of curtain wall

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

* Inputs are in blue

Building	Window Area (ft^2)	U-Factor of Existing Window	U-Factor of Proposed Window	Infiltration of Existing Window (CFM / linear ft)	Infiltration of Proposed Window (CFM / linear ft)	Total Linear feet of Curtain Wall	EER of Cooling System (Average)
Bradford Elementary School	9,286	0.70	0.41	0.00	0.00	0	11.0
Bullock Elementary School	11,164	0.70	0.41	0.00	0.00	0	11.0
Buzz Aldrin Middle School	9,286	0.70	0.41	0.00	0.00	0	11.0
Edgemont Elementary School	7,168	0.70	0.41	0.00	0.00	0	11.0
Glenfield Middle School	13,633	0.70	0.41	0.00	0.00	0	11.0
Valley Road Complex	15,979	0.70	0.41	0.00	0.00	0	11.0
Montclair High School	19,747	0.70	0.41	0.00	0.00	0	11.0
George Inness Annex (HS-9th), Athletics	11,507	0.70	0.41	0.00	0.00	0	11.0
Nishuane K-2	11,389	0.70	0.41	0.00	0.00	0	11.0
Northeast Elementary School	9,159	0.70	0.41	0.00	0.00	0	11.0
Renaissance Middle School	7,426	0.70	0.41	0.00	0.00	0	11.0
Watchung Elementary School	8,792	0.70	0.41	0.00	0.00	0	11.0
Woodman Field	4,423	0.70	0.41	0.00	0.00	0	11.0
Totals	**138,959**						

	Bradford Elementary School	Bullock Elementary School	Buzz Aldrin Middle School	Edgemont Elementary School	Glenfield Middle School	Valley Road Complex	Montclair High School	George Inness Annex (HS-9th), Athletics	Nishuane K-2	Northeast Elementary School	Renaissance Middle School	Watchung Elementary School	Woodman Field		Total	
Window ft^2 Audited	9,286	11,164	9,286	7,168	13,633	15,979	19,747	11,507	11,389	9,159	7,426	8,792	4,423			ft^2
U of Existing Window	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70			$btu/ft^2/°F$
U of Proposed Window	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41			$btu/ft^2/°F$
Infiltration of Existing Windows	-	-	-	-	-	-	-	-	-	-	-	-	-			CFM / ft
Infiltration of Proposed Windows	-	-	-	-	-	-	-	-	-	-	-	-	-			CFM / ft
Total Linear Ft of Curtain Wall	-	-	-	-	-	-	-	-	-	-	-	-	-			ft
EER of Cooling System (Average)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0			
Existing Occupied Heating Setpoint	72.0	73.0	79.0	81.0	76.0	74.0	75.0	76.0	77.0	78.0	77.0	78.0	72.0			°F
Existing Unoccup. Heating Setpoint	65.0	68.0	66.0	66.0	65.0	66.0	66.0	64.0	72.0	72.0	65.0	69.0	72.0			°F
Existing Occupied Cooling Setpoint	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0			°F
Existing Unoccup. Cooling Setpoint	72.0	80.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0			°F
Boiler Efficiency	72.5%	82.0%	69.4%	72.5%	91.0%	69.6%	69.6%	64.8%	64.8%	64.8%	72.5%	73.5%	70.6%			%
Safety Factor	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			%
Electrical Savings	12,439	7,825	12,439	9,602	18,262	21,405	26,452	15,414	15,256	12,269	9,947	11,777	5,925			kWh/Yr
Thermal Savings	5,226	5,231	5,590	4,179	6,271	9,286	11,549	7,595	6,319	5,119	4,313	4,647	2,170			Therms/Yr

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

CALCULATIONS

BRADFORD ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Window Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	9,286	0.1	0.1	0.1	0.0	0.1		0.1	0%	26	
95 to 100	97.5	-	19	2	21	12	9	9,286	2.1	1.7	1.3	1.0	1.6		1.6	0%	461	
90 to 95	92.5	-	44	13	57	28	30	9,286	4.0	4.3	2.3	2.5	3.4		3.4	0%	1,006	
85 to 90	87.5	1	167	60	228	104	124	9,286	11.5	13.6	6.7	8.0	10.4		10.4	0%	3,042	
80 to 85	82.5	31	283	162	476	180	296	9,286	13.4	22.1	7.8	12.9	14.7		14.7	0%	4,302	
75 to 80	77.5	191	235	280	706	164	542	9,286	6.4	21.1	3.7	12.4	11.4		11.4	0%	3,342	
70 to 75	72.5	203	177	222	602	129	473	9,286	0.5	1.7	0.3	1.0	0.9		0.9	0%	259	
65 to 70	67.5	325	165	204	694	132	562	9,286	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	9,286	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	9,286	9.2	1.5	5.4	6.5	8.9	-	8.9	0%		122
50 to 55	52.5	109	182	172	463	123	340	9,286	15.7	2.2	9.2	16.2	20.4	-	20.4	0%		282
45 to 50	47.5	105	119	142	366	84	282	9,286	13.3	1.8	7.8	18.8	22.5	-	22.5	0%		310
40 to 45	42.5	185	155	177	517	113	404	9,286	21.7	2.6	12.7	34.6	41.0	-	41.0	0%		565
35 to 40	37.5	236	200	241	677	146	531	9,286	32.8	3.5	19.2	55.6	65.7	-	65.7	0%		906
30 to 35	32.5	237	202	198	637	147	490	9,286	37.8	3.2	22.2	60.6	73.1	-	73.1	0%		1,008
25 to 30	27.5	121	115	113	349	83	266	9,286	23.9	1.7	14.0	38.0	46.2	-	46.2	0%		637
20 to 25	22.5	149	68	97	314	56	258	9,286	18.0	1.7	10.5	41.8	47.5	-	47.5	0%		656
15 to 20	17.5	95	40	46	181	33	148	9,286	11.9	1.0	6.9	26.7	30.6	-	30.6	0%		422
10 to 15	12.5	39	9	28	76	9	67	9,286	3.5	0.4	2.1	13.4	14.4	-	14.4	0%		198
5 to 10	7.5	21	5	5	31	5	26	9,286	2.1	0.2	1.2	5.7	6.4	-	6.4	0%		88
0 to 5	2.5	4	2	-	6	2	4	9,286	0.7	0.0	0.4	1.0	1.3	-	1.3	0%		18
-5 to 0	-2.5	4	-	-	4	0	4	9,286	0.2	0.0	0.1	0.9	1.0	-	1.0	0%		14
-10 to -5	-7.5	-	-	-	-	-	-	9,286	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	9,286	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										12,439	5,226

BULLOCK ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	11,164	0.2	0.1	0.1	0.0	0.1		0.1	0%	28	
95 to 100	97.5	-	19	2	21	12	9	11,164	2.6	1.4	1.5	0.8	1.6		1.6	0%	479	
90 to 95	92.5	-	44	13	57	28	30	11,164	4.8	3.1	2.8	1.8	3.3		3.3	0%	965	
85 to 90	87.5	1	167	60	228	104	124	11,164	13.8	7.9	8.1	4.6	9.0		9.0	0%	2,635	
80 to 85	82.5	31	283	162	476	180	296	11,164	16.1	6.3	9.4	3.7	9.3		9.3	0%	2,719	
75 to 80	77.5	191	235	280	706	164	542	11,164	7.7	-	4.5	-	3.2		3.2	0%	933	
70 to 75	72.5	203	177	222	602	129	473	11,164	0.5	-	0.3	-	0.2		0.2	0%	67	
65 to 70	67.5	325	165	204	694	132	562	11,164	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	11,164	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	11,164	11.8	7.2	6.9	11.0	8.8	-	8.8	0%		107
50 to 55	52.5	109	182	172	463	123	340	11,164	19.8	10.6	11.6	24.1	21.7	-	21.7	0%		264
45 to 50	47.5	105	119	142	366	84	282	11,164	16.7	8.8	9.8	26.5	24.6	-	24.6	0%		300
40 to 45	42.5	185	155	177	517	113	404	11,164	27.0	12.6	15.8	47.1	45.7	-	45.7	0%		557
35 to 40	37.5	236	200	241	677	146	531	11,164	40.5	16.6	23.7	74.1	74.3	-	74.3	0%		906
30 to 35	32.5	237	202	198	637	147	490	11,164	46.7	15.3	27.3	79.6	83.6	-	83.6	0%		1,019
25 to 30	27.5	121	115	113	349	83	266	11,164	29.4	8.3	17.2	49.4	53.2	-	53.2	0%		649
20 to 25	22.5	149	68	97	314	56	258	11,164	22.0	8.1	12.9	53.8	54.8	-	54.8	0%		669
15 to 20	17.5	95	40	46	181	33	148	11,164	14.5	4.6	8.5	34.1	35.5	-	35.5	0%		433
10 to 15	12.5	39	9	28	76	9	67	11,164	4.3	2.1	2.5	17.0	16.7	-	16.7	0%		203
5 to 10	7.5	21	5	5	31	5	26	11,164	2.6	0.8	1.5	7.2	7.4	-	7.4	0%		91
0 to 5	2.5	4	2	-	6	2	4	11,164	0.9	0.1	0.5	1.3	1.5	-	1.5	0%		19
-5 to 0	-2.5	4	-	-	4	0	4	11,164	0.2	0.1	0.1	1.2	1.1	-	1.1	0%		14
-10 to -5	-7.5	-	-	-	-	-	-	11,164	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	11,164	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										7,825	5,231

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

BUZZ ALDRIN MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	9,286	0.1	0.1	0.1	0.0	0.1		0.1	0%	26	
95 to 100	97.5	-	19	2	21	12	9	9,286	2.1	1.7	1.3	1.0	1.6		1.6	0%	461	
90 to 95	92.5	-	44	13	57	28	30	9,286	4.0	4.3	2.3	2.5	3.4		3.4	0%	1,006	
85 to 90	87.5	1	167	60	228	104	124	9,286	11.5	13.6	6.7	8.0	10.4		10.4	0%	3,042	
80 to 85	82.5	31	283	162	476	180	296	9,286	13.4	22.1	7.8	12.9	14.7		14.7	0%	4,302	
75 to 80	77.5	191	235	280	706	164	542	9,286	6.4	21.1	3.7	12.4	11.4		11.4	0%	3,342	
70 to 75	72.5	203	177	222	602	129	473	9,286	0.5	1.7	0.3	1.0	0.9		0.9	0%	259	
65 to 70	67.5	325	165	204	694	132	562	9,286	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	9,286	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	9,286	13.7	3.0	8.0	7.4	10.1	-	10.1	0%		146
50 to 55	52.5	109	182	172	463	123	340	9,286	21.3	4.4	12.5	17.5	21.8	-	21.8	0%		315
45 to 50	47.5	105	119	142	366	84	282	9,286	17.1	3.7	10.0	19.9	23.3	-	23.3	0%		336
40 to 45	42.5	185	155	177	517	113	404	9,286	26.9	5.2	15.8	36.1	42.0	-	42.0	0%		606
35 to 40	37.5	236	200	241	677	146	531	9,286	39.4	6.9	23.1	57.6	67.0	-	67.0	0%		966
30 to 35	32.5	237	202	198	637	147	490	9,286	44.6	6.4	26.1	62.4	74.5	-	74.5	0%		1,075
25 to 30	27.5	121	115	113	349	83	266	9,286	27.7	3.5	16.2	39.0	47.0	-	47.0	0%		678
20 to 25	22.5	149	68	97	314	56	258	9,286	20.5	3.4	12.0	42.8	47.9	-	47.9	0%		690
15 to 20	17.5	95	40	46	181	33	148	9,286	13.4	1.9	7.8	27.2	30.9	-	30.9	0%		445
10 to 15	12.5	39	9	28	76	9	67	9,286	3.9	0.9	2.3	13.6	14.4	-	14.4	0%		207
5 to 10	7.5	21	5	5	31	5	26	9,286	2.3	0.3	1.4	5.8	6.4	-	6.4	0%		92
0 to 5	2.5	4	2	-	6	2	4	9,286	0.8	0.1	0.5	1.1	1.3	-	1.3	0%		19
-5 to 0	-2.5	4	-	-	4	0	4	9,286	0.2	0.0	0.1	1.0	1.0	-	1.0	0%		14
-10 to -5	-7.5	-	-	-	-	-	-	9,286	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	9,286	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										12,439	5,590

EDGEMONT ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	7,168	0.1	0.1	0.1	0.0	0.1		0.1	0%	20	
95 to 100	97.5	-	19	2	21	12	9	7,168	1.7	1.3	1.0	0.7	1.2		1.2	0%	356	
90 to 95	92.5	-	44	13	57	28	30	7,168	3.1	3.3	1.8	1.9	2.6		2.6	0%	776	
85 to 90	87.5	1	167	60	228	104	124	7,168	8.9	10.5	5.2	6.1	8.0		8.0	0%	2,348	
80 to 85	82.5	31	283	162	476	180	296	7,168	10.3	17.0	6.0	10.0	11.3		11.3	0%	3,321	
75 to 80	77.5	191	235	280	706	164	542	7,168	4.9	16.3	2.9	9.6	8.8		8.8	0%	2,580	
70 to 75	72.5	203	177	222	602	129	473	7,168	0.4	1.3	0.2	0.8	0.7		0.7	0%	200	
65 to 70	67.5	325	165	204	694	132	562	7,168	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	7,168	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	7,168	11.5	2.3	6.7	5.7	8.2	-	8.2	0%		113
50 to 55	52.5	109	182	172	463	123	340	7,168	17.7	3.4	10.3	13.5	17.4	-	17.4	0%		240
45 to 50	47.5	105	119	142	366	84	282	7,168	14.1	2.8	8.2	15.3	18.3	-	18.3	0%		253
40 to 45	42.5	185	155	177	517	113	404	7,168	21.9	4.1	12.8	27.9	32.9	-	32.9	0%		454
35 to 40	37.5	236	200	241	677	146	531	7,168	31.9	5.3	18.7	44.5	52.3	-	52.3	0%		722
30 to 35	32.5	237	202	198	637	147	490	7,168	35.9	4.9	21.0	48.2	58.1	-	58.1	0%		802
25 to 30	27.5	121	115	113	349	83	266	7,168	22.2	2.7	13.0	30.1	36.7	-	36.7	0%		505
20 to 25	22.5	149	68	97	314	56	258	7,168	16.4	2.6	9.6	33.0	37.2	-	37.2	0%		513
15 to 20	17.5	95	40	46	181	33	148	7,168	10.7	1.5	6.2	21.0	24.0	-	24.0	0%		330
10 to 15	12.5	39	9	28	76	9	67	7,168	3.1	0.7	1.8	10.5	11.1	-	11.1	0%		154
5 to 10	7.5	21	5	5	31	5	26	7,168	1.8	0.3	1.1	4.5	5.0	-	5.0	0%		69
0 to 5	2.5	4	2	-	6	2	4	7,168	0.6	0.0	0.4	0.8	1.0	-	1.0	0%		14
-5 to 0	-2.5	4	-	-	4	0	4	7,168	0.1	0.0	0.1	0.7	0.8	-	0.8	0%		10
-10 to -5	-7.5	-	-	-	-	-	-	7,168	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	7,168	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										9,602	4,179

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

GLENFIELD MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	13,633	0.2	0.1	0.1	0.1	0.1		0.1	0%	39	
95 to 100	97.5	-	19	2	21	12	9	13,633	3.2	2.4	1.8	1.4	2.3		2.3	0%	677	
90 to 95	92.5	-	44	13	57	28	30	13,633	5.9	6.3	3.4	3.7	5.0		5.0	0%	1,477	
85 to 90	87.5	1	167	60	228	104	124	13,633	16.9	19.9	9.9	11.7	15.2		15.2	0%	4,466	
80 to 85	82.5	31	283	162	476	180	296	13,633	19.6	32.4	11.5	19.0	21.6		21.6	0%	6,316	
75 to 80	77.5	191	235	280	706	164	542	13,633	9.4	31.0	5.5	18.2	16.7		16.7	0%	4,907	
70 to 75	72.5	203	177	222	602	129	473	13,633	0.7	2.5	0.4	1.4	1.3		1.3	0%	380	
65 to 70	67.5	325	165	204	694	132	562	13,633	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	13,633	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	13,633	17.2	2.2	10.1	9.6	14.6	-	14.6	0%		160
50 to 55	52.5	109	182	172	463	123	340	13,633	27.7	3.2	16.2	23.7	32.0	-	32.0	0%		351
45 to 50	47.5	105	119	142	366	84	282	13,633	22.8	2.7	13.3	27.6	34.4	-	34.4	0%		377
40 to 45	42.5	185	155	177	517	113	404	13,633	36.3	3.9	21.2	50.8	61.9	-	61.9	0%		681
35 to 40	37.5	236	200	241	677	146	531	13,633	53.7	5.1	31.4	81.6	98.8	-	98.8	0%		1,085
30 to 35	32.5	237	202	198	637	147	490	13,633	61.2	4.7	35.8	88.9	109.6	-	109.6	0%		1,205
25 to 30	27.5	121	115	113	349	83	266	13,633	38.3	2.5	22.4	55.8	69.1	-	69.1	0%		760
20 to 25	22.5	149	68	97	314	56	258	13,633	28.5	2.5	16.7	61.3	70.7	-	70.7	0%		777
15 to 20	17.5	95	40	46	181	33	148	13,633	18.7	1.4	10.9	39.2	45.5	-	45.5	0%		500
10 to 15	12.5	39	9	28	76	9	67	13,633	5.5	0.6	3.2	19.6	21.3	-	21.3	0%		234
5 to 10	7.5	21	5	5	31	5	26	13,633	3.3	0.2	1.9	8.4	9.5	-	9.5	0%		104
0 to 5	2.5	4	2	-	6	2	4	13,633	1.1	0.0	0.7	1.5	2.0	-	2.0	0%		22
-5 to 0	-2.5	4	-	-	4	0	4	13,633	0.3	0.0	0.2	1.4	1.5	-	1.5	0%		16
-10 to -5	-7.5	-	-	-	-	-	-	13,633	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	13,633	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										18,262	6,271

VALLEY ROAD COMPLEX

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	15,979	0.2	0.1	0.1	0.1	0.2		0.2	0%	45	
95 to 100	97.5	-	19	2	21	12	9	15,979	3.7	2.8	2.2	1.7	2.7		2.7	0%	793	
90 to 95	92.5	-	44	13	57	28	30	15,979	6.9	7.4	4.0	4.3	5.9		5.9	0%	1,731	
85 to 90	87.5	1	167	60	228	104	124	15,979	19.8	23.4	11.6	13.7	17.9		17.9	0%	5,235	
80 to 85	82.5	31	283	162	476	180	296	15,979	23.0	38.0	13.5	22.2	25.3		25.3	0%	7,403	
75 to 80	77.5	191	235	280	706	164	542	15,979	11.0	36.4	6.4	21.3	19.6		19.6	0%	5,752	
70 to 75	72.5	203	177	222	602	129	473	15,979	0.8	2.9	0.5	1.7	1.5		1.5	0%	446	
65 to 70	67.5	325	165	204	694	132	562	15,979	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	15,979	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	15,979	18.0	5.1	10.6	12.8	15.1	-	15.1	0%		217
50 to 55	52.5	109	182	172	463	123	340	15,979	29.7	7.6	17.4	30.0	34.7	-	34.7	0%		499
45 to 50	47.5	105	119	142	366	84	282	15,979	24.8	6.3	14.5	34.2	38.2	-	38.2	0%		548
40 to 45	42.5	185	155	177	517	113	404	15,979	40.0	9.0	23.4	62.1	69.7	-	69.7	0%		1,001
35 to 40	37.5	236	200	241	677	146	531	15,979	59.6	11.9	34.9	99.1	112.0	-	112.0	0%		1,608
30 to 35	32.5	237	202	198	637	147	490	15,979	68.4	11.0	40.1	107.5	124.8	-	124.8	0%		1,793
25 to 30	27.5	121	115	113	349	83	266	15,979	43.0	6.0	25.2	67.2	79.0	-	79.0	0%		1,135
20 to 25	22.5	149	68	97	314	56	258	15,979	32.1	5.8	18.8	73.6	81.1	-	81.1	0%		1,165
15 to 20	17.5	95	40	46	181	33	148	15,979	21.2	3.3	12.4	46.9	52.3	-	52.3	0%		752
10 to 15	12.5	39	9	28	76	9	67	15,979	6.3	1.5	3.7	23.4	24.5	-	24.5	0%		353
5 to 10	7.5	21	5	5	31	5	26	15,979	3.7	0.6	2.2	10.0	10.9	-	10.9	0%		157
0 to 5	2.5	4	2	-	6	2	4	15,979	1.3	0.1	0.8	1.8	2.3	-	2.3	0%		32
-5 to 0	-2.5	4	-	-	4	0	4	15,979	0.3	0.1	0.2	1.6	1.7	-	1.7	0%		24
-10 to -5	-7.5	-	-	-	-	-	-	15,979	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	15,979	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										21,405	9,286

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

MONTCLAIR HIGH SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	19,747	0.3	0.2	0.2	0.1	0.2		0.2	0%	56	
95 to 100	97.5	-	19	2	21	12	9	19,747	4.6	3.5	2.7	2.1	3.3		3.3	0%	980	
90 to 95	92.5	-	44	13	57	28	30	19,747	8.5	9.1	5.0	5.3	7.3		7.3	0%	2,139	
85 to 90	87.5	1	167	60	228	104	124	19,747	24.4	28.9	14.3	16.9	22.1		22.1	0%	6,469	
80 to 85	82.5	31	283	162	476	180	296	19,747	28.4	46.9	16.7	27.5	31.2		31.2	0%	9,149	
75 to 80	77.5	191	235	280	706	164	542	19,747	13.6	45.0	8.0	26.3	24.3		24.3	0%	7,108	
70 to 75	72.5	203	177	222	602	129	473	19,747	1.0	3.6	0.6	2.1	1.9		1.9	0%	551	
65 to 70	67.5	325	165	204	694	132	562	19,747	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	19,747	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	19,747	23.6	6.3	13.8	15.8	19.2	-	19.2	0%		276
50 to 55	52.5	109	182	172	463	123	340	19,747	38.4	9.4	22.5	37.1	43.6	-	43.6	0%		627
45 to 50	47.5	105	119	142	366	84	282	19,747	31.8	7.8	18.6	42.3	47.7	-	47.7	0%		685
40 to 45	42.5	185	155	177	517	113	404	19,747	50.9	11.2	29.8	76.8	86.7	-	86.7	0%		1,246
35 to 40	37.5	236	200	241	677	146	531	19,747	75.7	14.7	44.3	122.5	139.2	-	139.2	0%		2,000
30 to 35	32.5	237	202	198	637	147	490	19,747	86.6	13.5	50.7	132.8	155.1	-	155.1	0%		2,229
25 to 30	27.5	121	115	113	349	83	266	19,747	54.3	7.4	31.8	83.0	98.1	-	98.1	0%		1,410
20 to 25	22.5	149	68	97	314	56	258	19,747	40.5	7.1	23.7	90.9	100.6	-	100.6	0%		1,445
15 to 20	17.5	95	40	46	181	33	148	19,747	26.6	4.1	15.6	57.9	64.9	-	64.9	0%		932
10 to 15	12.5	39	9	28	76	9	67	19,747	7.9	1.8	4.6	29.0	30.4	-	30.4	0%		436
5 to 10	7.5	21	5	5	31	5	26	19,747	4.7	0.7	2.7	12.3	13.5	-	13.5	0%		194
0 to 5	2.5	4	2	-	6	2	4	19,747	1.6	0.1	0.9	2.3	2.8	-	2.8	0%		40
-5 to 0	-2.5	4	-	-	4	0	4	19,747	0.4	0.1	0.2	2.0	2.1	-	2.1	0%		30
-10 to -5	-7.5	-	-	-	-	-	-	19,747	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	19,747	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										26,452	11,549

GEORGE INNESS ANNEX (HS-9TH), ATHLETICS

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	11,507	0.2	0.1	0.1	0.1	0.1		0.1	0%	33	
95 to 100	97.5	-	19	2	21	12	9	11,507	2.7	2.0	1.6	1.2	1.9		1.9	0%	571	
90 to 95	92.5	-	44	13	57	28	30	11,507	5.0	5.3	2.9	3.1	4.3		4.3	0%	1,246	
85 to 90	87.5	1	167	60	228	104	124	11,507	14.2	16.8	8.3	9.9	12.9		12.9	0%	3,770	
80 to 85	82.5	31	283	162	476	180	296	11,507	16.6	27.3	9.7	16.0	18.2		18.2	0%	5,331	
75 to 80	77.5	191	235	280	706	164	542	11,507	7.9	26.2	4.6	15.3	14.1		14.1	0%	4,142	
70 to 75	72.5	203	177	222	602	129	473	11,507	0.6	2.1	0.3	1.2	1.1		1.1	0%	321	
65 to 70	67.5	325	165	204	694	132	562	11,507	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	11,507	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	11,507	14.6	-	8.5	7.0	13.1	-	13.1	0%		202
50 to 55	52.5	109	182	172	463	123	340	11,507	23.4	-	13.7	18.4	28.1	-	28.1	0%		434
45 to 50	47.5	105	119	142	366	84	282	11,507	19.2	-	11.3	22.0	29.9	-	29.9	0%		462
40 to 45	42.5	185	155	177	517	113	404	11,507	30.6	-	17.9	40.9	53.6	-	53.6	0%		828
35 to 40	37.5	236	200	241	677	146	531	11,507	45.3	-	26.5	66.4	85.1	-	85.1	0%		1,315
30 to 35	32.5	237	202	198	637	147	490	11,507	51.7	-	30.3	72.8	94.2	-	94.2	0%		1,454
25 to 30	27.5	121	115	113	349	83	266	11,507	32.3	-	18.9	45.9	59.2	-	59.2	0%		915
20 to 25	22.5	149	68	97	314	56	258	11,507	24.0	-	14.1	50.6	60.5	-	60.5	0%		934
15 to 20	17.5	95	40	46	181	33	148	11,507	15.8	-	9.2	32.4	38.9	-	38.9	0%		601
10 to 15	12.5	39	9	28	76	9	67	11,507	4.7	-	2.7	16.3	18.2	-	18.2	0%		281
5 to 10	7.5	21	5	5	31	5	26	11,507	2.8	-	1.6	6.9	8.1	-	8.1	0%		125
0 to 5	2.5	4	2	-	6	2	4	11,507	1.0	-	0.6	1.3	1.7	-	1.7	0%		26
-5 to 0	-2.5	4	-	-	4	0	4	11,507	0.2	-	0.1	1.1	1.2	-	1.2	0%		19
-10 to -5	-7.5	-	-	-	-	-	-	11,507	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	11,507	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										15,414	7,595

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

NISHUANE K-2

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	11,389	0.2	0.1	0.1	0.1	0.1		0.1	0%	32	
95 to 100	97.5	-	19	2	21	12	9	11,389	2.6	2.0	1.5	1.2	1.9		1.9	0%	565	
90 to 95	92.5	-	44	13	57	28	30	11,389	4.9	5.3	2.9	3.1	4.2		4.2	0%	1,234	
85 to 90	87.5	1	167	60	228	104	124	11,389	14.1	16.7	8.2	9.8	12.7		12.7	0%	3,731	
80 to 85	82.5	31	283	162	476	180	296	11,389	16.4	27.1	9.6	15.9	18.0		18.0	0%	5,277	
75 to 80	77.5	191	235	280	706	164	542	11,389	7.8	25.9	4.6	15.2	14.0		14.0	0%	4,099	
70 to 75	72.5	203	177	222	602	129	473	11,389	0.6	2.1	0.3	1.2	1.1		1.1	0%	318	
65 to 70	67.5	325	165	204	694	132	562	11,389	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	11,389	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	11,389	15.2	14.6	8.9	15.5	7.2	-	7.2	0%		111
50 to 55	52.5	109	182	172	463	123	340	11,389	24.1	21.7	14.1	30.9	19.3	-	19.3	0%		297
45 to 50	47.5	105	119	142	366	84	282	11,389	19.7	18.0	11.5	32.3	22.4	-	22.4	0%		347
40 to 45	42.5	185	155	177	517	113	404	11,389	31.2	25.7	18.3	55.6	42.8	-	42.8	0%		661
35 to 40	37.5	236	200	241	677	146	531	11,389	46.0	33.9	26.9	85.5	70.7	-	70.7	0%		1,092
30 to 35	32.5	237	202	198	637	147	490	11,389	52.3	31.2	30.6	90.3	80.7	-	80.7	0%		1,247
25 to 30	27.5	121	115	113	349	83	266	11,389	32.6	17.0	19.1	55.3	51.9	-	51.9	0%		801
20 to 25	22.5	149	68	97	314	56	258	11,389	24.2	16.5	14.2	59.7	53.3	-	53.3	0%		822
15 to 20	17.5	95	40	46	181	33	148	11,389	15.9	9.4	9.3	37.5	34.7	-	34.7	0%		536
10 to 15	12.5	39	9	28	76	9	67	11,389	4.7	4.3	2.7	18.6	16.3	-	16.3	0%		251
5 to 10	7.5	21	5	5	31	5	26	11,389	2.8	1.7	1.6	7.8	7.3	-	7.3	0%		113
0 to 5	2.5	4	2	-	6	2	4	11,389	1.0	0.3	0.6	1.4	1.5	-	1.5	0%		24
-5 to 0	-2.5	4	-	-	4	0	4	11,389	0.2	0.2	0.1	1.3	1.1	-	1.1	0%		17
-10 to -5	-7.5	-	-	-	-	-	-	11,389	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	11,389	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										15,256	6,319

NORTHEAST ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	9,159	0.1	0.1	0.1	0.0	0.1		0.1	0%	26	
95 to 100	97.5	-	19	2	21	12	9	9,159	2.1	1.6	1.2	1.0	1.6		1.6	0%	455	
90 to 95	92.5	-	44	13	57	28	30	9,159	3.9	4.2	2.3	2.5	3.4		3.4	0%	992	
85 to 90	87.5	1	167	60	228	104	124	9,159	11.3	13.4	6.6	7.8	10.2		10.2	0%	3,000	
80 to 85	82.5	31	283	162	476	180	296	9,159	13.2	21.8	7.7	12.7	14.5		14.5	0%	4,243	
75 to 80	77.5	191	235	280	706	164	542	9,159	6.3	20.9	3.7	12.2	11.3		11.3	0%	3,297	
70 to 75	72.5	203	177	222	602	129	473	9,159	0.5	1.7	0.3	1.0	0.9		0.9	0%	256	
65 to 70	67.5	325	165	204	694	132	562	9,159	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	9,159	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	9,159	12.8	11.8	7.5	12.5	6.0	-	6.0	0%		93
50 to 55	52.5	109	182	172	463	123	340	9,159	20.2	17.4	11.8	24.9	15.8	-	15.8	0%		244
45 to 50	47.5	105	119	142	366	84	282	9,159	16.4	14.5	9.6	26.0	18.3	-	18.3	0%		282
40 to 45	42.5	185	155	177	517	113	404	9,159	25.8	20.7	15.1	44.7	34.7	-	34.7	0%		536
35 to 40	37.5	236	200	241	677	146	531	9,159	37.9	27.2	22.2	68.8	57.3	-	57.3	0%		884
30 to 35	32.5	237	202	198	637	147	490	9,159	43.0	25.1	25.2	72.6	65.3	-	65.3	0%		1,009
25 to 30	27.5	121	115	113	349	83	266	9,159	26.8	13.7	15.7	44.5	41.9	-	41.9	0%		648
20 to 25	22.5	149	68	97	314	56	258	9,159	19.9	13.2	11.6	48.0	43.0	-	43.0	0%		664
15 to 20	17.5	95	40	46	181	33	148	9,159	13.0	7.6	7.6	30.2	28.0	-	28.0	0%		432
10 to 15	12.5	39	9	28	76	9	67	9,159	3.8	3.4	2.2	14.9	13.1	-	13.1	0%		202
5 to 10	7.5	21	5	5	31	5	26	9,159	2.3	1.3	1.3	6.3	5.9	-	5.9	0%		91
0 to 5	2.5	4	2	-	6	2	4	9,159	0.8	0.2	0.5	1.1	1.2	-	1.2	0%		19
-5 to 0	-2.5	4	-	-	4	0	4	9,159	0.2	0.2	0.1	1.0	0.9	-	0.9	0%		14
-10 to -5	-7.5	-	-	-	-	-	-	9,159	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	9,159	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										12,269	5,119

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

RENAISSANCE MIDDLE SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	7,426	0.1	0.1	0.1	0.0	0.1		0.1	0%	21	
95 to 100	97.5	-	19	2	21	12	9	7,426	1.7	1.3	1.0	0.8	1.3		1.3	0%	369	
90 to 95	92.5	-	44	13	57	28	30	7,426	3.2	3.4	1.9	2.0	2.7		2.7	0%	804	
85 to 90	87.5	1	167	60	228	104	124	7,426	9.2	10.9	5.4	6.4	8.3		8.3	0%	2,433	
80 to 85	82.5	31	283	162	476	180	296	7,426	10.7	17.6	6.3	10.3	11.7		11.7	0%	3,441	
75 to 80	77.5	191	235	280	706	164	542	7,426	5.1	16.9	3.0	9.9	9.1		9.1	0%	2,673	
70 to 75	72.5	203	177	222	602	129	473	7,426	0.4	1.3	0.2	0.8	0.7		0.7	0%	207	
65 to 70	67.5	325	165	204	694	132	562	7,426	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	7,426	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	7,426	9.9	1.2	5.8	5.2	8.1	-	8.1	0%		112
50 to 55	52.5	109	182	172	463	123	340	7,426	15.7	1.8	9.2	12.9	17.7	-	17.7	0%		244
45 to 50	47.5	105	119	142	366	84	282	7,426	12.8	1.5	7.5	15.0	18.9	-	18.9	0%		261
40 to 45	42.5	185	155	177	517	113	404	7,426	20.3	2.1	11.9	27.6	34.0	-	34.0	0%		468
35 to 40	37.5	236	200	241	677	146	531	7,426	30.0	2.8	17.6	44.5	54.1	-	54.1	0%		746
30 to 35	32.5	237	202	198	637	147	490	7,426	34.1	2.5	20.0	48.4	60.0	-	60.0	0%		828
25 to 30	27.5	121	115	113	349	83	266	7,426	21.3	1.4	12.5	30.4	37.8	-	37.8	0%		522
20 to 25	22.5	149	68	97	314	56	258	7,426	15.8	1.3	9.3	33.4	38.6	-	38.6	0%		532
15 to 20	17.5	95	40	46	181	33	148	7,426	10.4	0.8	6.1	21.3	24.9	-	24.9	0%		343
10 to 15	12.5	39	9	28	76	9	67	7,426	3.1	0.3	1.8	10.7	11.6	-	11.6	0%		160
5 to 10	7.5	21	5	5	31	5	26	7,426	1.8	0.1	1.1	4.6	5.2	-	5.2	0%		71
0 to 5	2.5	4	2	-	6	2	4	7,426	0.6	0.0	0.4	0.8	1.1	-	1.1	0%		15
-5 to 0	-2.5	4	-	-	4	0	4	7,426	0.1	0.0	0.1	0.7	0.8	-	0.8	0%		11
-10 to -5	-7.5	-	-	-	-	-	-	7,426	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	7,426	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										9,947	4,313

WATCHUNG ELEMENTARY SCHOOL

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	8,792	0.1	0.1	0.1	0.0	0.1		0.1	0%	25	
95 to 100	97.5	-	19	2	21	12	9	8,792	2.0	1.6	1.2	0.9	1.5		1.5	0%	436	
90 to 95	92.5	-	44	13	57	28	30	8,792	3.8	4.1	2.2	2.4	3.3		3.3	0%	952	
85 to 90	87.5	1	167	60	228	104	124	8,792	10.9	12.9	6.4	7.5	9.8		9.8	0%	2,880	
80 to 85	82.5	31	283	162	476	180	296	8,792	12.7	20.9	7.4	12.2	13.9		13.9	0%	4,073	
75 to 80	77.5	191	235	280	706	164	542	8,792	6.1	20.0	3.5	11.7	10.8		10.8	0%	3,165	
70 to 75	72.5	203	177	222	602	129	473	8,792	0.4	1.6	0.3	0.9	0.8		0.8	0%	245	
65 to 70	67.5	325	165	204	694	132	562	8,792	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	8,792	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	8,792	12.3	7.1	7.2	9.5	7.6	-	7.6	0%		103
50 to 55	52.5	109	182	172	463	123	340	8,792	19.4	10.4	11.4	20.2	17.8	-	17.8	0%		242
45 to 50	47.5	105	119	142	366	84	282	8,792	15.7	8.7	9.2	21.9	19.7	-	19.7	0%		268
40 to 45	42.5	185	155	177	517	113	404	8,792	24.8	12.4	14.5	38.6	36.4	-	36.4	0%		495
35 to 40	37.5	236	200	241	677	146	531	8,792	36.4	16.3	21.3	60.3	59.0	-	59.0	0%		803
30 to 35	32.5	237	202	198	637	147	490	8,792	41.3	15.1	24.2	64.4	66.5	-	66.5	0%		904
25 to 30	27.5	121	115	113	349	83	266	8,792	25.7	8.2	15.1	39.8	42.3	-	42.3	0%		575
20 to 25	22.5	149	68	97	314	56	258	8,792	19.1	7.9	11.2	43.3	43.2	-	43.2	0%		588
15 to 20	17.5	95	40	46	181	33	148	8,792	12.5	4.5	7.3	27.4	28.0	-	28.0	0%		381
10 to 15	12.5	39	9	28	76	9	67	8,792	3.7	2.1	2.2	13.6	13.1	-	13.1	0%		178
5 to 10	7.5	21	5	5	31	5	26	8,792	2.2	0.8	1.3	5.8	5.9	-	5.9	0%		80
0 to 5	2.5	4	2	-	6	2	4	8,792	0.7	0.1	0.4	1.1	1.2	-	1.2	0%		17
-5 to 0	-2.5	4	-	-	4	0	4	8,792	0.2	0.1	0.1	0.9	0.9	-	0.9	0%		12
-10 to -5	-7.5	-	-	-	-	-	-	8,792	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	8,792	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										11,777	4,647

Montclair Board of Education
Exhibit D
ECM 13A Window Film
Window Film

WOODMAN FIELD

Amb. Temp Bin °F	Avg Temp °F	01-08 Hours	09-16 Hours	17-24 Hours	Total Bin Hours	Occupied Hours	Unoccupied Hours	Roof Square Feet	Existing Occupied Cooling Gain and Heating Loss	Existing Unoccupied Cooling Gain and Heating Loss	Proposed Occupied Cooling Gain and Heating Loss	Proposed Unoccupied Cooling Gain and Heating Loss	Cooling or Heating Savings	Infiltration savings	Total Heating or Cooling Savings	Safety Factor	kWh Saved	Input Therms Saved
COOLING									(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)	(MMBTU)			
100 to 105	102.5	-	1	-	1	1	0	4,423	0.1	0.0	0.0	0.0	0.0		0.0	0%	13	
95 to 100	97.5	-	19	2	21	12	9	4,423	1.0	0.8	0.6	0.5	0.7		0.7	0%	220	
90 to 95	92.5	-	44	13	57	28	30	4,423	1.9	2.0	1.1	1.2	1.6		1.6	0%	479	
85 to 90	87.5	1	167	60	228	104	124	4,423	5.5	6.5	3.2	3.8	4.9		4.9	0%	1,449	
80 to 85	82.5	31	283	162	476	180	296	4,423	6.4	10.5	3.7	6.2	7.0		7.0	0%	2,049	
75 to 80	77.5	191	235	280	706	164	542	4,423	3.0	10.1	1.8	5.9	5.4		5.4	0%	1,592	
70 to 75	72.5	203	177	222	602	129	473	4,423	0.2	0.8	0.1	0.5	0.4		0.4	0%	123	
65 to 70	67.5	325	165	204	694	132	562	4,423	-	-	-	-	-		-	0%	-	
60 to 65	62.5	180	152	195	527	111	416	4,423	-	-	-	-	-		-	0%	-	
HEATING																		
55 to 60	57.5	86	144	97	327	98	229	4,423	4.4	5.7	2.6	6.0	2.2	-	2.2	0%		31
50 to 55	52.5	109	182	172	463	123	340	4,423	7.5	8.4	4.4	12.0	6.7	-	6.7	0%		95
45 to 50	47.5	105	119	142	366	84	282	4,423	6.4	7.0	3.7	12.5	8.2	-	8.2	0%		116
40 to 45	42.5	185	155	177	517	113	404	4,423	10.4	10.0	6.1	21.6	15.9	-	15.9	0%		225
35 to 40	37.5	236	200	241	677	146	531	4,423	15.6	13.2	9.1	33.2	26.5	-	26.5	0%		376
30 to 35	32.5	237	202	198	637	147	490	4,423	18.0	12.1	10.6	35.1	30.4	-	30.4	0%		431
25 to 30	27.5	121	115	113	349	83	266	4,423	11.4	6.6	6.7	21.5	19.6	-	19.6	0%		278
20 to 25	22.5	149	68	97	314	56	258	4,423	8.6	6.4	5.0	23.2	20.3	-	20.3	0%		288
15 to 20	17.5	95	40	46	181	33	148	4,423	5.6	3.7	3.3	14.6	13.3	-	13.3	0%		188
10 to 15	12.5	39	9	28	76	9	67	4,423	1.7	1.7	1.0	7.2	6.3	-	6.3	0%		89
5 to 10	7.5	21	5	5	31	5	26	4,423	1.0	0.6	0.6	3.0	2.8	-	2.8	0%		40
0 to 5	2.5	4	2	-	6	2	4	4,423	0.3	0.1	0.2	0.6	0.6	-	0.6	0%		8
-5 to 0	-2.5	4	-	-	4	0	4	4,423	0.1	0.1	0.0	0.5	0.4	-	0.4	0%		6
-10 to -5	-7.5	-	-	-	-	-	-	4,423	-	-	-	-	-	-	-	0%		-
-15 to -10	-12.5	-	-	-	-	-	-	4,423	-	-	-	-	-	-	-	0%		-
Total		2,322	2,484	2,454	7,260	1,760	5,500										5,925	2,170

APPENDIX 3 CUTSHEETS

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VT8000 Room Controllers

VT8650 Data Sheet
Roof Top Unit (RTU), Heat Pump and Indoor Air Quality (IAQ)
Firmware release version 2.4

Programmable and application specific room controller with customizable covers and screen colors. The VT8650 is a rooftop, heat pump and indoor air quality room controller suitable for commercial and high end hospitality markets.

Product at a glance

The perfect balance between simplicity and sophistication. Select from a wide variety of configurable screen colors to match decor. Display your own logo and custom messages on screen to reinforce your brand and provide a more enjoyable occupant experience.

- **Interface:** touch screen interface.
- **Aesthetics:** up to ten selectable screen colors.
- **Flexible:** configurable economizer/scheduler, support for custom standby screen and Lua scripts uploads.
- **Conformity:** conforms to ASHRAE specifications for Green Building Standards and applicable safety, EMC and radio standards.
- **Customize**: supports the display of custom messages when integrated to a BACnet MS/TP system.
- **Protocols:** wired BACnet MS/TP, Modbus RTU and wireless ZigBee Pro.
- **Peripherals:** easy to install ZigBee Pro plug-in module or CO_2 sensor plug-in module.
- **Sensors**: CO_2 sensor, occupancy, motion, light, temperature, RH and water leak sensors.
- **Automatic Demand Response:** load shedding application for demand response.

Benefits

All models can be equipped with a discrete optional Passive Infrared (PIR) motion sensor. With this sensor installed, the VT8650 uses advanced occupancy routines to generate automatic energy savings during occupied and unoccupied periods without sacrificing comfort.

- Generate automatic energy savings
- Display custom logo
- Interchange between °C/°F
- Suitable for commercial/hospitality markets
- 20 selectable languages

Note: This specification applies to units with date code 1838 or later.



The VT8000 family is both application-specific AND programmable.

VICONICS Beyond Comfort

VT8650 Overview

Introduction

Smart energy management has never been easier than with the VT8650 room controllers for Rooftop Units, Heat Pump applications and Indoor air Quality applications.

Designed for new construction and retrofit projects, the room controllers dramatically decrease project delivery costs by reducing installation, configuration and commissioning time. No complex software or tools are required to customize functionality to meet your applications requirements. The room controllers provide all the advanced features and monitoring functions required by modern building automation systems in a simple compact enclosure.

Application Specific and Programmable

The VT8650 room controllers, part of the VT8000 family, are both application-specific AND programmable. This enables the modification of pre-configured control sequences, or the creation of entirely new control sequences for HVAC, lighting and other applications. The VT8650 room controllers provide exceptional control of staged heating and cooling equipment such as packaged roof-top units. Their configurable control sequences, economizer, and scheduler functionalities deliver all the flexibility necessary for optimal indoor air quality applications.

Touch Screen with Customizable User Experience

The touch screen of the VT8650 room controller offers a customizable user experience with selection of languages, temperature scales, buttons, and screen colors. Using the Uploader Tool, it also supports the upload of an image or logo that becomes the default standby screen of the device. Custom messages can also be displayed on-screen using BACnet® objects when the VT8650 room controller is integrated via a BACnet MS/TP or Modbus system.

Optional Passive Infrared Motion Sensor

All models are available with a discrete optional passive infrared (PIR) motion sensor. With this sensor, the VT8650 room controller uses advanced occupancy routines and optional additional Lua scripts to generate automatic energy savings during occupied and unoccupied periods without sacrificing comfort.

Automatic Demand Response

The Automatic Demand Respond (ADR) implements the Load Shedding application compatible with regulations for Occupant Controlled Smart Thermostats. The application requires a BACnet command from interfacing equipment to turn-on and turn-off the Load Shedding feature. Messaging and confirmations are performed by adjoining equipment having Internet connectivity and then providing the Room Controller the BACnet or Modbus command message.

ZigBee Wireless Sensors

The VT8650 room controllers support pairing of a number of ZigBee wireless sensors. Facility managers benefit from being able to monitor critical areas and be informed of events of concern in a timely manner which facilitates the maintenance of a safe and efficient operation.

VT8650 Features

Product highlights

The VT8650 Room Controller has the following high level functionality:

- Suitable for both commercial and hospitality markets and systems
- Customizable color digital touch screen interface with multi-language support
- Fully programmable control sequences using scripting
- On board configuration interface utility
- Configurable sequence of operations
- Configurable Economizer and Scheduler
- Change of Value (COV) function for BMS integration
- Universal inputs and outputs including a CO_2 sensor input, and a fresh air station input
- Humidity sensor with on-board dehumidification strategy
- Optional PIR occupancy sensor
- Optional wireless door and window switches (with optional ZigBee Pro® card) available
- Optional or embedded on-board ZigBee Pro module

Network Protocols

The VT8650 Room Controller natively supports BACnet MS/TP and Modbus RTU as well as optional ZigBee Pro protocols.

Integration to Schneider Electric Systems

The VT8650 Room Controller can be seamlessly integrated with the following:

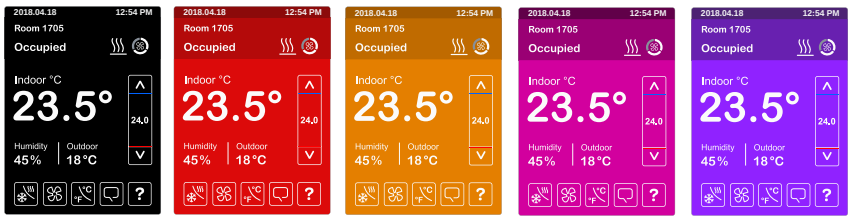
- EcoStruxure™ Building Expert™, EcoStruxure Building Operation and other Schneider Electric systems.
- Wireless integration to MPM devices
- Wireless integration to BACnet IP, oBIX and EWS via MPM devices
- Direct wired integration to BACnet MS/TP and Modbus

Custom Match Styling to Decor

The VT8650 Room Controller is available in ten screen colors.



10 selectable screen colors



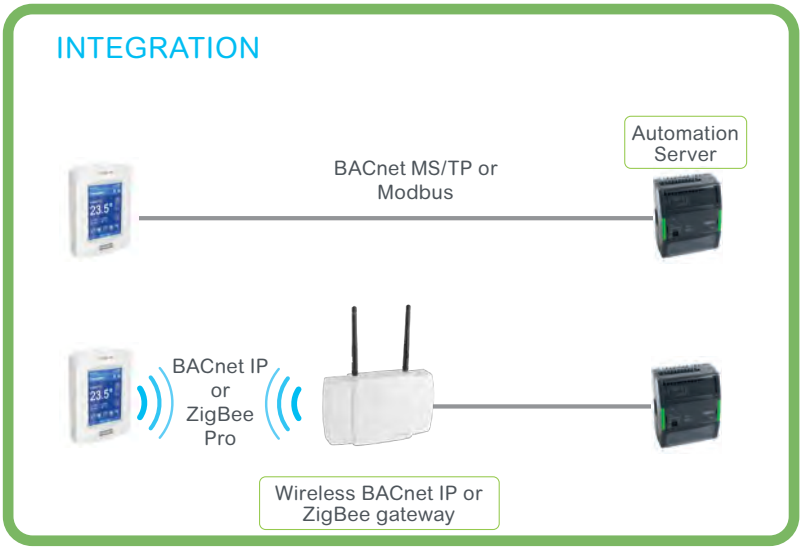
VT8650 Programming

Programming with Lua

The VT8650 room controllers are programmable using the open source programming language Lua. Although building management systems often use open protocols and standards, their Program BACnet objects and scripting features remain proprietary and incompatible with third party devices. The VT8650 room controllers use of an open language enables operability with all systems.

Programming with BMS Integration

When integrated into a BACnet MS/TP building management system, the VT8650 offers 10 Program BACnet objects able to contain 480 characters each. No special software, license or tool is required.



Programming without Integration

When there is no BACnet MS/TP or Modbus integration, a Lua script can be uploaded directly into the VT8650 unit using the VT8000 Uploader Tool. Unlike the 10 PG objects used when the unit is integrated via BACnet MS/TP or Modbus, there is only one script, which can contain up to 80kBytes. In addition to Lua scripts, standby screen images and firmware upgrades can also be loaded into the VT8650 using the VT8000 Uploader Tool.

HVAC Applications and Beyond

Programming can be used to go beyond the pre-configured control sequences of the VT8650 to create customized HVAC applications. It can also be used to comply with specific project requirements and manage other applications, such as lighting and other equipment. Using Lua scripts also enables you to take advantage of the extra inputs and outputs of the VT8650 to manage other devices, such as sensors and relays.

Integration and Custom Screens

The VT8650 is flexible and adapts to wired and wireless applications. Custom screen and display messages can be uploaded using the Uploader Tool.

Uploader Tool

The VT8000 Uploader Tool now enables Lua scripts, standby screen images and firmware upgrades to be loaded via a Micro-USB cable into and from the VT8650 room controller. This allows an existing VT8650 configuration to be copied from an existing device and loaded into another VT8650 room controller.

CUSTOM STANDBY SCREEN & MESSAGES

> Custom standby screen

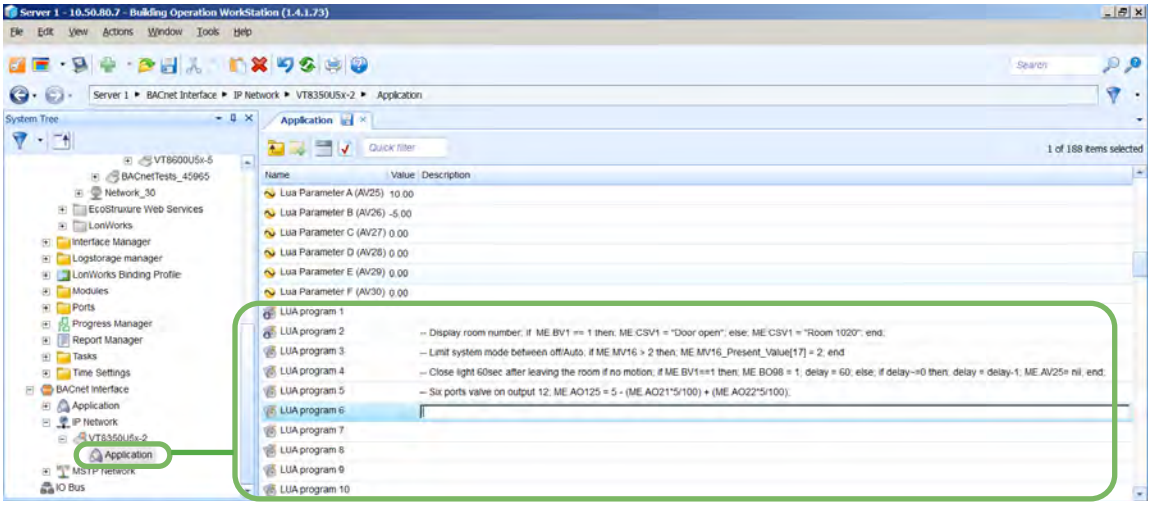


> Custom BACnet MS/TP or Modbus messages



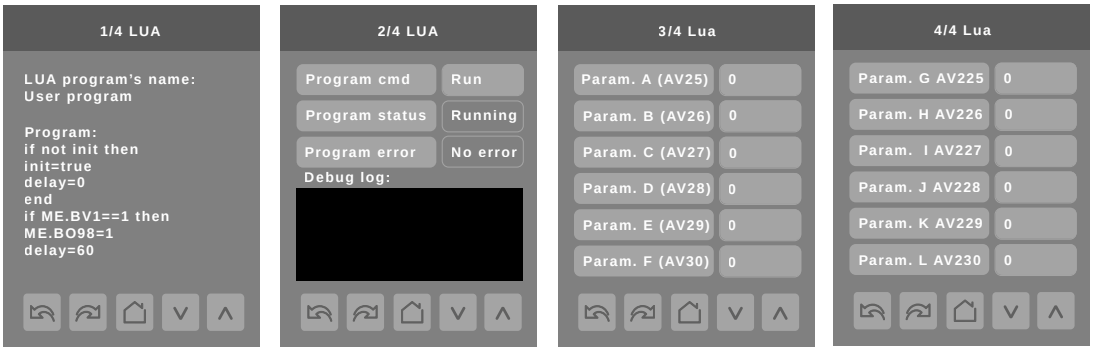
Viewing Objects in EcoStruxure Building Operation

All PG Objects of the VT8650 Room Controller can easily be viewed through a Building Management System.



Viewing Objects in Lua Touch Screens

All PG Objects of the VT8650 Room Controller can easily be viewed through the touch screen display.



VT8650 Applications

Indoor Air Quality

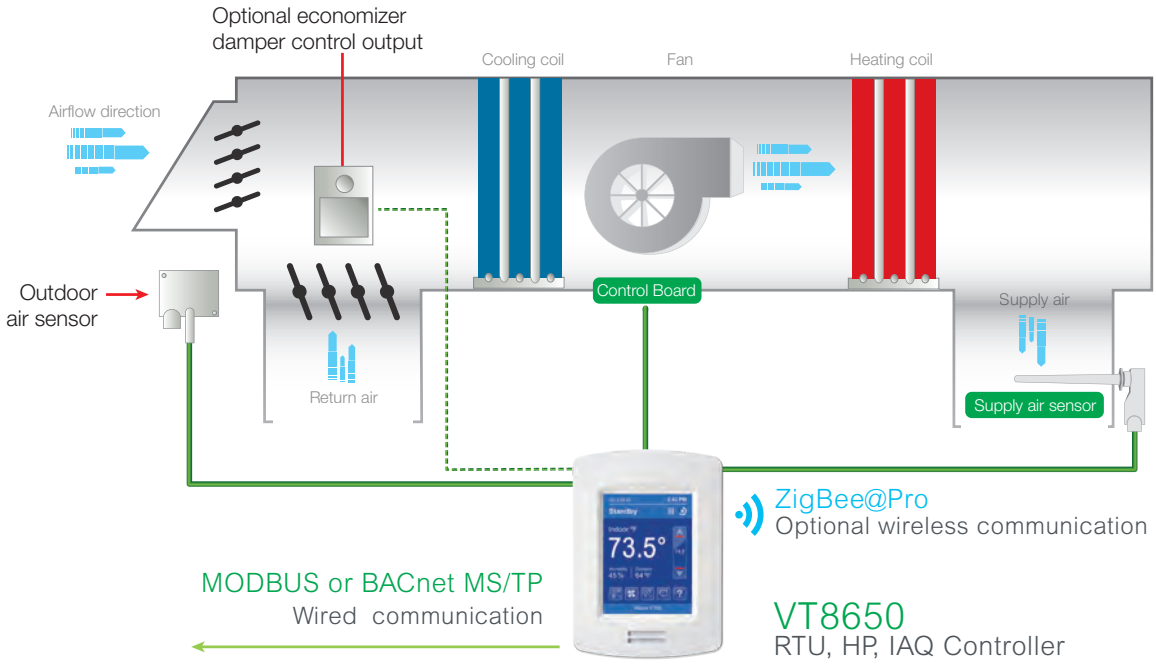
Indoor air quality is increasingly becoming a major concern to businesses, building managers, tenants, and employees because of its direct impact on the comfort, well-being, and productivity of the building's occupants. The VT8650 room controller, along with a CO_2 sensor, is a cost-effective solution capable of controlling economizer free cooling, and demand-based ventilation strategies, while providing a fresh air measurement input. When integrated to a building management system, the room controller can monitor and verify the CO_2 and fresh air levels, ensuring optimal air quality and energy efficiency.

Rooftop Units

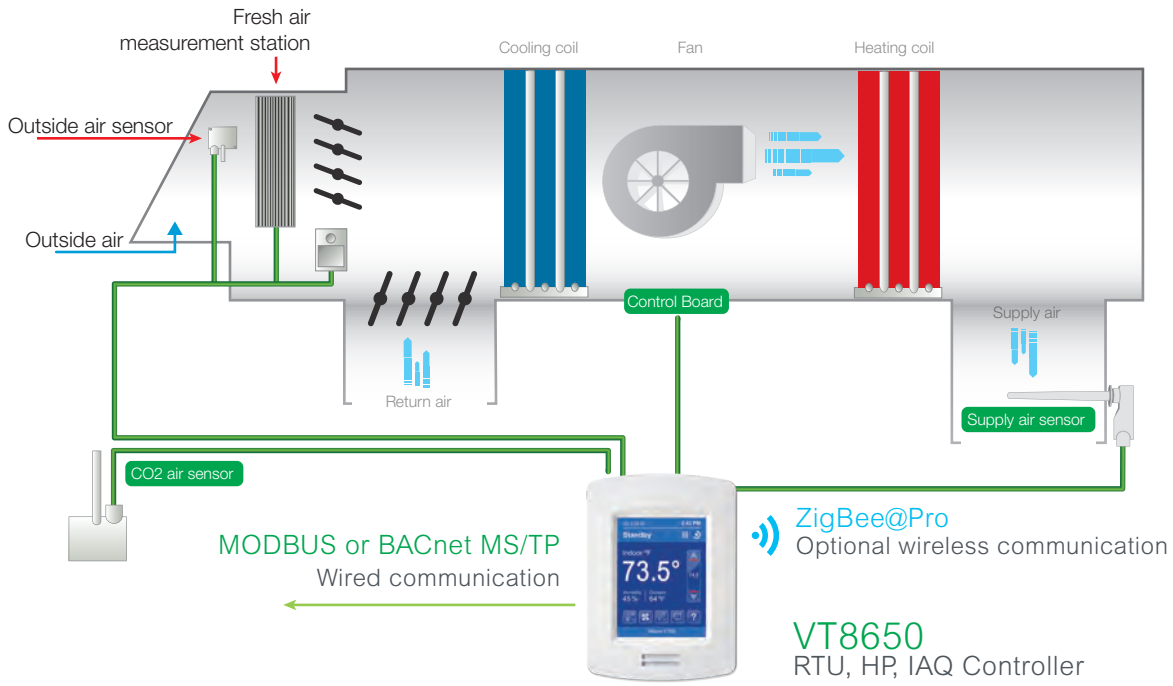
The VT8650 room controller can be configured to manage different types of staged equipment, such as the following:

- 1 Heating stage / 1 Cooling stage
- 2 Heating stages / 2 Cooling stages
- 3 Heating stages / 2 Cooling stages
- Modulating heat / 2 Cooling stages

Typical Room Application



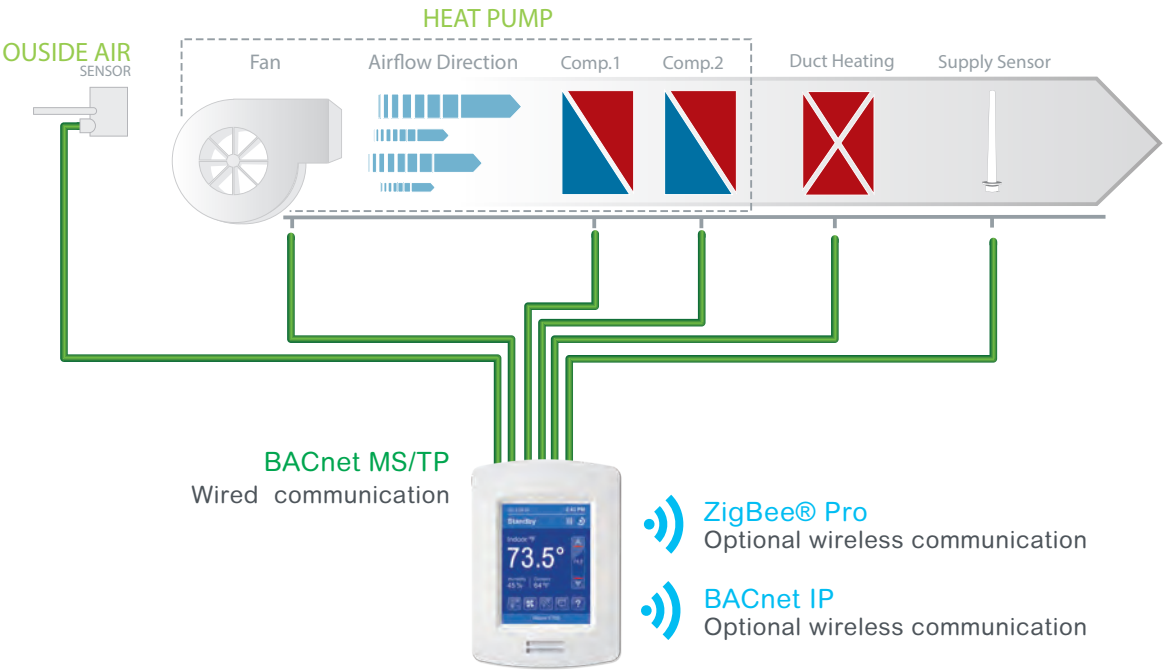
Typical Indoor Air Quality Application



Heat Pump

- Selectable single or dual stage compressor stages
- High balance point: Locks out auxiliary heating when outside air temperature is above this value
- Low balance point: Locks out heat pump compressor operation when outside air temperature is below this value
- Comfort/economy mode: In economy mode, heat pump use is maximized before turning on auxiliary heating
- Compressor/auxiliary interlock: Adds flexibility by locking out heat pump operation during auxiliary heating to prevent high pressure trip when the coil is downstream of the auxiliary heat source

Typical Heat Pump Application



Specifications

Main Specifications

Note: This specification applies to units with date code 1838 or later.

Item	Description
Dimensions	12cm/4.72in (H) x 8.6cm/3.38in (W) x 2.5cm/1in (D)
Power Requirements	Input: 24VAC ±15%, 50/60Hz Peak device consumption: up to 12VA with CO2 sensor module Transformer maximum rating: 100VA, 4.17 A
Output Ratings	**Nine Electronic Relays**: 28Vac 50/60Hz, 1.0 Amp., in-rush = 3.0 Amps; **Four Analog Outputs**: 0 - 10 Vdc, 5mA maximum, (2 kilo-ohm resistance) Configurable Output Analog/Electronic Relay
Operating Conditions	0 °C to 50 °C (32 °F to 122 °F) 0% to 75% R.H. non-condensing
Storage Conditions	-30 °C to 50 °C (-22 °F to 122 °F) 0% to 75% R.H. non-condensing
Temperature Sensor	Local 10 K NTC type 2 thermistor
Temperature Sensor Resolution	± 0.1 °C (± 0.2 °F)
Temperature Control Accuracy	±0.5 ° C (± 0.9 °F) @ 21 °C (70 °F) typical calibrated
Humidity Sensor Precision	Reading range from 10-90 % R.H. non-condensing 10 to 20% precision: 10% 20% to 70% precision: 5% 70% to 90% precision: 10%
Humidity Sensor Stability	Less than 0.25 % yearly (typical drift)
Dehumidification Setpoint Range	30% to 95% R.H.
Occ, Unocc and Standby Cooling Setpoint Range	12.0 to 37.5 °C (54 to 100 °F)
Occ, Unocc and Standby Heating Setpoint Range	4.5 °C to 32 °C (40 °F to 90 °F)
Room and Outdoor Air Temperature Display Range	-40 °C to 50 °C (-40 °F to 122 °F)
Proportional Band for Room Temperature Control	Cooling and Heating: Default: 1.8°C (3.2°F)
Analog Inputs	Modulating 0-10 VDC across UI19, UI24 to Common
Binary Inputs	Dry contact across terminals UI16, UI17 to Common
Remote Temperature Sensor	10 K NTC type 2 thermistor UI20, UI22, UI23
Wire Gauge	Power supply: 18 gauge or larger, Communications: 24 gauge or larger
Shipping Weight	0.34 kg (0.75 lb)

Safety and Certifications

EMC/ Safety Standards	Radio Standards (For models with ZigBee Radio)
EMV Directive 2014/30/EU	RE Directive 2014/53/EU
FCC 15B Class B	ETSI EN 300 328 V2.1.1
ICES-003 Class B	ETSI EN 301 489-1 V1.9.2
	ETSI EN 301 489-17 V2.2.1
EN 60730-1:2016	FCC Part 15C
IEC 60730-1:2010	RSS-247
EN 60730-2-9:2010	
IEC 60730-2-9:2008	
EN 60730-2-13:1998	
UL 60730-1:2016	
CAN/CSA-E60730-1:2015	
UL 60730-2-9:2017	
CAN/CSA-E60730-2-9:2015	
UL60730-2-13:2014	
IEC 60730-2-13:2014	

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE , AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

THE GRANTEE IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
In order to comply with FCC/ISED RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

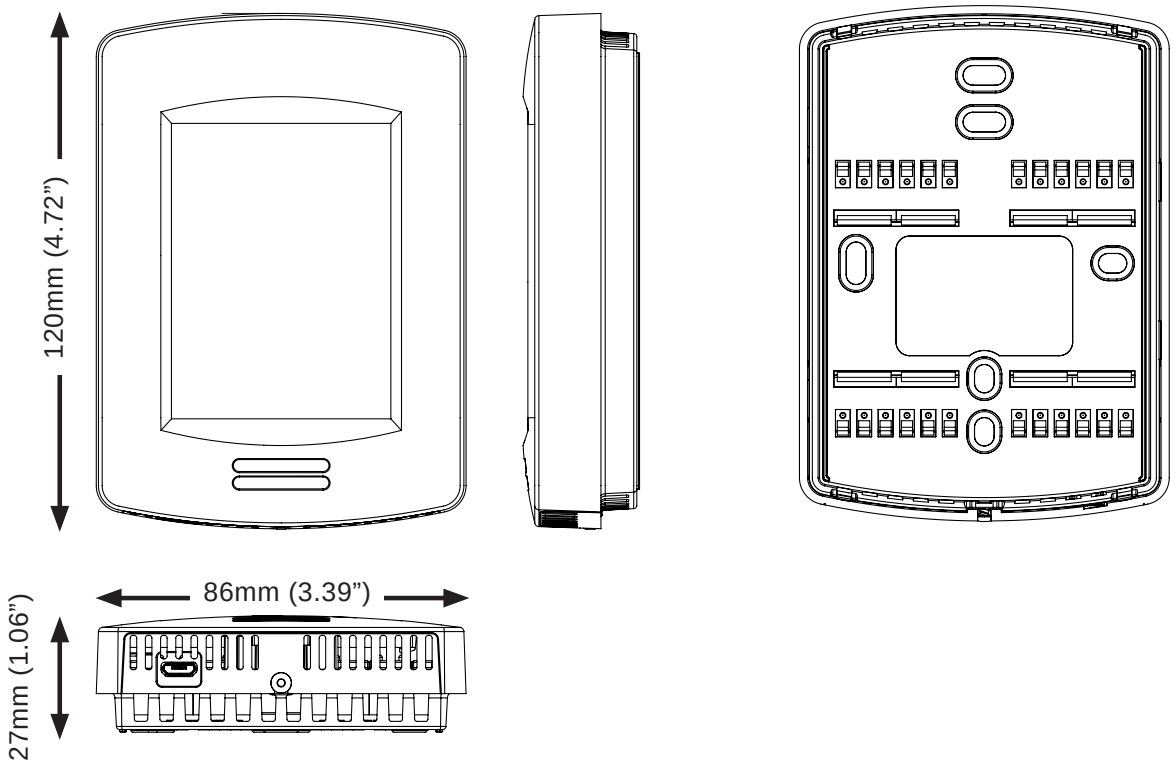
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1) l'appareil ne doit pas produire de brouillage;
2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Afin de se conformer aux exigences d'exposition RF FCC/ISED, cet appareil doit être installé pour fournir au moins 20 cm de séparation du corps humain en tout temps.

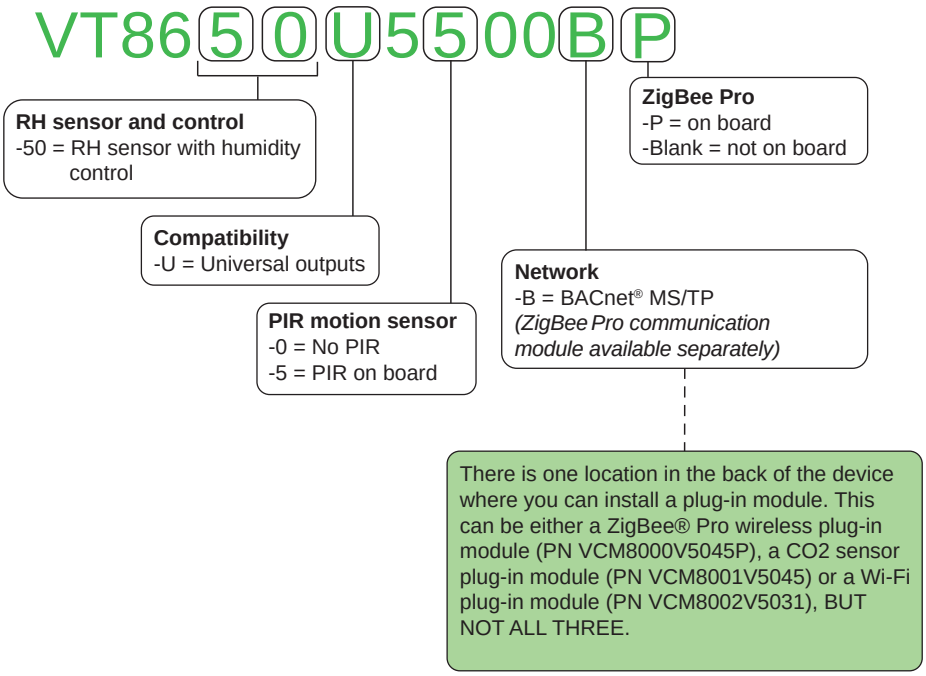


Check with your local government for instruction on disposal of this product.

Dimensions



Ordering Information



Part numbers

VT8650 Part numbers	ZigBee built-in	RH sensor & control	PIR motion sensor
VT8650U5000B		x	
VT8650U5500B		x	x
VT8650U5500BP	x	x	x

Part numbers

Communication modules
Consult respective datasheets for the latest available part numbers and features

compatible with
Smart Struxure™ Solution
Smart Struxure™ Lite Solution

Communication Module VCM8000V5000P

Communication Module for VT8000 Room Controller

Technical Cut Sheet

Accessory communication module that allows the upgrade of all network-ready VT8000 Series Room Controllers to support networking communication using the ZigBee® Pro wireless protocol.





VICONICS
Beyond Comfort

VCM8000V5000P Communication Module Features



AT A GLANCE

Communication options

- ZigBee Pro extended profile (P)

Overview

Accessory communication modules allow the upgrade of all network-ready VT8000 Series Room Controllers to support wireless communication.

All current network-ready VT8000 Series Room Controllers are capable of being retrofitted in the field with an accessory communication module. This enables the controllers to be integrated into a 2.4 GHz ZigBee Pro wireless network.

This approach provides the flexibility to add network communication strategies as budgets allow, or as building management needs change.

Wireless Option

- Current generation of ZigBee Pro
- Makes VT8000 Series products compatible with SmartStruxure™ Lite solution's StruxureWare™ Building Expert
- Building Expert versions 2.5 and 2.6 offer a fixed Home Automation profile view of the Room Controller and its objects
- Building Expert 2.7 and subsequent versions offer an extended object profile view of the Room Controller and its objects
- Building Expert 2.7 and subsequent versions can be integrated into SmartStruxure solution and other Schneider Electric building management systems

VCM8000V5000P Communication Module Features

Easy Installation

VCM8000V5000P communication modules are easy to install. Network-ready VT8000 Series Room Controllers are specifically designed to enable upgrades to their communication capabilities.

Adding a communication module only takes a few minutes but provides a big advantage to existing installations that require new networking and integration functionality.

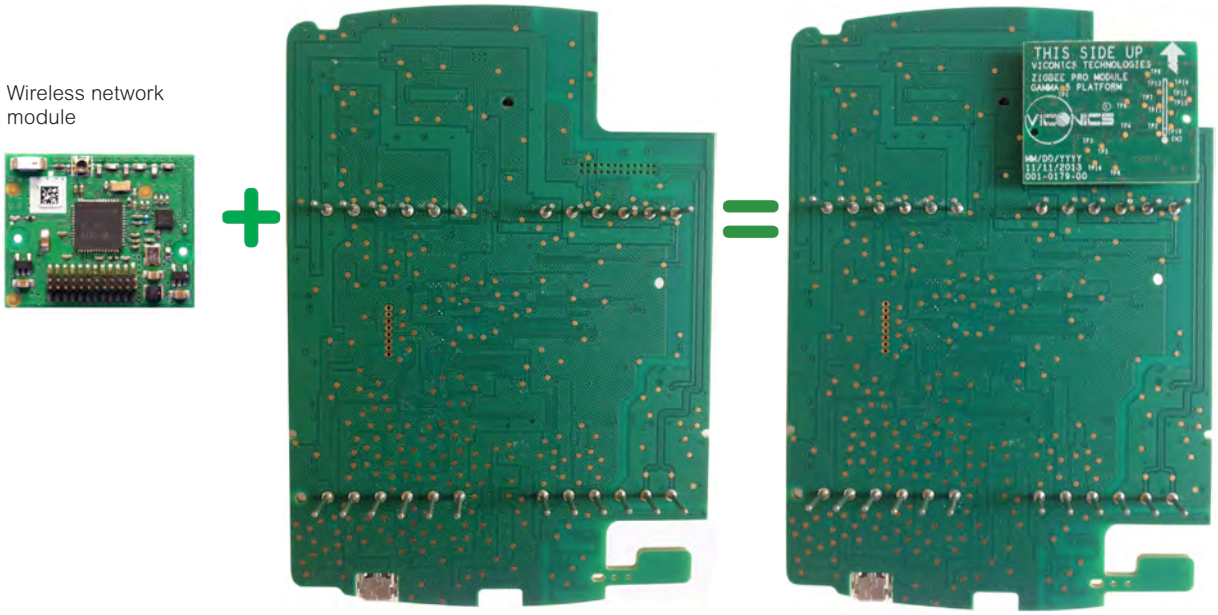


WHERE A COMMUNICATION MODULE FITS

Wireless network module

Network-ready controller

Wireless network controller



VCM8000V5000P Communication Module

Specifications

Operating Conditions
0 °C to 50 °C (32 °F to 122 °F)
0% to 95% R.H. non-condensing
Storage Conditions
-30 °C to 50 °C (-22 °F to 122 °F)
0% to 95% R.H. non-condensing
Approximate shipping weight
0.34kg (0.75lb)
Module Profile
ZigBee Pro (HA Profile)
Frequency Range: 2405 - 2475 MHz for (channels 11 - 25)
Agency approvals wireless models
FCC: Compliant to: Part 15, Subpart C
EN 300 328 V1.8.1
EN 301 489-1 V1.9.2
EN 301 489-1M V2.2.1

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

NOTE: THE MANUFACTURER IS NOT RESPONSIBLE FOR ANY RADIO OR TV INTERFERENCE CAUSED BY UNAUTHORIZED MODIFICATIONS TO THIS EQUIPMENT. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.



Check with your local government for instruction on disposal of these products.

Module Versions

All modules shipped after December 15, 2016 are Version 9 (V9) modules. The V9 module is required for the VT8000 Series Room Controllers to communicate wirelessly with the SEC-TE Smart Controller (VTR8300 only)

NOTE: All VTR8300 Room Controllers must be running Firmware version 1.5.1 to activate CO_2 Sensor Module functionality as well as communicate with the SED-TE Smart Controller. The Smart Controller must be version 16 (v16) or later.

NOTE: All VT8000 Series Room Controller require Version 10 (V10) modules and later to enable features available with Firmware Version 1.7 and later.

Ordering information

ZigBee Pro extended profile (P)

VCM8000V5000P	ZigBee Pro extended profile retrofit communication module for all VT8000 Series

CO_2 + TRH Sensor

Wireless CO_2 Temperature and Humidity Sensor

Monitor indoor air quality, review data on interfacing devices, and control fresh air inside customizable zones.



Product at a glance

Comfort is more than just a serene, pleasant ambiance. It's also about clean, fresh air, and ensuring a healthy environment inside a building.

Whether you're in a school, restaurant, office or other small building, the CO_2 + TRH Sensor will help ensure the well-being of your customers, students, or personnel.

Putting you on the fast track to Building LEED, BREEAM and Green Star Certification, the CO_2 +TRH Sensor delivers:

- **Performance:** maintains high performance in varying air type environments
- **Reliability:** provides accurate and reliable carbon dioxide, temperature and humidity measurement
- **Conformity:** conforms to ASHRAE specifications for Green Building Standards
- **Improved air quality**: achieves optimal ventilation and reduces stagnant air
- **Durability:** adapts to a multitude of environments
- **Affordable:** easily convince customers to invest in improved Indoor Air Quality (IAQ)
- **Features:** choose between the TRH and CO_2 + TRH model to fit your needs

Benefits

All CO_2 sensors are maintenance-free in normal environments thanks to the built-in Automatic Baseline Correction (ABCLogic™) algorithm function.

The sensors have a life expectancy of 10 years.

- Miniature size
- Requires no calibration
- Maintenance free
- Long term stability
- Low power consumption



The convenience of an out-of-the-box module allows full implementation in minutes.

Version 1

Specifications

Main Specifications

Function	Description
Operating Principle	Non-dispersive infrared (NDIR)
Dimensions	3.26in x 2.85in x 0.72in 82.9 mm x 72.4 mm x 18.4 mm
Operating temperature	0°C to 50°C (32°F to 122°F)
Temperature accuracy	±0.3°C (0.54 °F) typical within operating range
Humidity range	0% to 100%
Humidity accuracy	± 3% RH (typical within 0% to 80% RH)
Measurement range	0 to 5000 ppm
Measurement/ Transmission intervals	2.5 minutes (day), 10 minutes (evening) Note: Battery life will be reduced should interval be shortened (i.e. using remote temperature/humidity functions)
CO_2 accuracy at NTP	±60ppm +3% of reading (400 - 2,000ppm range)
CO_2 calibration	Automatic calibration
CO_2 measurement pressure dependency	0.13% of reading per mm Hg (normal atmospheric conditions of ~100Kpa)
CO_2 resolution at NTP	+/- 20ppm at 800ppm
Transmission protocol	Zigbee 3.0 Green Power (encrypted, bi-directional)
Transmission range	Up to 100m (328 ft) free field 20 to 30m (66 - 98ft) indoor
Battery lifetime	10+ years (non-replaceable) Note: Battery life can be reduced when sensor is operated at temperatures approaching the operating limits.
HMI	Push button & LED (for commissioning)
Power supply / Battery cell	3.6 V AA Lithium ion
Enclosure	Polycarbonate, white (front) and black (back)
Protection	IP 20
Environment & health	Halogen free, RoHS, WEEE
Storage temperature	-30°C to 70°C

Ordering Information

Part number	
SED-CO2-G-5045	Wireless CO_2 Sensor with Room Temperature and Humidity
SED-TRH-G-5045	Wireless Sensor with Room Temperature and Humidity

Firmware Version

The VT8000 Series Room Controller must be running Firmware version 1.7 or greater to integrate with the wireless CO_2 and TRH sensors. The sensors will not function with any Firmware version below 1.7. Make sure to download the latest Firmware before attempting to integrate the sensors with any VT8000 Series Room Controller. Also, version 10 or greater of the wireless communication module is required to bind the sensors to the Room Controller.

Note: Only one sensor can be commissioned per VT8000 Room Controller.

Note: Contact technical support for MPM compatibility using LUA.

8000 Room Controllers

Frequently Asked Questions

Q1: Using the uploader software, can I convert my 8350 to an 8650 and vice-versa?

A1: It is not possible anymore since the new hardware version (firmware v2.0+).

Q2: Why are the 8350 Cool and Heat outputs simultaneously activated?

A1: The Dehumidification is activated. If dehumidification is not required, set the "Dehum lockout" parameter to "Disable".

Q3: Why does the 8350 fan stay in low speed instead of shutting down when there is no demand?

A1: The "Fan mode" is set to "Low" instead of "Auto".

A2: The "Auto Fan func." is set to "AS". Change the setting to "AS / AD".

A3: The Dehumidification is activated. If dehumidification is not required, set the "Dehum lockout" parameter to "Disable".

Q4: Why does the 8650 fan stay ON even when there is no demand?

A1: The "Fan mode" is set to "On" or "Smart". Change the setting to "Auto".

A2: The Dehumidification is activated. If dehumidification is not required, set the "Dehum lockout" parameter to "Disable".

Q5: Why is the 8650 Modulating output UO11 not modulating?

A1: The "Heat stages" parameter must be set to 0 (zero) to activate 0-10 Vdc heat on UO11.

A2: The output will stay at 0 Vdc if there is a demand for Cooling or if there is no demand for Heating from the Room nor Supply.

Note: You can use the "Test outputs" page to force a voltage on UO11 (anywhere between 0 and 10 Vdc).

Q6: Why are the 8650 Heat stages turning ON, but the Fan remaining Off?

A1: The "Fan cont. heat" parameter is set to "Off". Change the setting to "On".

Q7: Why is the configuration parameter highlighted in red and not editable?

A1: The configuration parameter has been overwritten at a higher BACnet priority. This may have been done by a Building Automation System (via BACnet MS/TP or IP), or by a LUA script running on the room controller.

Q8: After setting temperature setpoints over BACnet, why can they not be changed at the thermostat?

A1: The point has been added to the BAS as "Present Value". Change it to "Relinquish Default".

Q9: Why are parameters configured via BACnet lost after a power-cycle?

A1: BACnet points written between priorities 4 to 16 are lost after a power-cycle. Use priority 1, 2 or 3 or "Relinquish Default".

Q10: Why do heating outputs W1 and W2 indicate ON but there is no voltage output?

A1: W1 and W2 outputs are isolated. They do not switch "RC" 24 Vac. They are switching "RH" terminal. Install a jumper across "RC" and "RH".

Q11: What type of temperature sensors are compatible?

A1: NTC 10,000 Ohm type 2.

Q12: Can a remote sensor average with an internal sensor?

A1: The remote room sensor (UI20) can take over the internal sensor but not average with it.

A2: A custom LUA program can be loaded in the 8000 to average, or to get the highest and lowest temperatures from one or multiple remote sensors.

Q13: Can an 8650 Outside Air Temperature (OAT) sensor input (UI23) be used for another sensor like Mixed Air?

A1: No, the input will automatically display "Outdoor: XX°X" on the display and the related OAT lockouts may block thermostat operations.

A2: Use another free input such as UI19, UI20, UI22 or UI24.

Q14: Can the outdoor temperature be sent over BACnet instead of using a wired 8650 OAT sensor? If yes, will the lockouts still work?

A1: Yes, the outside air temperature can be sent to all 8000 room controllers over BACnet. All OAT-related features and lockouts will work.

Q15: Can a remote humidity sensor be used?

A1: Not natively, a custom LUA program can be loaded in the 8000 to use a 0-10 Vdc humidity sensor and take over the 8000 internal sensor.

Q16: Do analog inputs accept a 4-20 mA signal?

A1: The 8000 does not accept a 4-20 mA signal, however, a 500 Ohm resistor across the input transforms 4-20 mA to 2-10 Vdc.

Q17: Can 0-10 Vdc input and outputs be set to 2-10 Vdc?

A1: Most inputs and outputs are operating on the full range of 0 to 10 Vdc. There is no parameter to re-scale to 2-10 Vdc, except for the damper actuator and duct fan on the VAV 8250.

A2: A custom LUA program can be loaded in the 8000 to re-scale the inputs and outputs to 2-10 Vdc or anything else.

Q18: Why does the 8650 dehumidification status indicate ON but the Y1 and Y2 compressors are Off?

A1: The 8650 dehumidification does NOT activate Cooling nor Heating outputs. It only activates Fan and UO12 (for units with a built-in dehumidification sequence).

A2: A custom LUA program can be loaded in the 8650 to activate Y1, Y2, and W1 with sub-cool and over-heat protections.

Q19: Can configuration parameters and the occupancy schedule be saved from one 8000 then loaded in others?

A1: Use the Uploader8000 Software to download configuration points, schedule, date and time, etc. from one 8000 then upload into all others.

Q20: Can the 8000 communicate with 3rd-party ZigBee devices?

A1: No, it is not possible.

Q21: What can I do when the 8000 is password protected and I do not have it?

A1: Call your Technical Support agent, who will guide you through the password recovery process..

Q22: Is there or will there be an SEZ8650 for the corresponding RTU/AHU?

A1: There is currently no plan to create a VVT system with an 8650 controlling the RTU/AHU for zones controlled by the 8250.

Q23: Can we rename the objects?

A1: The 8000 series does not support renaming of objects.

Q24: Is there a suggested list of actuators and flow control?

A1: Recommended damper:
Schneider Electric MS41-6043 or equivalent

A2: Recommended air flow sensor:
Schneider Electric (Veris) PX3PXX01 or equivalent

Q25: Can you explain how CFM is measured in this application?

A1: Refer to the documentation for details. Flow measurement requires a Differential Pressure Sensor with a 0-10V analog output.

Q26: On the Bacnet IP product announcement, it mentioned a future wired Bacnet IP solution. Is that still planned?

A1: Wired ethernet is on our priority list, but support from the 8000 family is not currently scheduled due to complexities of mechanical design and installation.

Q27: Can you install the CO_2 plugin module?

A1: Yes, you can use the VCM8001 CO_2 module with the 8250. As there is only one expansion connector you can only install one VCM (ZigBee, CO_2 or Wi-Fi).

Note: SKUs are available with internal ZigBee, leaving the expansion connector available for CO_2 or Wi-Fi.

Q28: Is the duct heating only controlled via Room Temperature via its Demand, or can it be configured to do Discharge Air Control thru Configuration - or would that require LUA Script ATM?

A1: Duct heating is currently only controlled via Room Temperature, and hence Heating Demand.

ComfortPoint Open

CPO-PC-6A PLANT CONTROLLER

DATA SHEET



GENERAL

The ComfortPoint™ Open Plant Controller CPO-PC-6A is an Ethernet-based, freely programmable native BACnet® building Controller (B-BC), which is designed for a wide variety of complex applications.

The CPO-PC-6A features a large complement of different analog inputs, analog outputs, binary inputs, binary outputs, and relays.

The CPO-PC-6A also features numerous communication interfaces, chief among them four different RS485 interfaces (three of which are screw-type terminals located in the terminal block at the upper left-hand corner; the fourth consists of push-in terminals at the upper right-hand corner). It also possesses two standard Ethernet interfaces.

The CPO-PC-6A is thus compatible with a wide range of other electronic devices (see also Fig. 1. ComfortPointTM Open System architecture on pg. 3).

Clearly visible LED control lamps convey important status and alarm information.

The CPO-PC-6A has a durable, anthracite-colored plastic housing conforming with DIN 43880, with a max. slot height of 45 mm. It is thus suitable for mounting in fuse boxes, but can also be mounted on 35 mm standard panel rails (both vertical and horizontal mounting possible).

FEATURES

- **BACnet 2010 certified**
- **24 Vac/dc power supply (from external transformer).**
- **Three separate RS485 interfaces consisting of screw-type terminals.**
- **One additional RS485 interface consisting of push-in terminals.**
- **Three pairs of LEDs indicating the transmission and reception (respectively) of data via the three screw-type RS485 interfaces.**
- **Quick and convenient connection to neighboring modules using the XS816 Bridge Connector (regular cabling also possible).**
- **Alarm LED, power LED.**
- **Three DIP switches for manually switching internal biasing resistors to the three screw-type RS485 interfaces.**
- **Two Ethernet connectors and corresponding status LEDs.**
- **Watchdog for connection to optical or acoustical signaling devices.**
- **Communication using the Panel Bus communication protocol (all four RS485 interfaces), the BACnet MS/TP protocol (RS485 interfaces 1, 2, and 3), the Field Bus protocol (RS485 interfaces 1, 2, and 3), the Modbus protocol (RS485 interfaces 1, 2, and 3), and the CP-IO protocol (RS485 interface 4, only).**
- **Built-in advanced diagnostics software facilitating troubleshooting.**
- **RAM (incl. online data and real-time clock time) are buffered by a super capacitor for 72 hours.**
- **UTF-8 and UCS-2 character encoding formats are supported.**
- **Maximum number of Trend objects permitted: 100**
- **Maximum number of samples per Trend: 200**
  NOTE: Trend samples are based on COV.
- **Supports Peer-to-Peer communication.**

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IO scan time

Expansion IO:

Points present in IO board	No. of Extn IO Boards Connected	IO Cycle Time (Including Cycle Time Delay) ms
Input points (AI+BI)	1	198
	16	884
	n	((n+1)*49) + 100ms
Output points (AO+BO)	1	158
	16	564
	n	((n+1)*29) + 100
Input+Output	1	256
	16	1348
	n	((n+1)*78)

n: number of points

Field bus scan time:

Number of modules	IO Cycle Time ms
32	505.6

Panelbus scan time:

Points present in IO board	No. of Extn IO Boards Connected	IO Cycle Time (Including Cycle Time Delay) ms
Input points (AI+BI+ ACC)	1	26
	16	116ms
	n	(n * 6) + 20
Output Points (AO+BO+ MO)	1	15 + 250 + 20
	16	240 + 250 + 20
	n	(n * 15) + 250 + 20

n: number of connected boards

DESCRIPTION

The ComfortPoint™ Open System consists of the CPO-PC-6A Plant Controller and other field-level devices as well as management-level systems connected via the controller's various interfaces and bus connections. See also Fig. 1.

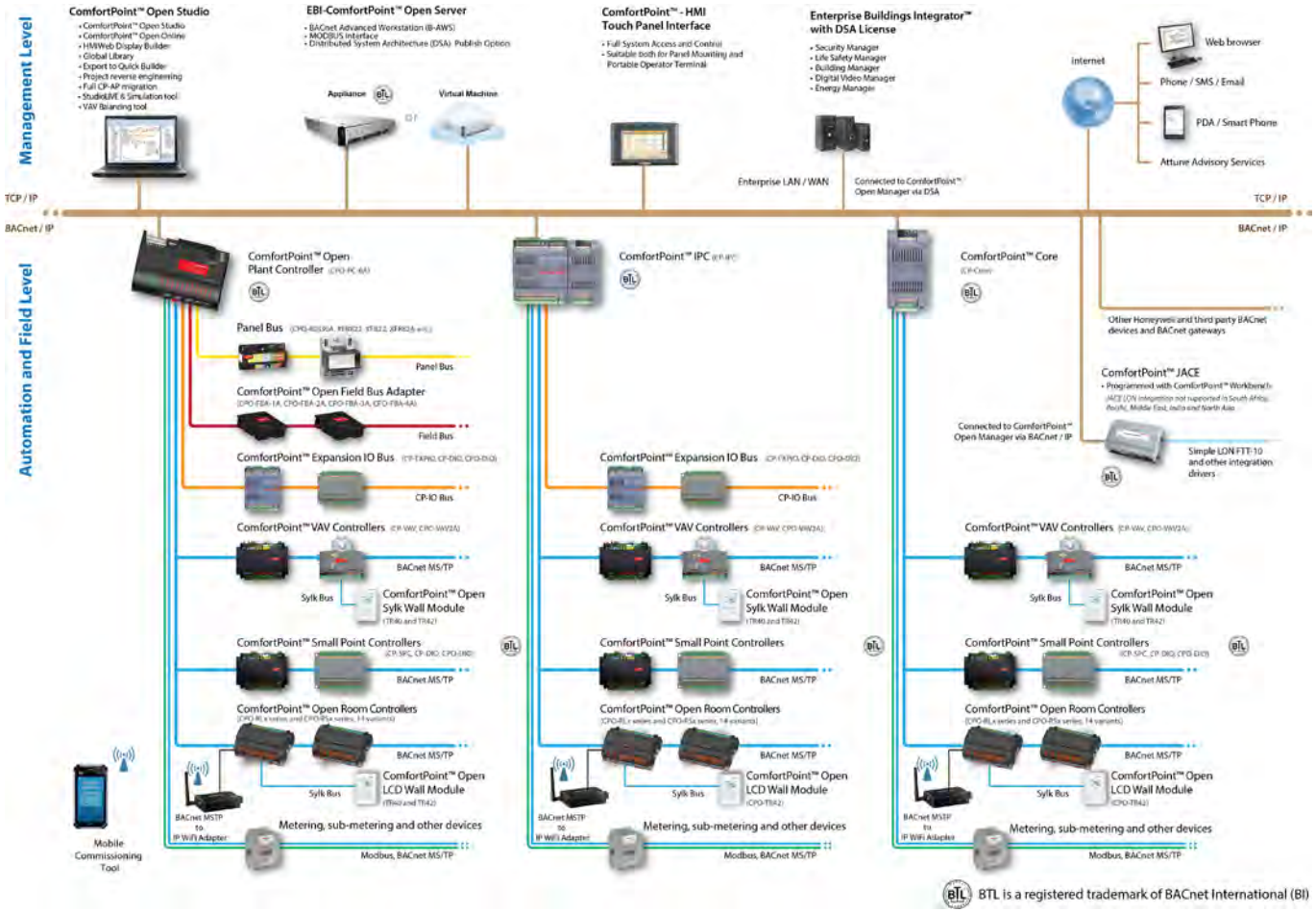


Fig. 1. ComfortPoint™ Open System architecture

INTERFACES AND TERMINALS

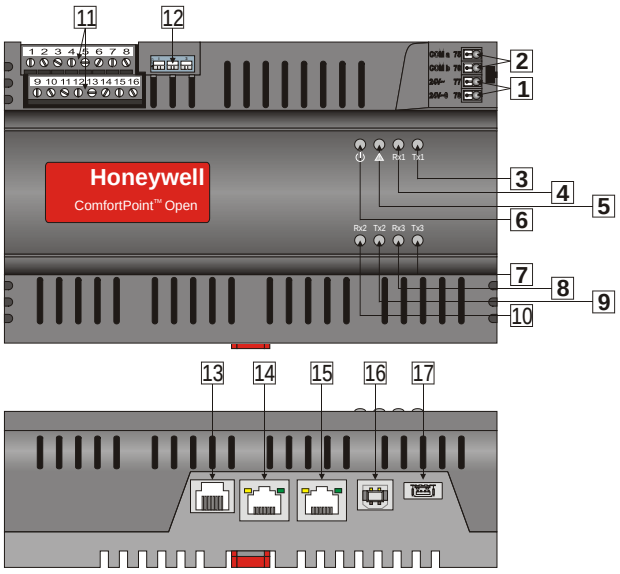


Fig. 2. Interfaces and terminals

Legend

1 Power supply for I/O modules
2 Panel Bus communication terminals
3 Tx 1 LED (yellow)
4 Rx 1 LED (yellow)
5 Alarm LED (red)
6 Power LED (green)
7 Tx 3 LED (yellow)
8 Rx 3 LED (yellow)
9 Tx 2 LED (yellow)
10 Rx 2 LED (yellow)
11 two terminal blocks, incl. terminals 1-16
12 DIP switches for individually setting RS485 buses
13 RS232 interface
14 Ethernet 1 connector
15 Ethernet 2 connector
16 USB-B connector (not used)
17 USB-A connector (not used)

CPO-PC-6A Terminals

Table 1. Description of CPO-PC-6A terminals

Type	Term.	Signal	Comment
SCREW-TYPE TERMINALS	1	24 V~	power supply (24 Vac/dc) from transformer (internal connection to terminal 77)
	2	24 V~0	power supply (24 Vac/dc) from transformer (internal connection to terminal 78)
	3		(+) for RS485 interface 1
	4		(-) for RS485 interface 1
	5		(GND) for RS485 interface 1
	6		(GND) for RS485 interface 4
	7		not used.
	8		not used.
	9		watchdog relay
	10		watchdog relay
	11		(+) for RS485 interface 2
	12		(-) for RS485 interface 2
	13		(GND) for RS485 interface 2
	14		(+) for RS485 interface 3
	15		(-) for RS485 interface 3
	16		(GND) for RS485 interface 3
PUSH-IN TERMINALS	75	COM a	(+) for RS485 interface 4
	76	COM b	(-) for RS485 interface 4
	77	24 V~	power supply for connected modules
	78	24 V~0	power supply for connected modules

NOTICE

Equipment damage!

- ► Make sure that the CPO-PC-6A is not connected to earth ground.
- ► If nonetheless earth grounding is required, make sure that only terminal 2 is connected to earth ground. Terminal 1 must not be connected to earth ground.

Tx LED and Rx LED

The CPO-PC-6A is equipped with three Tx LEDs (status: yellow/OFF) and three corresponding Rx LEDs (status: yellow/OFF).

These LEDs indicate (by flickering) the transmission / reception of data by the CPO-PC-6A via its three RS485 interfaces.

Specifically:

- Tx1 and Rx1 indicate the transmission/reception (respectively) of data by the CPO-PC-6A via its RS485 interfaces 1 (Bus 1: terminals 3, 4, and 5).
- Tx2 and Rx2 indicate the transmission/reception (respectively) of data by the CPO-PC-6A via its RS485 interfaces 2 (Bus 2: terminals 11, 12, and 13).
- Tx3 and Rx3 indicate the transmission/reception (respectively) of data by the CPO-PC-6A via its RS485 interfaces 3 (Bus 3: terminals 14, 15, and 16).

Table 2. Behavior and meaning of RS485 LEDs

LED behavior	meaning
OFF	No communication over the given RS485 interface.
ON steadily	Fault.
ON/OFF randomly	Communication occurring over the given RS485 interface.

RS232 Interface

The CPO-PC-6A is equipped with an RS232 Interface for the connection of a terminal via a standard XW885 cable.

Ethernet 1 Interface

RJ45 female interface for permanent connection to the ETHERNET network.

Ethernet 2 Interface

For connection of a laptop or PC (onto which ComfortPoint Open Studio has been installed) via a standard Ethernet cross-over cable for application download/upload, or application de-bugging, or Internet Browser access, while the CPO-PC-6A can remain connected in the Ethernet network without interruption. This allows parallel access, e.g., without creating alarm showers at the front-end.

USB Interfaces

USB-A and USB-B interfaces are currently not supported.

Power LED (Green)

The CPO-PC-6A is equipped with a power LED.

Table 3. Power LED

behavior	meaning
ON	Normal operation. CPO-PC-6A is in Boot loader mode. Either Boot loader 1 or Boot loader 2 is running.
OFF	No power to processor, LED damaged, low voltage to board, first second of power up, or boot loader damaged or NAND flash formatting is in process.
very slow blink	CPO-PC-6A is operating normally and the firmware is executing the application.
slow blink	Firmware is not executing application.

Alarm LED (red) and Watchdog

The alarm LED indicates the status of the watchdog relay (terminals 9 and 10). The watchdog relay is for connection to optical or acoustical signals, and allows 24 V, 500 mA dry contacts. These contacts are closed when the power is OFF, when no application is loaded, or when the firmware or application is not working properly. The watchdog resets the CPO-PC-6A if the delay since the previous trigger exceeds 20 sec. Further, the watchdog locks the CPO-PC-6A if the trigger between two restarts is not set.

NOTE: In the event of software problems, the CPO-PC-6A should be restarted by switching the power OFF and then back ON.

Table 4. Alarm LED

behavior	meaning
OFF	Watchdog alarm relay contacts are open = normal operation (or unpowered).
ON	Watchdog alarm relay contacts are closed = failure (alarm) status. • CPO-PC-6A has encountered a hardware problem. • The application has a fault. • CPO-PC-6A powered up without application or operator has manually stopped application, e.g., using the ComfortPoint Open Online Tool. The LED will then light up 13 min. after power-up without application.

Table 5. Permissible load of terminals 9, 10

	max. load	min. current
per normally closed contact (terminals 9, 10)	**19…29 Vac** current at cos φ ≥ 0.6: 0.5A **19…29 Vdc** 0.5 A resistive or inductive	10 mA

DIP Switches

The CPO-PC-6A features three DIP switches (equipped with 510 Ω bias resistors) located to the right of the two blocks of non-removable screw-type terminals. Each DIP switch can be used to switch the 510 Ω bias resistors of the corresponding RS485 interface ON and OFF.

- The bias resistors of RS485 interface 1 (terminals 3, 4, and 5) is switched ON/OFF using DIP switch 1.
- The bias resistors of RS485 interface 2 (terminals 11, 12, and 13) is switched ON/OFF using DIP switch 2.
- The bias resistors of RS485 interface 3 (terminals 14, 15, and 16) is switched ON/OFF using DIP switch 3.

The resultant communication rate over RS485 interfaces 1, 2, and 3 depends upon the given communication protocol selected during engineering using ComfortPoint Open Studio.

HARDWARE SPECIFICATIONS

Table 6. CPO-PC-6A

Feature	Description
SRAM	512 KB
NOR-Flash	4 MB
NAND-Flash	512 MB
CPU	Freescale Coldfire MCF5485, 200 MHz, 32-bit
Operating System	MQX (Message Queue eXecutive)

NOTE: The CPO-PC-6A does not contain a battery. The contents of RAM (incl. online data [out-of-service flag and runtime datapoint properties] and real-time clock time) are buffered by a super capacitor for (typically) 72 hours.

Serial number, date code, part number, and manufacturing location are stored in the CPO-PC-6A non-volatile memory and are thus protected against deleting or overwriting.

GENERAL SAFETY INFORMATION

- ► When performing any work (installation, mounting, start-up), all manufacturer instructions and in particular the Installation and Commissioning Instructions (EN1B-0462GE51) are to be observed.
- ► The ComfortPoint™ Open System (including the CPO-PC-6A Plant Controller, Panel Bus I/O modules, manual disconnect modules, and the auxiliary terminal packages) may be installed and mounted only by authorized and trained personnel.
- ► Rules regarding electrostatic discharge should be followed.
- ► If the ComfortPoint™ Open System is modified in any way, except by the manufacturer, all warranties concerning operation and safety are invalidated.
- ► FCC-CERTIFIED: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- ► Make sure that the local standards and regulations are observed at all times. Examples of such regulations are VDE 0800 and VDE 0100 or EN 60204-1 for earth grounding.
- ► Use only accessory equipment which comes from or has been approved by Honeywell.
- ► It is recommended that devices be kept at room temperature for at least 24 hours before applying power. This is to allow any condensation resulting from low shipping/storage temperatures to evaporate.
- ► The ComfortPoint Open System must be installed in a manner (e.g., in a lockable cabinet) ensuring that uncertified persons have no access to the terminals.
- ► Investigated according to United States Standard UL-60730 and UL-916.
- ► Investigated according to Canadian National Standard(s) C22.2, No. 205-M1983 (CNL-listed).
- ► Do not open the CPO-PC-6A, as it contains no user-serviceable parts inside!
- ► CE declarations according to LVD Directive 2006/95/EC and EMC Directive 2004/108/EC.
- ► Product standards are EN 60730-1 and EN 60730-2-9.

Safety Information as per EN60730-1

The ComfortPoint Open System is intended for home (residential, commercial, and light-industrial) environments.

The ComfortPoint Open System is an independently mounted electronic control system with fixed wiring.

The CPO-PC-6A is suitable for mounting in fuse boxes conforming with standard DIN43880, and having a slot height of max. 45 mm.

It is suitable for panel rail mounting on 35 mm standard panel rail (both horizontal and vertical rail mounting possible).

The CPO-PC-6A is used for the purpose of building HVAC control and is suitable for use only in non-safety controls for installation on or in appliances.

Table 7. Safety information as per EN60730-1

Shock protection	24 V-powered controls: Class III mains-powered controls: Class II
Pollution degree	Pollution Degree 2, suitable for use in home and industrial environments.
Installation	Class 3
Overvoltage category	24 V-powered controls: Category I mains-powered controls: Category II
Rated impulse voltage	330 Vac for Category I 2500 Vac for Category II
Automatic action	Type 1.C (micro-interruption for the relay outputs)
Software class	Class A
Enclosure	IP20 according to EN-60529
Ball-pressure test temperature	75 °C for all housing and plastic parts 125 °C in the case of devices applied with voltage-carrying parts and connectors
Electromagnetic interference	Tested at 230 Vac, with the modules in normal condition.
System transformer	Europe: safety isolating transformers according to IEC61558-2-6 U.S.A. and Canada: NEC Class-2 transformers

TECHNICAL DATA

System Data

Table 8. System data

operating voltage	24 Vac, ± 20% (50/60 Hz), 21 … 30 Vdc
power consumption	7 VA
overvoltage protection	Protected against overvoltages of max. 28 Vac or 40 Vdc, terminals protected against short-circuiting.

Standards

Table 9. Standards

protection class	IP20
product standards	EN 60730-1, EN 60730-2-9, UL6730-1, CAN/CSA-E60730-1:02
testing electrical components	IEC68
certification	CE, cUL60730, UL916, BACnet 2010
system transformer	The system transformer(s) must be safety isolating transformers according to IEC 61558-2-6. In the U.S.A. and Canada, NEC Class 2 transformers must be used.

Operational Environment

Table 10. Operational environment

ambient operating temperature	0 … 50 °C (32 … 122 °F)
ambient operating humidity	5 … 95% relative humidity (non-condensing)
vibration under operation	0.024” double amplitude (2 … 30 Hz), 0.6 g (30 … 300 Hz)
dust, vibration	According to EN60730-1
RFI, EMI	home (residential, commercial, and light-industrial) environments
MTBF (Mean Time Between Failure)	11.7 years

Interfaces and Bus Connections

Via its various interfaces and bus connections, the CPO-PC-6A can be connected to a variety of devices and systems.

Hardware Interfaces

Table 11. Hardware interfaces

Ethernet	10/100 Mbit/s, RJ45
MSTP Port	Supports 9.6, 38.4, and 76.8 Kbps
Modbus	0.6 to 115.2 Kbps
Panel bus	115.2 Kbps

Supported Communication Protocols

The following communication protocols are supported. (There are no limitations pertaining to the parallel / concurrent use of communication protocols.) See Table 12.

Table 12. Protocols supported by communication interfaces

communication interface	supported protocol(s)
Panel Bus (terminals 75, 76)	Panel Bus; CP-IO
RS485 interface 1 (term. 3, 4, 5)	Panel Bus, BACnet MS/TP, Mod-Bus, Field Bus
RS485 interface 2 (term. 11, 12, 13)	
RS485 interface 3 (term. 14, 15, 16)	
watchdog (terminals 9, 10)	--
RS232 interface	--
Ethernet 1 interface	BACnet/IP, Telnet
Ethernet 2 interface	BACnet/IP, Telnet
USB-A, USB-B interfaces	not used

The communication rate across each communication interface is dependent upon the given communication protocol.

DIMENSIONS

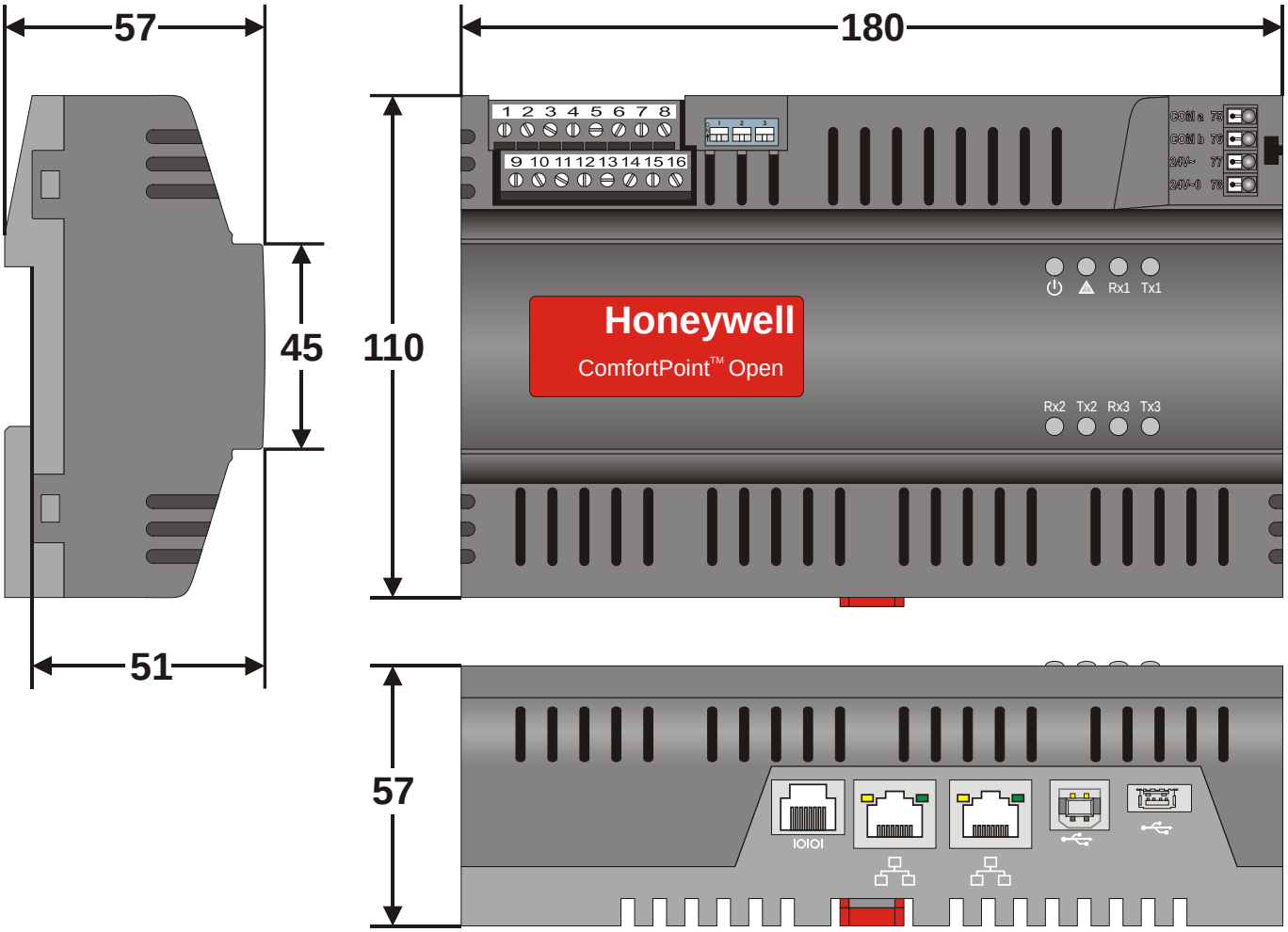


Fig. 3. CPO-PC-6A dimensions (mm)

Honeywell

Manufactured for and on behalf of the Environmental and Combustion Controls Division of Honeywell Technologies Sàrl, Rolle, Z.A. La Pièce 16, Switzerland by its Authorized Representative:

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Honeywell

ComfortPoint Open

CPO-Rxx ROOM CONTROLLERS

DATA SHEET

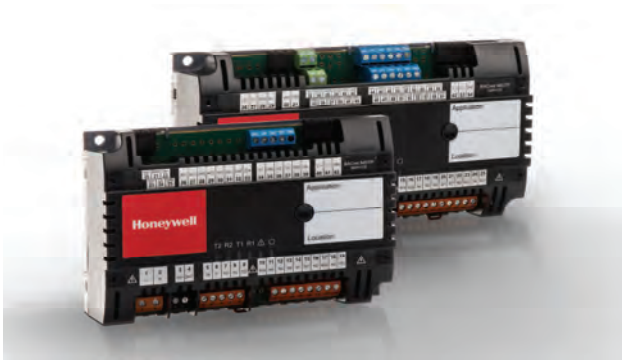


Fig. 1. CPO-Rxx (without optional covers)

GENERAL

The CPO-Rxx family of room controllers provide flexible, configurable, demand-led control that delivers tangible benefits to reduce energy spends and drives new levels of functionality and efficiency in today's buildings. With scalable and freely programmable BACnet MS/TP-based room controllers, smart engineering & commissioning tools, and SYLK technology, multiple and flexible configurations can be achieved to address specific applications.

FEATURES

- Designed to control terminal units such as 2- and 4-pipe fan coil units, chilled ceilings, hydronic, air quality control, and a mix of these applications.
- For complex applications requiring high I/O count.
- Both configurable and freely programmable, covering enhanced applications.
- Support for 1-3 stage fans, variable fan speed drives (VSDs), thermal, floating, and proportional actuators.
- Dual-loop support allows for 2-room application.
- Auto Mac-addressing.
- Fast commissioning using plug-and-play solutions, pre-defined applications and state-of-the-art commissioning via the RoomUp mobile application – eliminating the need for two people when commissioning.
- Reduced number of sensors because sensors are shared across different applications.
- BACnet BTL®-Listed as Advanced Application Controllers (B-AAC) rev 1.12.
- Two housing dimensions and several different I/O versions to match your individual needs.
- 24 VAC and 230 VAC versions.
- Universal mounting options, including terminal covers and color-coded terminals.
- The 230 VAC models feature 24 VAC aux. output voltage, allowing direct connection and powering of field devices.
- Two-wire polarity-insensitive bus interface to connect to Honeywell Sylk wall modules.
- All models with real-time clock. RL4, RL5, RL6, and RL7U with super capacitor for 72-hr data retention.

SYSTEM OVERVIEW

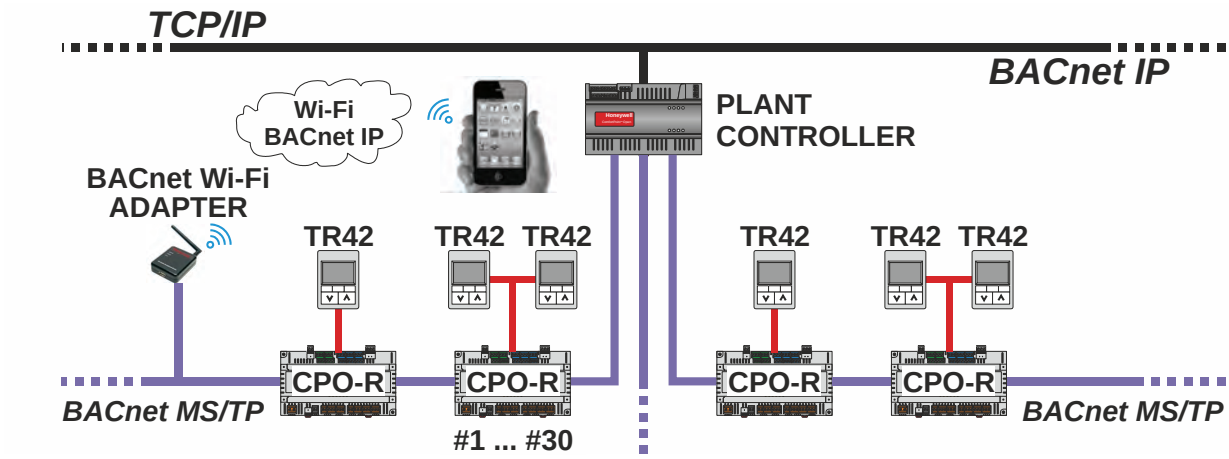


Fig. 2. System overview

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Table 1. Overview of models

	OS no.: CPO-…	power supply	AOs	UIs	relays (N.O.)	triacs (24 / 230 VAC)	total no. of I/Os	max. 24 VAC output	remarks
large housing (198 x 110 x 57.5 mm)	RL1	230 VAC	2	6	1	2	11	300 mA	--
	RL2	230 VAC	2	6	4	4	16	300 mA	--
	RL3	24 VAC	2	6	4	4	16	600 mA	--
	RL4	230 VAC	6	10	4	4	24	300 mA	72-hr data retention
	RL5	24 VAC	6	10	4	4	24	600 mA	72-hr data retention; with removable terminals
	RL6	24 VAC	6	10	4	4	24	600 mA	72-hr data retention
	RL7U	24 VAC	6	10	4*	4	23	600 mA	72-hr data retention; with watchdog relay
	RL8	230 VAC	6	10**	4	4	24	300 mA	With lighting support
small housing (162 x 110 x 57.5 mm)	RS1	230 VAC	3	3	0	0	6	300 mA	--
	RS2	230 VAC	1	3	0	2	6	300 mA	Configurable, only
	RS3	230 VAC	0	3	3	2	8	300 mA	Configurable, only
	RS4	230 VAC	4	4	4	2	14	300 mA	--
	RS5	24 VAC	4	4	4	2	14	600 mA	--
	RS6	24 VAC	1	3	0	2	6	600 mA	Configurable, only

*Including relay 4 (the watchdog), which is not available for use by the application.

**UI1-UI4 are binary-only inputs.

CPU: 32-bit MK24FN Freescale Kinetis Cortex M4

DIMENSIONS AND MOUNTING

Housings

The controller is available in two housing sizes, both conforming to IP20:

- RLxx (large housing):
  W x L x H = 110 x 198 x 59 mm and
- RSxx (small housing):
  W x L x H = 110 x 162 x 59 mm

See also Fig. 3 and Fig. 4.

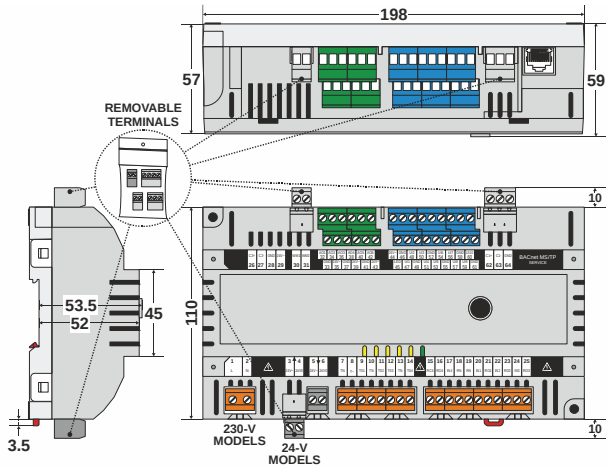


Fig. 3. RLxx dimensions (in mm)

NOTE: In the case of the RL5, all of the terminal blocks are removable.

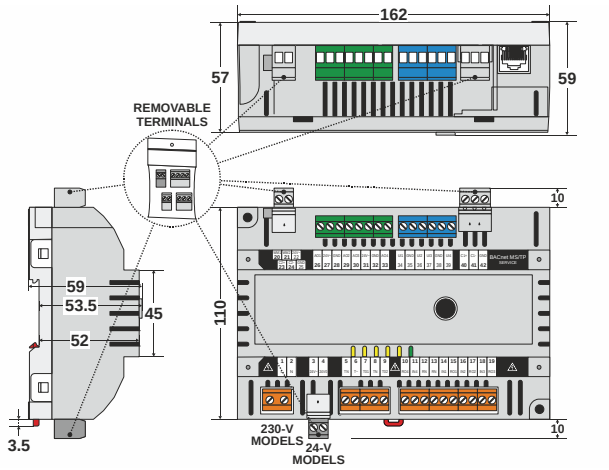


Fig. 4. RSxx dimensions (in mm)

The unit is suitable for mounting on a standard rail, on walls, as well as in wiring cabinets or fuse boxes.

Terminal Protection Covers for IP30

In the case of controllers mounted outside of a cabinet, before applying power to the device, Terminal Protection Covers (10-pc. bulk packs, order no.: IRM-RLC for large housings and IRM-RSC for small housings) must be mounted so as to provide IP30.

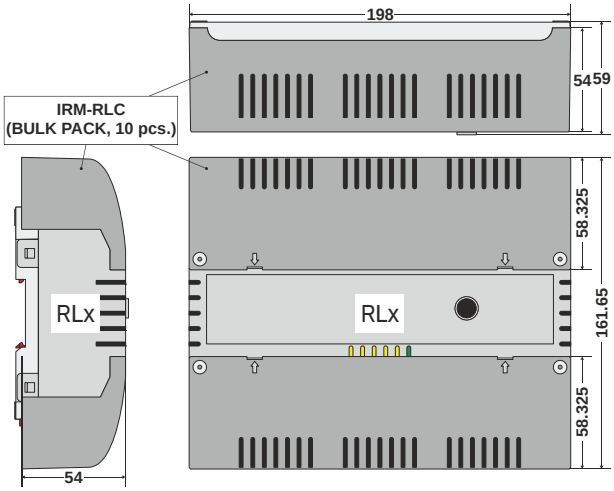


Fig. 5. Large housing, with terminal protection covers, dimensions (in mm)

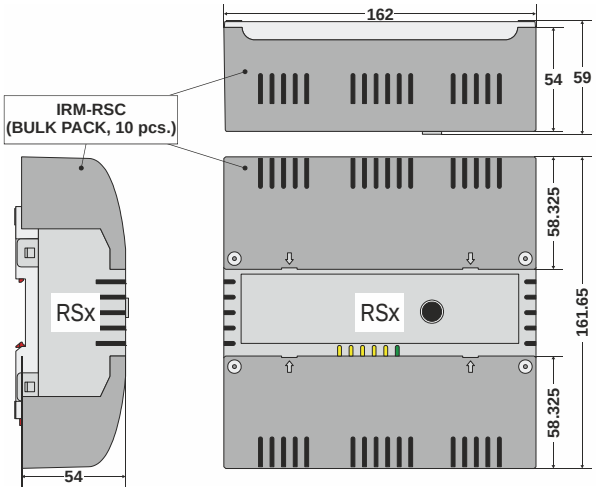


Fig. 6. Small housing, with terminal protection covers, dimensions (in mm)

TERMINAL ASSIGNMENT

General

For a complete list of all terminals and a description of their functions, see Table 2 and Table 6.

Communication Interfaces

All models of the controller features the following communication interfaces:

- A Sylk Bus interface for connection to TR40x/42x Wall Modules;
- A BACnet MS/TP interface;
- An RJ45 connector for connection of the BACnet WiFi Adapter.

Table 2. RSxx Room Controllers: Overview of terminals and functions (by model)

term.	printing	function	RS1	RS2	RS3	RS4	RS5	RS6
1, 2	"L", "N"	230-V power supply	X	X	X	X	--	--
3, 4	"24V~", "24V0"	Removable 24-V power supply input	--	--	--	--	X	X
3, 4	"24V~", "24V0"	Aux. output voltage (24 VAC) for all triacs	X	X	X	X	--	--
5	"TN"	Aux. term. for triac neutral wiring (internally connected with terminal 8)	--	X	X	X	X	X
6	"T~"	Triac input voltage (24 VAC / 230 VAC) for all triacs; triac-switched	--	X	X	X	X	X
7	"T01"	Triac-switched output	--	X	X	X	X	X
8	"TN"	Aux. term. for triac neutral wiring (internally connected with terminal 5)	--	X	X	X	X	X
9	"T02"	Triac-switched output	--	X	X	X	X	X
10, 11	"RO4", "IN4"	Output of Relay 4, Input for Relay 4	--	--	--	type 2	type 2	--
12, 13	"RN", "RN"	Aux. terminals for relay neutral wiring	--	--	--	X	X	--
14, 15	"IN1", "RO1"	Input for Relay 1, Output of Relay 1	--	--	type 1	type 1	type 1	--
16, 17	"IN2", "RO2"	Input for Relay 2, Output of Relay 2	--	--	type 1	type 1	type 1	--
18, 19	"IN3", "RO3"	Input for Relay 3, Output of Relay 3	--	--	type 1	type 1	type 1	--
20, 21	"WM1", "WM2"	Removable interface for Sylk Bus	X	X	X	X	X	X
22, 23, 24, 25	"24V~", "C2+", "C2-", "GND"	Aux. power (24 VAC ±20%, 50/60 Hz) + RS485 Modbus interface + corresp. GND	--	--	--	--	--	--
26	"AO1"	Analog Output 1	type 2	type 2	--	type 2	type 2	type 2
27	"24V~"	24 VAC power for field devices	X	X	--	X	X	X
28	"GND"	Ground for AOs	X	X	--	X	X	X
29	"AO2"	Analog Output 2	type 1	--	--	type 1	type 1	--
30	"AO3"	Analog Output 3	type 1	--	--	type 1	type 1	--
31	"24V~"	24 VAC power for field devices	X	--	--	X	X	--
32	"GND"	Ground for AOs	X	--	--	X	X	--
33	"AO4"	Analog Output 4	--	--	--	type 1	type 1	--
34	"UI1"	Universal Input 1	type 1	type 1	type 1	type 1	type 1	type 1
35	"GND"	Ground for UIs	X	X	X	X	X	X
36	"UI2"	Universal Input 2	type 1	type 1	type 1	type 1	type 1	type 1
37	"UI3"	Universal Input 3	type 1	type 1	type 1	type 1	type 1	type 1
38	"GND"	Ground for UIs	X	X	X	X	X	X
39	"UI4"	Universal Input 4	--	--	--	type 1	type 1	--
40, 41, 42	"C1+", "C1-", "GND"	Removable BACnet MS/TP interface and corresponding GND	X	X	X	X	X	X
Relay output types: See Table 3. Universal input types: Table 4. Analog output types: See Table 5.								

Table 3. Relay output types and characteristics

	type 1 (standard)	type 2 (high in-rush current)	type 3 (watchdog)
corresponding ROs of RSxx	RO1, RO2, RO3	RO4	--
corresponding ROs of RLxx	RO2, RO3	RO1, RO4	RC4
contact	N.-O.	N.-O.	N.-C. (CO)
min. load	5 VAC, 100 mA	24 VAC, 40 mA	5 VAC, 100 mA
switching voltage range	15 … 253 VAC	15 … 253 VAC	15 … 253 VAC
max. continuous load at 250 VAC (cos φ = 1)	4 A	10 A	1 A
max. continuous load at 250 VAC (cos φ = 0.6)	4 A	10 A	1 A
in-rush current (20 ms)	--	80 A	--
usage	fan motor	light switching and fan motor	See section "Watchdog Functionality (RL7U, only)"

NOTE: The max. sum load of all relay currents at the same time is 14 A.

Table 4. Universal input types and characteristics

	type 1	**type 2**	**type 3**
	UI1, UI2, UI3, UI4, UI5, UI6	UI7, UI8, UI9, UI10	UI1, UI2, UI3, UI4 (RL8, only)
dry contact (closed: res. <10 kΩ; open: res. > 20 kΩ; max. 0.2 Hz; pull-up voltage: 10 V)	X	X	--
dry contact (closed: res. <10 kΩ; open: res. > 20 kΩ; max. 0.2 Hz; pull-up voltage: 24 V); suitable for light switch applications	--	--	X
fast binary (=counter) input (max. 30 Hz; pulse ON = min. 16 ms; pulse OFF = min. 16 ms; closed: voltage < 1 V; open: voltage > 5 V; pull-up voltage: 10 V)	X	X	--
fast binary (=counter) input (max. 30 Hz; pulse ON = min. 16 ms; pulse OFF = min. 16 ms; closed: voltage < 1 V; open: voltage > 5 V; pull-up voltage: 24 V)	--	--	X
0(2) … 10 V	X	X	--
NTC20kΩ	X	--	--
SetPoint and FanSpdSW (from T7460x)	X	--	--
NTC10kΩ	X	--	--
PT1000 + Ni1000TK5000	--	X	--

Table 5. Analog output types and characteristics

	type 1	**type 2**	**type 3**	**type 4**	**type 5**
output voltage	0…11 V				
output current	0…1 mA	0…5 mA	0…10 mA	0…20 mA	-1…+1 mA
min. accuracy	±150 mV				
max. ripple	±100 mV				
accuracy at zero point	0…200 mV				±150 mV

Table 6. RLxx Room Controllers: Overview of terminals and functions (by model)

term.	printing	function	RL1	RL2	RL3	RL4	RL5	RL6	RL7U	RL8
1, 2	"L", "N"	230-V power supply	X	X	--	X	--	--	--	X
3, 4	"24V~", "24V0"	Removable 24-V power supply input	--	--	X	--	X	X	X	--
5, 6	"24V~", "24V0"	Aux. output voltage (24 VAC) for all triacs	X	X	X	X	X	X	X	X
7	"TN"	Aux. terminal for triac neutral wiring (internally connected with terminals 10 + 13)	X	X	X	X	X	X	X	X
8	"T~"	Triac input voltage (24 VAC / 230 VAC) for all triacs; triac-switched	X	X	X	X	X	X	X	X
9	"T01"	Triac-switched output	X	X	X	X	X	X	X	X
10	"TN"	Aux. terminal for triac neutral wiring (internally connected with terminals 7 + 13)	X	X	X	X	X	X	X	X
11	"T02"	Triac-switched output	X	X	X	X	X	X	X	X
12	"T03"	Triac-switched output	--	X	X	X	X	X	X	X
13	"TN"	Aux. terminal for triac neutral wiring (internally connected with terminals 7 + 10)	--	X	X	X	X	X	X	X
14	"T04"	Triac-switched output	--	X	X	X	X	X	X	X
15	"RC4"	N.C. contact (watchdog) of Relay 4	--	--	--	--	--	--	type 3	--
16, 17	"RO4", "IN4"	Output of Relay 4, Input for Relay 4	type 2	type 2	type 2	type 2	type 2	type 2	type 2	type 2
18	"RN"	Aux. terminal for relay neutral wiring	X	X	X	X	X	X	X	X
19	"RN"	Aux. terminal for relay neutral wiring	--	X	X	X	X	X	X	X
20, 21	"IN1", "RO1"	Input for Relay 1, Output of Relay 1	--	type 2	type 2	type 2	type 2	type 2	type 2	type 2
22, 23	"IN2", "RO2"	Input for Relay 2, Output of Relay 2	--	type 1	type 1	type 1	type 1	type 1	type 1	type 1
24, 25	"IN3", "RO3"	Input for Relay 3, Output of Relay 3	--	type 1	type 1	type 1	type 1	type 1	type 1	type 1
26, 27, 28, 29	"C2+", "C2-", "GND", "24V~"	RS485 Modbus interface, corr. GND, + aux. power (24 VAC ±20%, 50/60 Hz)	--	--	--	--	--	--	--	--
30, 31	"WM1", "WM2"	Removable interface for Sylk Bus	X	X	X	X	X	X	X	X
32	"AO1"	Analog Output 1	type 3	type 3	type 3	type 3	type 3	type 3	type 3	type 4
33	"GND"	Ground for AOs	X	X	X	X	X	X	X	X
34	"AO2"	Analog Output 2	type 3	type 3	type 3	type 3	type 3	type 3	type 3	type 3
35	"24V~"	24 VAC power for field devices	X	X	X	X	X	X	X	X
36	"AO3"	Analog Output 3	--	--	--	type 1	type 1	type 1	type 1	type 5
37	"GND"	Ground for AOs	--	--	--	X	X	X	X	X
38	"AO4"	Analog Output 4	--	--	--	type 1	type 1	type 1	type 1	type 5
39	"24V~"	24 VAC power for field devices	--	--	--	X	X	X	X	X
40	"AO5"	Analog Output 5	--	--	--	type 1	type 1	type 1	type 1	type 1
41	"GND"	Ground for AOs	--	--	--	X	X	X	X	X
42	"AO6"	Analog Output 6	--	--	--	type 1	type 1	type 1	type 1	type 1
43	"24V~"	24 VAC power for field devices	--	--	--	X	X	X	X	X
44	"24V~"	24 VAC power for field devices	X	X	X	--	--	--	--	X
45	"LED"	Output to LED of T7460C,E,F	X	X	X	--	--	--	--	X
46	"GND"	Ground for UIs	X	X	X	X	X	X	X	X
47	"UI1"	Universal Input 1	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 3 (BI)
48	"UI2"	Universal Input 2	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 3 (BI)
49	"GND"	Ground for UIs	X	X	X	X	X	X	X	X
50	"UI3"	Universal Input 3	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 3 (BI)
51	"UI4"	Universal Input 4	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 3 (BI)
52	"GND"	Ground for UIs	X	X	X	X	X	X	X	X
53	"UI5"	Universal Input 5	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 1
54	"UI6"	Universal Input 6	type 1	type 1	type 1	type 1	type 1	type 1	type 1	type 1
55	"GND"	Ground for UIs	X	X	X	X	X	X	X	X
56	"UI7"	Universal Input 7	--	--	--	type 2	type 2	type 2	type 2	type 2
57	"UI8"	Universal Input 8	--	--	--	type 2	type 2	type 2	type 2	type 2
58	"GND"	Ground for UIs	--	--	--	X	X	X	X	X
59	"UI9"	Universal Input 9	--	--	--	type 2	type 2	type 2	type 2	type 2
60	"UI10"	Universal Input 10	--	--	--	type 2	type 2	type 2	type 2	type 2
61	"GND"	Ground for UIs	--	--	--	X	X	X	X	X
62, 63, 64	"C1+", "C1-", "GND"	Removable BACnet MS/TP interface and corresponding GND	X	X	X	X	X	X	X	X
Relay output types: See Table 3. Universal input types: Table 4. Analog output types: See Table 5.										

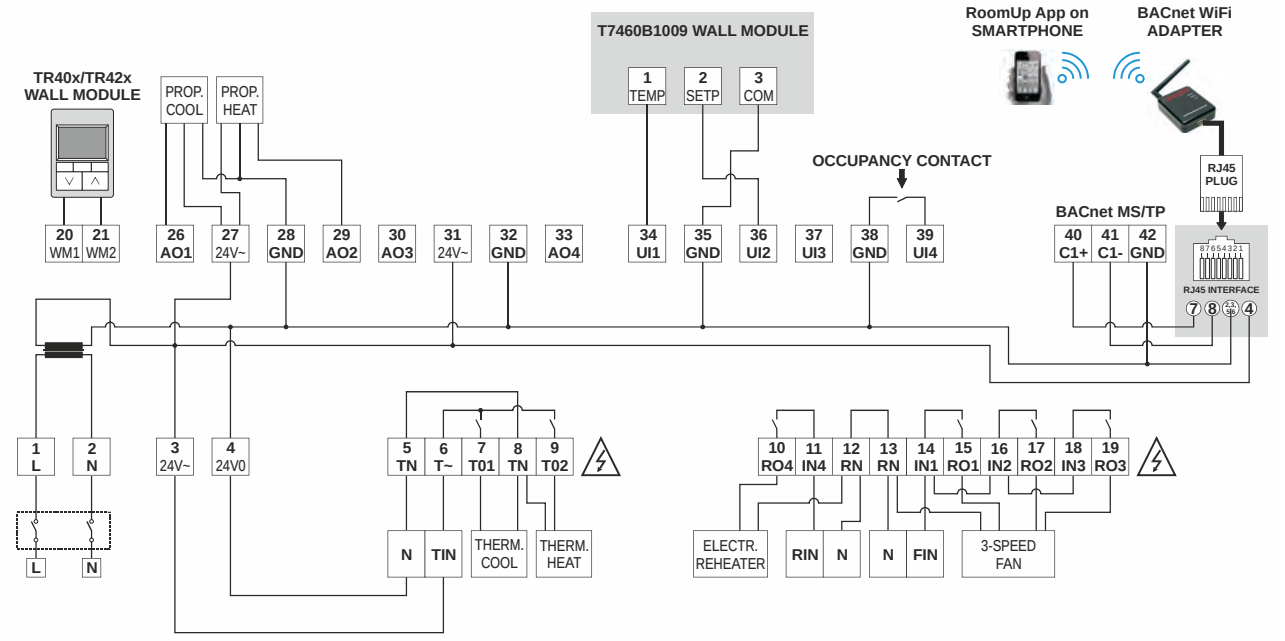


Fig. 7. RS2, RS3, and RS4 (230-V models) and example wiring

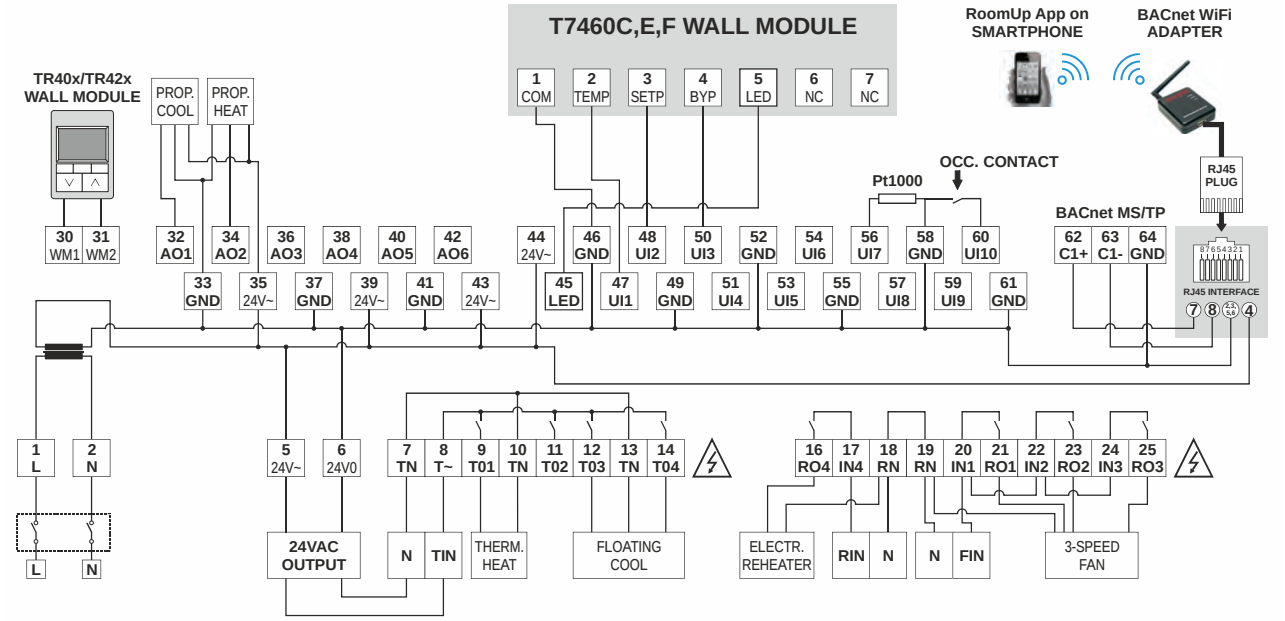


Fig. 8. RL2 and RL4 (230-V models) and example wiring

ELECTRICAL DATA

RL1, RL2, RL4, RL8, RS1, RS2, RS3, RS4 (230 VAC)

Power via terminals 1 + 2: 230 VAC +10% / -15%, 50/60 Hz.

Max. power consumption (when unloaded): 8 W.

Max. power consumption (when loaded): 18 W.

The controller is "unloaded" when it has no external load. Thus, the only load on the controller is the inherent load (8 W) of the electronics, themselves. The heat dissipation then amounts to 8 W. The controller is "loaded" when – besides the inherent load – an additional sum load of max. **300 mA** is applied to the 24 VAC output terminals. The max. unloaded output voltage at terminals 3 and 4 is 33 VAC (typically: 29.5 VAC).

RL3, RL5, RL6, RL7U, RS5, RS6 (24 VAC)

Power via terminals 3+4: 24 VAC ±20%, 50/60 Hz.

Max. current consumption (when unloaded): 300 mA.

Max. current consumption (when loaded): 900 mA.

The controller is "unloaded" when it has no external load. The heat dissipation then amounts to 7 W. The controller is "loaded" when – besides the inherent load (300 mA) – an additional sum load of max. **600 mA** is applied to the 24 VAC output terminals.

COMMISSIONING

The controller can be used with freely programmable applications or with a configurable application.

Freely Programmable Applications

Of the 14 models of the controller, eleven (see Table 1) can be used with applications which the application engineer can freely program for each controller. This process is performed on a PC on which the CPO Studio software program has been installed (see also Table 9 on pg. 12).

Configurable Application

All 14 models can be used with the configurable application already included in the controller. Three models (RS2, RS3, and RS6) can be used only with the configurable application (i.e., they are not freely programmable).

The configurable application has the advantage that it is proven and quickly commissioned using the RoomUp commissioning tool running on an Android Smart device.

Configuration and commissioning can be performed using the RoomUp commissioning tool available in the Google Playstore (URL: https://play.google.com/store).

NOTE: Before configuring, if as yet no WLAN is present, the commissioning engineer will require a BACnet WiFi Adapter (order no.: BACA-A) to establish wireless communication between his Android Smart device and the controller.

Example Application Types

The configurable application supports the following application types:

- The **FCU application type** supports 1-, 2-, and 3-stage or variable-speed fan. It also supports water cooling, water heating (2-pipe or 4-pipe), electric re-heating, and dx-cooling (incl. fan interlock). It supports PID and, optionally, cascade control as well as min. temperature limitation. This application type may be used in combination with other types (see following).
- The **chilled/heated ceiling application type** uses PID with dewpoint protection (2-pipe or 4-pipe). It also supports 6-way valve on AO. It may be used in combination with other applications (e.g., min. temperature).
- The **radiator heating** application type.
- The **underfloor heating application type** uses PID and, optionally, max. temperature limitation. It may be used in combination with other applications.
- The **intake air / air quality control application type** for cooling and air quality control uses PID and, optionally, min. temperature limitation. It may be used in combination with other applications.

The use of different application types is limited by the number of I/Os supported by the given model.

Supported Actuators

The application supports open/close, PWM (thermal), floating, and proportional (0[2]…10 V) actuators. Proportional actuators may be used with 6-way valves for heating and cooling, in chilled/heated ceilings.

Supported Sensors

A variety of sensors (e.g., room temperature sensors, supply temperature sensors, condensation switch, window sensors, occupancy sensors, and card readers) may be used to optimize control quality.

Supported Operating Modes

The application supports a variety of different operating modes (e.g., occupied, standby, unoccupied, building protection, fan automatic/manual/fan, only [FCU application type, only], night purge [intake air application type, only]).

I/Os not used by the configurable application may be used by a plant controller for monitoring or to switch an actuator (e.g., window actuator).

Automatic MAC Addressing

In contrast to many other MS/TP controllers, the CPO-R Controller features automatic MAC addressing. There is thus no need to manually set the MAC address.

BACnet MS/TP Master/Slave Functionality

During configuration, the commissioning engineer can identify (e.g., using the RoomUp configuration tool) which of the controllers located on a given BACnet MS/TP bus are so-called "Masters," and which are so-called "Slaves." The commissioning engineer is not allowed to assign more than a single Master to each Slave; this is the only action which the commissioning engineer is required to perform. The Slave controller will inform its Master that it has been assigned to be

its Slave. Once this is done, Master/Slave communication is as shown in Fig. 9.

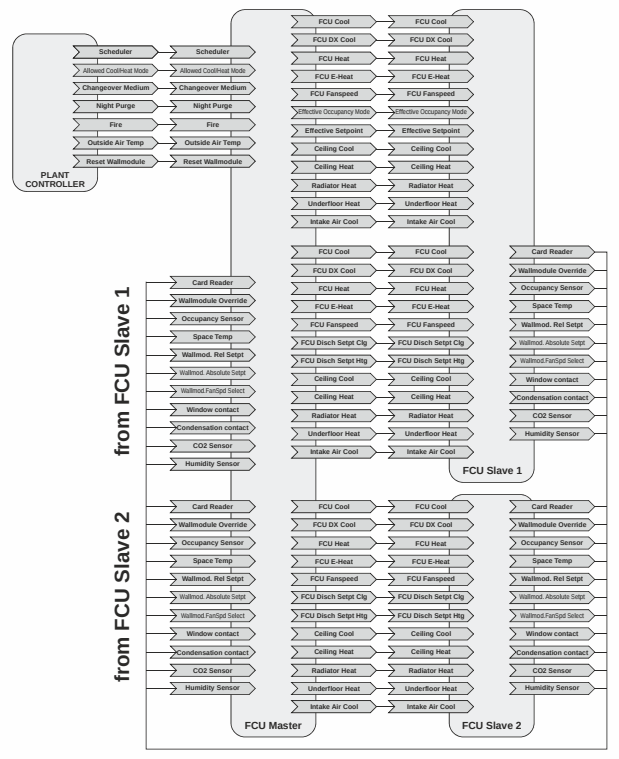


Fig. 9. Master/Slave communication

The given application in the Master controller defines how this group (consisting of the Master controller and its Slave controllers) reacts to sensor inputs.

Examples:

- Activation of a window contact (indicating an opened window) will cause the application to stop heating/cooling.
- Receipt of a condensation signal will stop cooling.
- Occupancy will be detected if one of the occupancy sensors detects occupancy.
- A key card will be detected if one of the key card sensors detects a key card.
- Occupancy override from one of the connected wall modules will trigger an occupancy override.
- The last setpoint change (temperature setpoint or fan speed setpoint) on one of the wall modules (T7460x or TR40x/TR42x) will define the setpoint (NOTE: All TR42x wall modules will show the actual settings used by the controllers. The T7460x and TR40x do not feature a display and are thus unable to provide the actual setting, nor does their setpoint wheel reflect setpoint changes enacted using another wall module in the same group).
- For such sensor values as temperature, CO_2, and humidity, the commissioning engineer can configure the use of the average, min., or max. value (thus improving system robustness against failures of a single sensor.)
- A changeover signal from one of the controllers will set the group to the corresponding mode.
- The Master shares schedule, heat/cool mode, night purge, emergency, and actuator positions with its Slave(s).

OPERATOR INTERFACES

LEDs

The controller features the following LEDs:



Fig. 10. Controller LEDs

Table 7. Description of LED behaviors

symbol	color	function, description
T2	yellow	Not used
R2	yellow	Not used
T1	yellow	LED indicating transmission of communication signals via the BACnet MS/TP interface
R1	yellow	LED indicating reception of communication signals via the BACnet MS/TP interface.
⚠	yellow	Status LED indicating firmware problems, hardware problems, etc.
⏻	green	Power LED indicating firmware problems, hardware problems, etc.
	red	Watchdog (RL7U, only) has locked controller.

Watchdog Functionality (RL7U, only)

The RL7U features a watchdog (relay 4) which enhances the system's reliability.

The watchdog indicates whether or not the controller's software and processor are functioning properly. In the event that either the software or the processor is not functioning properly, the watchdog will reboot the controller.

If, after this reboot, the watchdog again detects a problem, the watchdog will then lock the controller (i.e., permanent reset). The following will then occur: The watchdog will operate (i.e., terminal 15 will be connected with terminal 17), the power LED will light up RED, and the status LED will remain OFF (see Table 7).

Optionally, the user can connect an alarm (e.g., beeper) to terminals 15 and 17.

The watchdog relay is not available for use by the application.

See also Table 3 for technical details on the watchdog relay.

Service Button

The controller's Service Button is used to trigger dedicated events.

COMMUNICATION INTERFACES

BACnet MS/TP Interface

The controller features an RS485 interface (RLx: terminals 62, 63, and 64; RSx: terminals 40, 41, and 42) suitable for BACnet MS/TP communication. The terminal block containing it is black. The cable length affects the baud rate. See Table 8.

Table 8. Baud rate vs. max. cable length

baud rate	max. cable length (L)
9.6, 19.2, 38.4, 57.6, and 76.8 kbps	1200 m
115.2 kbps	800 m

For information on wire gauge, max. permissible cable length, possible shielding and grounding requirements, and the max. number of devices which can be connected to a bus, refer to standard EIA-485.

RJ45 Connector for BACnet WiFi Adapter

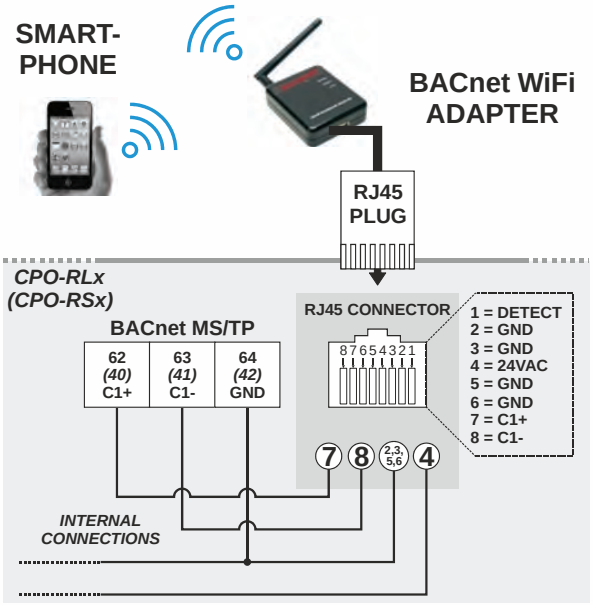


Fig. 11. RJ45 interface and BACnet WiFi Adapter

⚠ CAUTION

It is permitted to connect ***only*** the BACnet WiFi Adapter to this RJ45 connector. Do ***not*** connect IP!

A BACnet WiFi Adapter can be connected to the controller's RJ45 connector in order to establish wireless communication with an Android Smart device so that the application engineer can configure the controller (using the RoomUp configuration tool).

NOTE: When the BACnet WiFi Adapter is connected to the controller's RJ45 connection, it is powered by the controller. It is then prohibited to simultaneously power the BACnet WiFi Adapter via a wall adapter. When, on the other hand, the BACnet WiFi Adapter is instead connected to the controller's BACnet MS/TP interface, it is prohibited to simultaneously use an RJ45 plug; instead, the BACnet WiFi Adapter must then be powered by a wall adapter (standard 5-V USB wall adapter with micro USB connector).

See also corresponding Technical Literature listed in Table 9 on pg. 12.

Wall Modules

The T7460x and TR40x/TR42x Wall Modules can be used in conjunction with the controller to perform room temperature sensing, setpoint adjustment, fan speed manual override, and occupancy override.

I/O TERMINALS

Relay Outputs

⚠ CAUTION

Mixing of different voltages (e.g., 24 V and 230 V) within the relay block is not allowed.

The terminal blocks containing the controller's relay outputs are orange. Relay output types: See Table 3.

NOTE: If inductive components are to be connected to the relays and if these relays switch more often than once every two minutes, these components must be prevented from causing harmful interference to radio or television reception (conformance with EN 45014).

Triac Outputs

The terminal blocks containing the controller's triac outputs are orange.

These triac outputs can be configured (using, e.g., the RoomUp configuration tool) for a variety of different functions, e.g., for connection to either a floating drive or to a thermal actuator. Once the triac outputs have been configured, the corresponding devices can then be connected to them directly.

NOTE: The VC6983 actuator is intended for use at relay outputs, only and must not be used at the controller's triac outputs.

Triac Current Limitations

In the case of the 230-VAC versions of the controller, when the triacs are to be supplied with 24-VAC power from the controller's internal transformer, then the following applies:

- 300 mA max., i.e., a max. of one thermal actuator for heating and one thermal actuator for cooling can be operated (provided that heating and cooling are not operated at the same time).

⚠ CAUTION

The max. permissible power output of all 24 VAC terminals combined is 300 mA! If the triacs, alone, are loaded with 300 mA, then it is not permitted to connect a load at any other 24 VAC output terminal.

In all other cases, when the triacs are to be supplied with power (24 VAC or 230 VAC) from an external source, then the following applies:

- 700 mA (peak) and 600 mA (max.), i.e., two to three thermal actuators can be operated in parallel (depending upon the current consumption of the given actuator).

Universal Inputs

The terminal blocks containing the controller's universal outputs are blue. Universal input types: See Table 4.

The universal inputs are protected against voltages of max. 29 VAC and 30 VDC (due to, e.g., miswiring).

Bias Resistors

Each universal input is equipped with one bias resistor.

Analog Outputs

The terminal blocks containing the controller's analog outputs are green. Analog output types: See Table 5.

The analog outputs of the RLxx controllers (large housing) are protected against voltages of max. 29 VAC and 30 VDC (due to, e.g., miswiring).

NOTE: Connecting 24 VAC to any analog output of the RSxx controllers (small housing) will damage the hardware.

TROUBLESHOOTING

All units feature a Service LED, Power LED, and Service Button for commissioning and troubleshooting. See also sections "LEDs", "Watchdog Functionality (RL7U, only)", and "Service Button".

Check if the Service LED's behavior is changed if you switch the power OFF/ON. Please contact Honeywell if this does not solve the problem.

ACCESSORIES

Terminal Protection Cover

Required for wall mounting. Bulk pack, set of ten covers.

- For LARGE controllers, order no.: **IRM-RLC**
- For SMALL controllers, order no.: **IRM-RSC**

APPROVALS, CERTIFICATIONS, AND STANDARDS

Approvals and Certifications

- 24-V models and 230-V models: UL 60730-1, Standard for Automatic Electric Controls for Household and Similar Use, Part 1: General Requirements;
- 24-V models and 230-V models: CAN/CSA-E60730-1:02, Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements;
- 24-V models and 230-V models: Complementary listing for UL916, CSA C22.2 No. 205;
- BACnet AAC profile;
- CE-approved;
- SASO and EAC-approved;
- FCC part 15B-compliant.

Classification according to EN 60730-1

EN 60730 sub part:	EN 60730-2-9
Environmental conditions:	For use in home (residential, commercial, and light-industrial) environments
Construction:	Independently mounted electronic control unit with fixed wiring; panel-mounted on DIN rail
Action:	type 1.C
Rated impulse voltage:	230 V circuits: 2500 V 24 V circuits: 500 V
Pollution degree:	2
Protection against shock:	Class 0 (without terminal cover) Class II (with terminal cover)
Software class:	A

Classification according to EN 60529

(Degree of protection provided by enclosures)

IP20. In the case of controllers mounted outside of a cabinet, before applying power to the device, Terminal Protection Covers (10-pc. bulk packs, order no.: IRM-RLC for large housings and IRM-RSC for small housings) must be mounted so as to provide IP30.

Ambient Environmental Limits

24-V Models (5...95% r.H., non-condensing)

Operating temperature:	0 … +50 °C (RL7U: -40 … +65 °C)
Storage temperature:	-20 … +70 °C

230-V Models (5...95% r.H., non-condensing)

Operating temperature (floor/ceiling mounting):	0 … +40 °C
Operating temperature (wall/rail mounting):	0 … +50 °C
Storage temperature:	-20 … +70 °C

RELATED TECHNICAL LITERATURE

Table 9. Related Technical Literature

Title	Product Lit. no.
CPO-Rxx Room Controller – Mount. Instr.	MU1B-0590GE51
CPO-Rxx Room Controller – Data Sheet	EN0B-0732GE51
CPO-Rxx Room Controller – Inst. & Comm. Instr.	EN1B-0591GE51
BACnet WiFi Adapter – Product Data	EN0B-0733GE51
BACnet WiFi Adapter – Mounting & Op. Instr.	MU1B-0592GE51
ComfortPoint Open Studio– User's Guide	EN1B-0001IE10
ComfortPoint Open Studio Online – User's Guide	EN1B-0002IE10
ComfortPoint Open Studio – Installation Guide	EN1B-0004IE10
ComfortPoint Open Studio Online – Inst. Guide	EN1B-0011IE10
ComfortPoint Open Studio – User's Guide	EN2B-0001IE10
ComfortPoint Open Online – User's Guide	EN2B-0002IE10
ComfortPoint Open – System Engineering Guide	EN2B-0052IE10
ComfortPoint Open Room Contr. – App. Guide	EN2B-0053IE10
T7460A,B,C,D,E,F – Specification Data	EN0B-0236GE51
T7460A,B,C,D,E,F – Installation Instructions	EN1B-0291GE51
TR40x/TR42x – Specification Data	63-1389

Trademark Information

BACnet™ is a trademark of ASHRAE Inc.

ComfortPoint™ Open is a trademark of Honeywell Inc.

Honeywell

Manufactured for and on behalf of the Environmental & Energy Solutions Division of Honeywell Technologies Sàrl, Rolle, Z.A. La Pièce 16, Switzerland by its Authorized Representative:

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Fax +49 (0) 7031 637 740
http://ecc.emea.honeywell.com

data sheet

JACE® 8000 controller

PRODUCT DEFINITION

The JACE 8000 is a compact, embedded IoT (Internet of Things) controller and server platform for connecting multiple and diverse devices and sub-systems. With Internet connectivity and Web-serving capability, the JACE 8000 controller provides integrated control, supervision, data logging, alarming, scheduling and network management. It streams data and rich graphical displays to a standard Web browser via an Ethernet or wireless LAN, or remotely over the Internet.

The licensing model for the JACE 8000 controller is simplified and features standard drivers along with optional IO and field bus expansion modules for ultimate flexibility and expandability. The JACE 8000 controller operates with Niagara 4, the latest version of the Niagara Framework®, for optimum performance. In larger facilities, multi-building applications and large-scale control system integrations, Niagara 4 Supervisors can be used with JACE 8000 controllers to aggregate information, including real-time data, history and alarms, to create a single, unified application.

HARDWARE SPECIFICATIONS

TI AM3352: 1000MHz ARM® Cortex™-A8
1GB DDR3 SDRAM
Removable micro-SD card with 4GB flash total storage/2GB user storage
Wi-Fi (Client or WAP) *IEEE802.11a/b/g/n* *IEEE802.11n HT20 @ 2.4GHz* *IEEE802.11n HT20/HT40 @ 5GHz* *Configurable radio (Off, WAP, or Client)* *WPAPSK/WPA2PSK supported*
USB type A connector *Back-up and restore support*
(2) isolated RS-485 with selectable bias and termination
(2) 10/100MB Ethernet ports
Secure boot
24VAC/DC power supply
Runs Niagara 4.1 and later
Real time clock
Batteryless



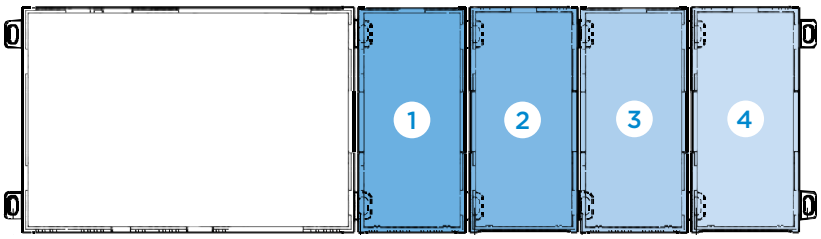
powered by
niagara framework®

EXPANSION MODULE AND IO CONFIGURATIONS

MAXIMUM EXPANSION MODULES SUPPORTED	MAXIMUM IO MODULES SUPPORTED
NPB-8000-LON: 4	T-IO-16-485: 16
NPB-8000-232: 4	
NPB-8000-2X-485: 2	

MAXIMUM COMBINATIONS

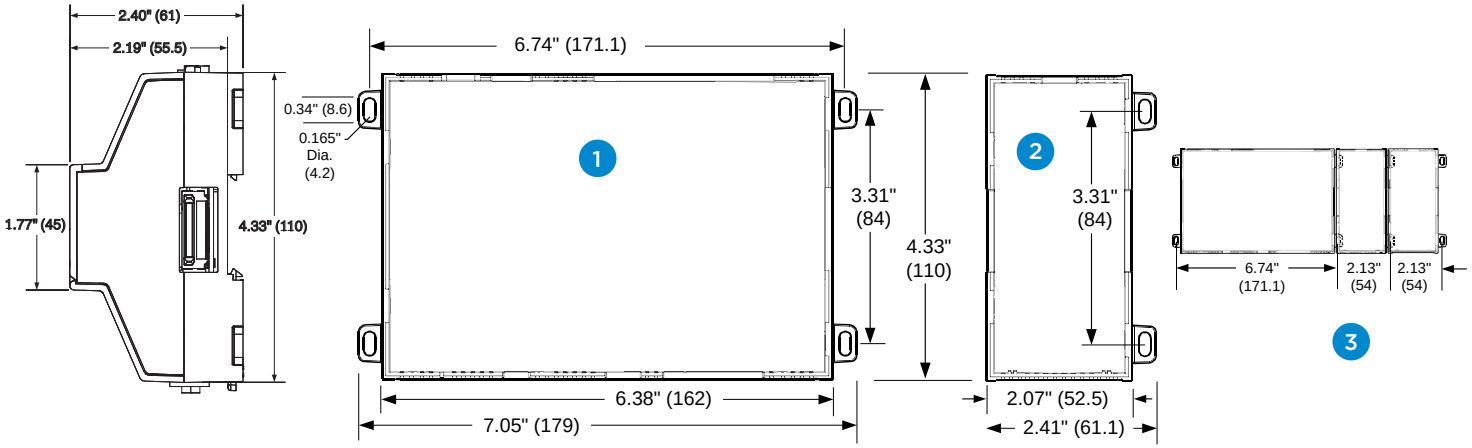
EXPANSION 1	EXPANSION 2	EXPANSION 3	EXPANSION 4
232 or LON	232 or LON	232 or LON	232 or LON
485 485	232 or LON	232 or LON	232 or LON
485 485	485 485	232 or LON	
485 485	485 485		





JACE® 8000 CONTROLLER MOUNTING & DIMENSIONS

1. JACE 8000 controller. Allow at least 1.5″ (38mm) clearance around all sides and minimum 3″ (76mm) at bottom for Wi-Fi antenna
2. Expansion module. Up to four (4) may be used. See "Expansion Module and IO Configurations"
3. Distances between center of tabs from one unit to another unit



Compatible with (DIN43880) enclosures
Suitable for mounting to a panel or to an EN50022 standard 35mm rail

AGENCY CERTIFICATIONS

- UL 916
- CE EN 61326-1
- FCC Part 15 Subpart B, Class B
- FCC Part 15 Subpart C
- C-UL listed to Canadian Standards Association (CSA) C22.2 No. 205-M1983 “Signal Equipment”
- 1999/5/EC R&TTE Directive
- CCC
- SRRC
- RSS
- ROHS

ENVIRONMENTAL SPECIFICATIONS

- **Operating temperature:** -20–60°C
- **Storage temperature:** -40–85°C
- **Humidity:** 5%–95% — Non condensing
- **Shipping & vibration:** ASTM D4169, Assurance Level II
- **MTTF:** 10 years+

TRIDIUM

ORDERING INFORMATION

Part number	Description
JACE-8000	Base unit includes two isolated RS485 ports, two 10/100MB Ethernet ports, USB Backup & Restore and Wi-Fi connectivity
JACE-8000-DEMO	Base unit includes two isolated RS485 ports, two 10/100MB Ethernet ports, USB Backup & Restore, Wi-Fi connectivity, all available Tridium drivers and a 500 device license. Hardware Accessories purchased separately
NC-8005	Up to 5 devices/250 point core
NC-8010	Up to 10 devices/500 point core
NC-8025	Up to 25 devices/1,250 point core
NC-8100	Up to 100 devices/5,000 point core
NC-8200	Up to 200 devices/10,000 point core
DEVICE-10	Up to 10 devices/500 point upgrade (can be purchased during initial licensing)
DEVICE-25	Up to 25 devices/1,250 point upgrade (can be purchased during initial licensing)
DEVICE-50	Up to 50 devices/2,500 point upgrade (can be purchased during initial licensing)
DEVICE-UP-10	Up to 10 devices/500 point upgrade (can be purchased post initial licensing)
DEVICE-UP-25	Up to 25 devices/1,250 point upgrade (can be purchased post initial licensing)
DEVICE-UP-50	Up to 50 devices/2,500 point upgrade (can be purchased post initial licensing)
JACE-8000-AX	Enables JACE® 8000 controller to run Niagara AX (3.8U). 3.8U Build with JACE 8000 controller support
NPB-8000-2X-485	JACE 8000 controller — add on dual port RS-485 module
NPB-8000-LON	JACE 8000 controller — add on single port LON FTT10A module
NPB-8000-232	JACE 8000 controller — add on single port RS-232 module
WPM-8000	Universal power supply for JACE 8000 controller
T-IO-16-485	Remote IO module, compatible with the JACE 8000 controller. Communication using RS 485, maximum IO supported T-IO-16-485 modules: 16
T-NPB-PWR	24V power supply for T-IO-16-485
T-NPB-PWR-UN	Universal power supply for T-IO-16-485

**All NC-8XXX parts include a Niagara 4 license and Tridium's standard driver suite. Please see Tridium standard driver suite documentation for more details.*

The JACE 8000 controller is available through a wide variety of original equipment manufacturers. Our open distribution business model and open protocol support allow a vendor-neutral application compatible with devices and systems throughout the world.

TRIDIUM **804.747.4771** Corporate HQ / **877.305.1745** Customer Support **tridium.com**

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2015-0013

28HE Series High Efficiency Steam Boilers



THE HEATING Pros

Smith
CAST IRON BOILERS



High Efficiency

Smith Boilers is the only manufacturer offering a high-efficiency steam boiler; replace an aging or failed system and still attain fuel cost savings.

Efficiency [makes replacement the smart choice]

When you can get extensive savings from a high efficiency steam boiler, extensive costs of system conversion are no longer justified. When plans require an eye on value over time, and call for less hands-on operation and maintenance, Smith Boilers will get you there. Proven in decades past, proving it for decades to come.



Simple Install & Maintenance

Smith Boilers designs products with the needs of the contractor and end-user in mind. Our sectional design installs easily within existing mechanical rooms. Easy access for service and maintenance provides a longer service life.



Optimal Operation

Larger heat transfer surface and cast-in heat transfer pins allow for maximum thermal efficiency—during the course of its lifetime, the boiler pays for itself several times over. Additionally, our integral flue gas collector enables quieter operation.

Engineered [to be your long-term answer]



When you choose a replacement boiler, you want one that won't itself need replacement or extensive service. Smith Boilers's specialized machining and components ensure your decision stands up over time.



1. Machined Feet

Smith Boilers ship with their own steel floor rails that match section feet assembly; no need for shims or field adjustments. Sections are drawn together pair-by-pair to reduce stress for simplified, no-jack connection



2. Indestructible Port Connectors

Precise sectional alignment accommodates graphite port connectors that permanently withstand exposure to flue gases and steam pressure up to 15 psi, and any water pH factor



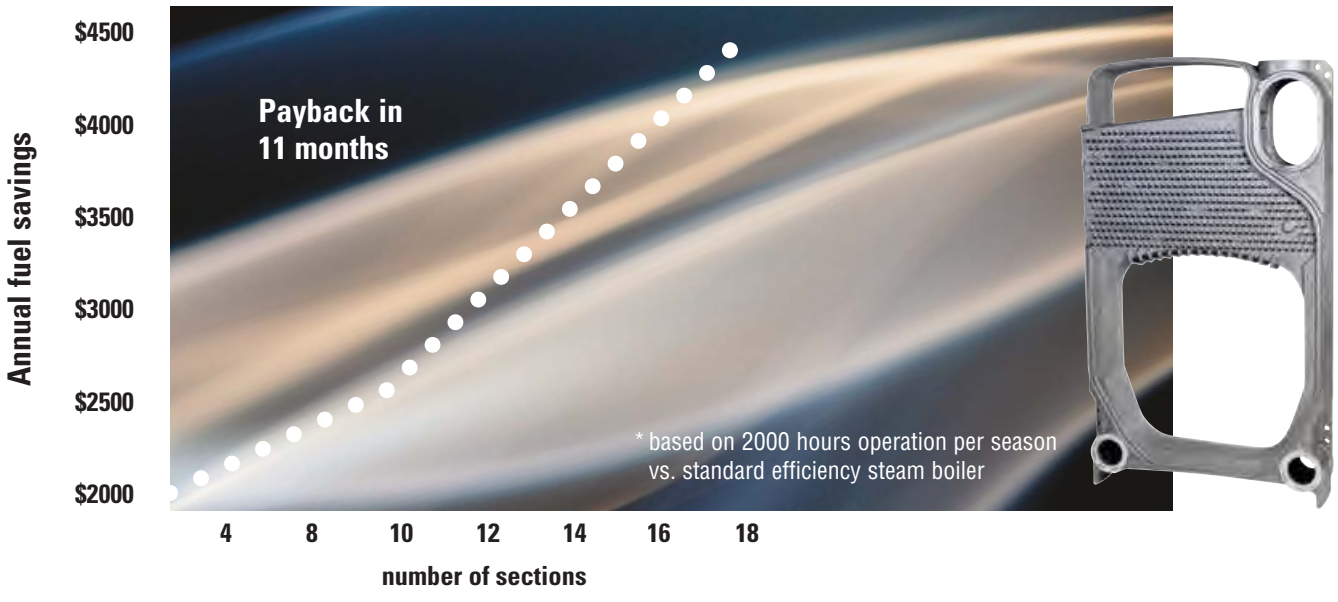
3. Large Steam Chest

The obround design of the upper port provides improved internal circulation and a drier steam, enhancing performance



4. Continuous Seal/ Integral Smokehood

The exact alignment of the sections allows for a convenient continuous ceramic rope seal, as well as a cast-in smokehood in order to reduce the operational noise



28HE Series

HIGH EFFICIENCY STEAM BOILERS

Steam Standard Equipment

- Cast iron wet-base sections
- Insulated metal jacket
- Cast iron smokehood with integral damper
- Burner mounting plate with insulation block
- Front and rear flame observation ports
- Stack thermometer
- Steel angle floor rails
- Ceramic fiber rope seal between sections
- Graphite port connectors
- Low NOx available
- 15 psi working pressure sections
- ASME relief valve, 15 psi
- Steam gauge
- Manual reset, Hi-Limit pressuretrol (Boiler/Burner units only)
- Operating pressuretrol (Boiler/Burner units only)
- Gauge glass and fittings

I B R Ratings, Burner Capacities and Dimensions (inches)

Designed and tested to the ASME boiler and pressure vessel code, section IV for maximum allowable working pressure, steam 15 psig.

Boiler Model Number (Note 1)	Boiler Horse-power	I=B=R Gross Output (MBH)	Net I=B=R Ratings (Note 2)				Water Contents (Gals)	Boiler Jacket Length	Dia. Vent Conn.	Thermal Efficiency		Combustion Efficiency	
			Steam		I=B=R Burner Capacity								
			Sq Ft	MBH	Oil GPH (Note 3)	Gas MBH (Note 4)	Steam			Oil	Gas	Oil	Gas
†28HE-S-4	27	931	2908	698	7.9	1143	103.8	35	10	83.9	81.4	86.2	83.6
†28HE-S-5	35	1194	3733	896	10.2	1458	125.8	43	10	84.4	81.9	86.2	83.6
†28HE-S-6	43	1458	4625	1110	12.2	1773	147.8	51	10	84.8	82.2	86.1	83.5
†28HE-S-7	51	1722	5542	1330	14.4	2088	169.8	59	12	85.0	82.5	86.1	83.5
†28HE-S-8	59	1985	6421	1541	16.6	2403	191.8	69	12	85.2	82.6	86.1	83.5
†28HE-S-9	67	2249	7275	1746	18.8	2718	213.8	75	14	85.3	82.7	86.1	83.5
†28HE-S-10	75	2513	8129	1951	21.0	3033	235.8	83	14	85.4	82.8	86.1	83.5
†28HE-S-11	83	2776	8979	2155	23.0	3348	257.8	91	14	85.5	82.9	86.0	83.5
†28HE-S-12	91	3040	9833	2360	25.5	3663	279.8	99	14	85.6	83.0	86.0	83.5
†28HE-S-13	98	3304	10,688	2565	27.5	3978	301.8	107	14	85.6	83.0	86.0	83.5
†28HE-S-14	106	3567	11,538	2769	29.5	4293	323.8	115	16	85.7	83.1	86.0	83.5
†28HE-S-15	114	3831	12,392	2974	32.0	4608	345.8	123	16	85.7	83.1	86.0	83.4
†28HE-S-16	122	4095	13,246	3179	34.0	4923	367.8	131	16	85.7	83.2	86.0	83.4
†28HE-S-17	130	4358	14,100	3384	36.5	5238	389.8	139	18	85.8	83.2	86.0	83.4
†28HE-S-18	138	4622	14,954	3589	38.5	5553	411.8	147	18	85.8	83.2	86.0	83.4

(Note 1) Important ordering information

(†) Add prefix for type of fuel to be burned. "LO" for Light Oil, "G" for Gas or "GO" for Gas/Oil.

(Note 2) Ratings for steam boilers are based on piping and pick-up factor as follows:
4 and 5 section = 1.333 6 and 7 section = 1.305 8 section and larger = 1.288

(Note 3) Light Oil having a heat content of 140,000 BTU/Gal.

(Note 4) Gas having a heat content of 1,000 BTU/Cu. Ft., 0.60 specific gravity.

AHRI CERTIFIED www.ahridirectory.org

ASME H

Smith
CAST IRON BOILERS
(413) 562-9631 • FAX: (413) 562-3799

Series 3
Gas, Oil & Gas/Oil
Water or Steam
MBH: 2,540-8,660
Combustion Eff.: 84%

94™ BOILER

- PACKAGED FOR KNOCK DOWN
- EASY TO INSTALL AND SERVICE
- GAS, OIL, GAS/OIL
- WATER OR STEAM
- MADE WITH WEIL-McLAIN QUALITY



WEIL-McLAIN®
weil-mclain.com

WEIL-McLAIN®

Presenting... the Weil-McLain No. 94 heavy-duty cast iron boiler is designed for heating apartments, schools, churches, offices, and other commercial and institutional buildings. The boiler is available for hot water or steam in 18 sizes with net I-B-R ratings from 1,763.5 to 6,060.9 MBH.

The 94 is available as a complete boiler-burner unit furnished with a light oil burner (BL Unit), power gas burner (BG Unit), or combination gas light oil burner (BGL Unit). It is also available as a boiler only (H Unit) for use with heavy oil burners approved by Weil-McLain.

In addition to total fuel flexibility, the 94 also features total installation flexibility: It is available in individual sections, with factory-assembled sections, or as a completely assembled and factory fire-tested package boiler.

The 94 features forced draft firing at over 80% operating efficiency. Outstanding design and construction features include provision for multiple tankless water heaters, patented section sealing method, Hydro-Wall wet-base design, insulated steel jacket, provision for easy cleaning, built-in air eliminator in water boilers, simplified piping no refractory combustion course, Weil-McLain cast iron construction.

Forced Draft Firing

The No. 94 boiler is pressurized for forced draft firing and therefore does not require a chimney for draft... only a 3-foot vent above the roof is necessary. This feature is particularly valuable in replacement installations, since an existing chimney with insufficient draft because of low height or poor construction is not a problem. Other advantages of a forced draft boiler: No mechanical draft equipment is required, boiler room space requirements are reduced, and a pressurized boiler is more energy efficient.



Design Features

1. Forced draft firing with light oil, gas combination gas-light oil, or heavy oil. Burner mounting plate furnished as standard equipment (additional equipment for heavy oil boilers).
2. Hydro-Wall design with water circulating completely around the combustion area... no refractory combustion chamber, no separate base.
3. Cast iron sections for corrosion resistance and extra long life... special sealing rope assures a gastight seal.
4. Short draw rods permit faster, easier assembly of boiler sections.
5. Patented section sealing method assures a watertight seal and reduces installation time.
6. Simplified piping reduces installation time. No return header necessary.
7. Multiple tankless heaters. Up to eight heaters can be installed in larger boilers.
8. Supply outlets with built-in air eliminator simplify piping.
9. Extra-large top port opening forms internal header for better water circulation... large steam area assures rapid production of dry steam.
10. Steel jacket finished in attractive blue hammerloid, completely insulated, designed for fast installation.
11. Designed for easy cleaning through front cleanout doors and openings.
12. Stronger boiler construction. H and T-shaped cross sections provide maximum design strength, 80 lbs. working pressure available.

Hydro Wall Design

The No. 94 boiler has a water-backed combustion area with water circulating completely around the firebox. The crown sheet and sidewalls maximize heat-transfer surface.

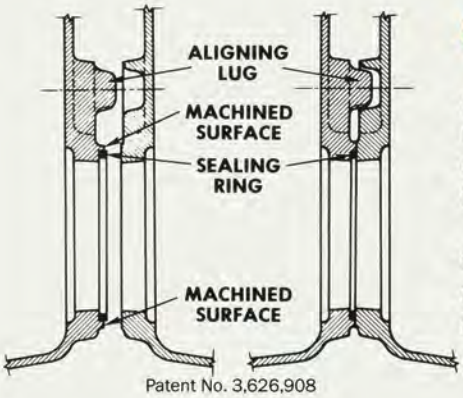
Hydro-Wall section design also permits lower height, reduces heat loss through the bottom of the boiler, and permits installation on any floor.

The cast iron sections are not face-ground; the tough outer skin is retained to protect against rust and corrosion.



No Refractory Combustion Chamber

A refractory combustion chamber is not required for the 94 boiler because the combustion area is entirely surrounded by water, and flame retention burners do not require hot refractory for combustion. This feature of the boiler saves the cost of combustion chamber material, the labor to install it, and there is no future replacement cost.

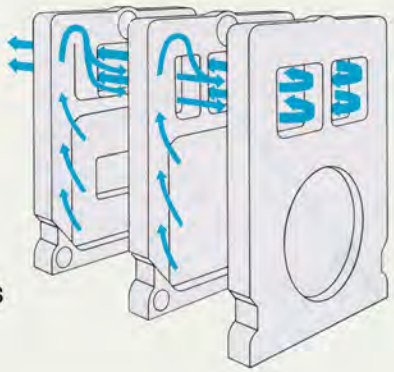


Patent No. 3,626,908

Section Sealing Method

A flexible elastomer sealing ring is used in each port opening of the 94 boiler to assure a permanent, water-tight seal between sections. This sealing method, combined with the use of short draw rods to tie sections together, also permits faster section assembly.

As shown in the illustrations, the machined surface of the port opening controls the compression ratio of the sealing ring for a watertight seal. The aligning lugs assure proper section alignment during assembly and positive locking of the sections.



Flue Gas Traveler

Multiple uptakes, combined with "3-pass" design, force hot gases to wipe the entire flue area, assure balanced flue gas travel, and prevent shortcuts to the chimney. Extra-long flue gas travel and higher velocities increases heat absorption of the secondary heating surfaces.



Assembled with short draw rods

Multiple short draw rods, instead of a single long rod and expansion washers, are used to tie the sections of the 94 boiler together. This is a standard feature of Weil-McLain boilers and is recognized by leading insurance companies. Short draw rods permit faster, easier assembly of boiler sections.

Tappings (1 ½") may be provided in front, back and intermediate sections for access to waterway areas and for inspection above the crown sheet and at the bottom of the boiler.

Front Cleanout Openings



The No. 94 boiler has two large cleanout doors that give complete access to center flueways for easy cleaning. These frameless doors are hinged to a center plate, sealed with rope, and made airtight by tightening the wing nuts. There are also six rope-sealed cleanout plates at the front of the boiler for cleaning the side flues.



No Return Header... Flanged flue collar

No separate return header is necessary for the 94 boiler, saving valuable installation time and material costs. Return water or condensate enters the center opening and is directed to the left and right port openings by internal vanes in the section.

For water boilers 894 through 1294 and all steam boilers, the center opening is covered with a plate with a 6" tapping. For water boilers 1394 through 2094, the opening accepts a standard 8" counter flange; for water boilers 2194 through 2594, the opening accepts a 10" counter flange.

The flanged flue collar has a steel counter flange so the breeching may be welded to the collar of the gastight seal required for forced draft firing. (Note: 2294 through 2594 boilers are furnished with a counter flange with a 12-inch-long male adapter.) Rope seal between the flange and counter flange eliminates air leakage. The flue collar has a built-in breeching damper that can be locked in position to maintain positive pressure over fire.

The large access panel gives easy access tot the firebox for servicing. The panel has a refractory liner; an additional refractory heat shield provides further cooling of the panel. An observation port on the access panel permits close study of the flame.

Supply Outlets

The 94 boiler requires only one or tow supply outlets, which reduces installation time. All water boilers and the 894 steam boiler use one supply outlet; remaining steam boilers use two. Three types of supply outlets are furnished as standard equipment depending on boiler size: (1) supply elbow with 6" tapping, (2) supply elbow with 8" flanged opening, and (3) top outlet with 10" flanged opening (see table). The outlets feature a built-in trap, which separates the air from the water.



10" flanged top supply outlet



Supply elbow with 6" tapped opening



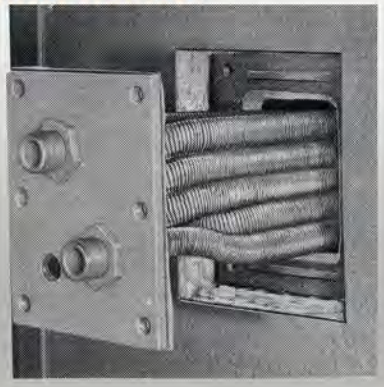
Supply elbow with 8" flanged opening

	One 6" Tapped Elbow	One 8" Flanged Elbow	Two 8" Flanged Elbow	One 10" Top Outlet	Two 10" Top Outlet
Water Boilers	894 through 1294	1394 through 2094	-	2194 through 2594	-
Steam Boilers	-	894	994 through 2094	-	2194 through 2594

Multiple Tankless Water Heaters

Up to eight tankless water heaters can be installed in the 94 boiler. Storage heaters are also available.

Multiple tankless heaters offer these advantages: (1) increased volume of hot water, (2) hot water at different temperatures, or (3) one heater for snow melting.



Domestic Water Heater Capacities

Tankless Heaters*

Heater Number	**Intermittent Draw GPM 100º Average Temperature Rise	***Continous Draw GPM 100º Temperature Rise	Inlet and Outlet Tappings
92-K-34	9 GPM	11 GPM	3/4"

*Weil-McLain ratings
**Gallons of water per min. heated 40º to 140º with 200ºF. boiler water temp.
***Continuous draw–no recovery period.

Tankless Heater Section Location

Location of TI sections (intermediate sections with tankless heater opening) counting from front to back to match jacket knockouts.

Boiler	Max No. Of Heaters	All Heaters Must Be on R.H. Side of Boiler
894	3	2, 4, 6
994	4	2, 4, 6, 8
1094	4	2, 4, 7, 9
1194	4	2, 4, 8, 10
1294	5	2, 4, 6, 9, 11
1394	5	2, 4, 6, 9, 11
1494	6	2, 4, 6, 9, 11, 13
1594	6	2, 4, 6, 10, 12, 14
1694	7	2, 4, 6, 8, 11, 13, 15
1794	7	2, 4, 6, 8, 11, 13, 15
1894	8	2, 4, 6, 8, 11, 13, 15, 17
1994	8	2, 4, 6, 9, 11, 14, 16, 18
2094	8	2, 4, 6, 9, 11, 15, 17, 19

	Steam	Water	Steam	Water
2194	5	7	2, 9, 11, 13, 20	6, 9, 11, 13, 16, 18, 20
2294	5	7	2, 9, 11, 13, 21	6, 9, 11, 13, 17, 19, 21
2394	6	8	2, 9, 11, 13, 15, 22	6, 9, 11, 13, 15, 18, 20, 22
2494	6	8	2, 9, 11, 13, 17, 23	6, 9, 11, 13, 17, 19, 21, 23
2594	7	8	2, 9, 11, 13, 15, 18, 24	6, 9, 11, 13, 17, 19, 21, 23

Note: If TI sections are ordered (see boiler rating table footnote), it is important to position them in the boiler section assembly in the exact location shown in the table above so that heater openings will match the jacket knockouts. If one or two TI sections are ordered with boiler, they MUST be located in one jacket panel because only ONE jacket side panel will have knockouts for tankless heaters. If more than two TI sections are ordered, additional jacket side panels with knockouts will be provided according to the table. The location of TI sections in other positions in the section assembly is possible, but jacket openings must then be cut by the installer.



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The flanged flue collar has a steel counter flange so the breeching may be welded to the collar of the gastight seal required for forced draft firing. (Note: 2294 through 2594 boilers are furnished with a counter flange with a 12-inch-long male adapter.) Rope seal between the flange and counter flange eliminates air leakage. The flue collar has a built-in breeching damper that can be locked in position to maintain positive pressure over fire.

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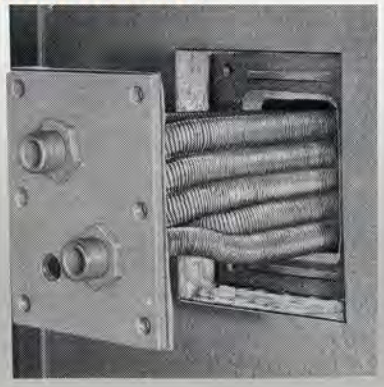
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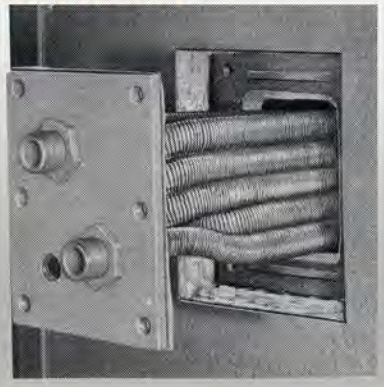
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**Gallons of water per min. heated 40º to 140º with 200ºF. boiler water temp.
***Continuous draw–no recovery period.

Tankless Heater Section Location

Location of TI sections (intermediate sections with tankless heater opening) counting from front to back to match jacket knockouts.

Boiler	Max No. Of Heaters	All Heaters Must Be on R.H. Side of Boiler
894	3	2, 4, 6
994	4	2, 4, 6, 8
1094	4	2, 4, 7, 9
1194	4	2, 4, 8, 10
1294	5	2, 4, 6, 9, 11
1394	5	2, 4, 6, 9, 11
1494	6	2, 4, 6, 9, 11, 13
1594	6	2, 4, 6, 10, 12, 14
1694	7	2, 4, 6, 8, 11, 13, 15
1794	7	2, 4, 6, 8, 11, 13, 15
1894	8	2, 4, 6, 8, 11, 13, 15, 17
1994	8	2, 4, 6, 9, 11, 14, 16, 18
2094	8	2, 4, 6, 9, 11, 15, 17, 19

	Steam	Water	Steam	Water
2194	5	7	2, 9, 11, 13, 20	6, 9, 11, 13, 16, 18, 20
2294	5	7	2, 9, 11, 13, 21	6, 9, 11, 13, 17, 19, 21
2394	6	8	2, 9, 11, 13, 15, 22	6, 9, 11, 13, 15, 18, 20, 22
2494	6	8	2, 9, 11, 13, 17, 23	6, 9, 11, 13, 17, 19, 21, 23
2594	7	8	2, 9, 11, 13, 15, 18, 24	6, 9, 11, 13, 17, 19, 21, 23

Note: If TI sections are ordered (see boiler rating table footnote), it is important to position them in the boiler section assembly in the exact location shown in the table above so that heater openings will match the jacket knockouts. If one or two TI sections are ordered with boiler, they MUST be located in one jacket panel because only ONE jacket side panel will have knockouts for tankless heaters. If more than two TI sections are ordered, additional jacket side panels with knockouts will be provided according to the table. The location of TI sections in other positions in the section assembly is possible, but jacket openings must then be cut by the installer.

WEIL-McLAIN®

Ratings

Boiler Unit No. Steam or Water	I=B=R Burner Capacity: Light Oil GPH	Heavy Oil GPH	Gas MBH	Gross I=B=R Output MBH	I=B=R Burner Capacity: Steam Sq. Ft.	Steam MBH	Water MBH	Net Sq. Ft. Water	Boiler H.P.	Net Firebox Volume Cu. Ft.	Stack Gas Volume CFM Light Oil & Gas	Draft Loss Through Boiler-in. H20	I=B=R Chimney Size Vent Dia. Inches
894	17.50	16.65	2526	2,028	6,560	1,574	1,763	11,755	60.6	45.40	1088	.175	14
994	20.00	19.00	2887	2,320	7,505	1,801	2,017	13,450	69.3	51.48	1242	.215	14
1094	22.50	21.35	3247	2,612	8,450	2,028	2,271	15,140	78.0	57.58	1397	.255	16
1194	25.00	23.75	3608	2,904	9,395	2,254	2,525	16,835	86.7	63.64	1555	.295	16
1294	27.50	26.10	3969	3,190	10,320	2,476	2,773	18,490	95.3	69.72	1710	.335	16
1394	30.00	28.45	4330	3,480	11,260	2,701	3,026	20,175	104.0	75.80	1866	.375	18
1494	32.50	30.80	4691	3,770	12,195	2,927	3,278	21,855	112.6	81.88	2020	.415	18
1594	35.00	33.15	5052	4,070	13,165	3,159	3,539	23,595	121.6	87.96	2175	.455	18
1694	37.50	35.55	5412	4,360	14,105	3,385	3,791	25,275	130.2	94.04	2325	.485	18
1794	40.00	37.90	5773	4,650	15,045	3,610	4,043	26,955	138.9	100.12	2480	.525	20
1894	42.50	40.25	6134	4,940	15,980	3,835	4,295	28,640	147.6	106.20	2640	.565	20
1994	45.00	42.60	6495	5,230	16,920	4,060	4,542	30,285	156.2	112.28	2795	.605	20
2094	47.50	45.00	6856	5,520	17,855	4,285	4,800	32,000	164.9	118.36	2945	.650	20
2194	50.00	47.40	7216	5,810	18,795	4,510	5,052	33,675	173.6	124.44	3120	.750	20
2294	52.50	49.80	7577	6,100	19,735	4,736	5,304	35,360	182.2	130.52	3255	.850	22
2394	55.00	52.20	7938	6,390	20,670	4,961	5,556	37,045	190.9	136.60	3410	.950	22
2494	57.50	54.60	8299	6,680	21,610	5,186	5,808	38,725	199.6	142.68	3565	1.050	22
2594	60.00	57.00	8660	6,970	22,550	5,411	6,060	40,406	208.2	148.76	3730	1.150	22

- Burner input based on maximum of 2,000 ft. altitude-for higher altitudes consult Weil-McLain applications Engineering Department.
- No.2 oil-Commercial standard spec. CS75-56. Heat value 140,000 BTU/G.
- Consult Weil-McLain Applications Engineering Department for gas pressure required.
- Gross I=B=R ratings have been determined under the I=B=R provision governing forced draft boiler-burner units.
- Net I=B=R ratings are based on net installed radiation of sufficient quality for the requirements of the building and nothing need be added for normal piping and pick-up. Water ratings are based on a piping and pick-up allowance of 1.15. Steam ratings on am allowance of 1.288.
- An additional allowance should be made for gravity hot water systems or for unusual piping and pick-up loads. Consult Weil-McLain Applications Engineering Department.
- Based on average water temperature of 170F. in heat distributing units.
- Stack gas volume at outlet tempuature.
- Add .100 to obtain firebox pressure.

Control Tappings

Indentification	Location	Size	Steam: Description	Steam: Location	Water: Description	Water: Location
J1†	Front Section	1/2"	See J1 and J5	–	High Limit Control or Pressure Gauge	AL
J2†	Front Section	1/2"	Plug	NA	Plug	NA
J5†	Front Section	1/2"	See J1 and J5	–	Plug	NA
J1† & J5†	Front Section	1/2"	Gauge Glass	DL	–	–
M1† & M2†	Front Section	1"	Low-Water Cutoff; or Low-Water Cutoff & Pump Control; or Low-Water Cutoff & Feeder Combination	DL	Low-Water Cutoff; or Low-Water Cutoff & Feeder Combination	DL
M3† & M4†	Front Section	1"	Low-Water Cutoff; or Low-Water Cutoff & Pump Control; or Low-Water Cutoff & Feeder Combination	AL	Low-Water Cutoff; or Low-Water Cutoff & Feeder Combination	AL
P1*	Front Supply Elbow	3"	Skim Tapping	AL	High Limit or Dual Operating and Limit Control	DL
P2◉	Back Supply Elbow	3"	•Steam Safety Valve (994 through 2094 boilers only)	DL	–	–
R1*	Front Supply Elbow	4"	Skim Tapping	DL	Plug	NA
R2◉	Back Supply Elbow	4"	•Steam Safety Valve (1294 through 2094 boilers only)	DL	–	–
S1*	Front Supply Elbow	3/4"	Steam Pressure Gauge and/or Pressure Limit & Operating Controls	DL	–	–
S2 •	Back Supply Elbow	3/4"	Pressure Limit and Operating Control (994-2094 only)	AL	–	–
T1†*	Front Supply Elbow	1 1/4"	Pressure Limit and Operating Control	AL	Piping to Compression Tank or Pressure Gauge	DL
T2†*	Front Supply Elbow	1 1/4"	Pressure Limit and Operating Control (and Firing Rate Control, where used)	DL	Piping to Compression Tank or Pressure Gauge	DL
T3†◉	Back Supply Elbow	1 1/4"	•Pressure Limit and Operating Control (Steam Safety Valve 1094 & 1194 steam boilers only)	AL	–	–
T4†◉	Back Supply Elbow	1 1/4"	•Pressure Limit and Operating Control (Steam Safety Valve 1094 & 1194 steam boilers only)	AL	–	–
U1▲	Back Outlet Cover	2"	•Steam Safety Valve (894 steam boilers only)	DL	•Pressure Relief Valve (2094 through 2594	DL
U2▲	Back Outlet Cover Plate	2"	Plug (894 steam boilers only)	NA	•Pressure Relief Valve (2094 through 2594; Plug (894 through 1994)	DL
V1∅	Front Outlet Cover Plate	4"	•Steam Safety Valve and Skim Tapping	DL	Fire Rate Control	DL
W1∅	Front Outlet Cover Plate	3/4"	Pressure Limit Control, Pressure Operating Control and Firing Rate Control	DL	Combination High-Limit and Low-Limit Control; or High-Limit Control	DL
W2∅	Front Outlet Cover Plate	3/4"	Steam Pressure Gauge	DL	Combination Pressure-Temperature-Altitude Gauge; or Temp Gauge	DL
V2◆	Back Outlet Cover Plate	4"	•Steam Safety Valve and Skim Tapping	DL	–	DL
W3◆	Back Outlet Cover Plate	3/4"	Pressure Limit and Operating Control	AL	–	–
W4◆	Back Outlet Cover Plate	3/4"	Pressure Limit and Operating Control	AL	–	–
X1†∅	10" Front Supply Outlet	1 1/4"	Pressure Gauge	AL	Pressure Gauge	AL
X2†∅	10" Front Supply Outlet	1 1/4"	Plug	NA	Piping to Compression Tank	DL
X3 ◆	10" Back Supply Outlet	1 1/4"	Pressure Gauge	AL	–	–
X4 ◆	10" Back Supply Outlet	1 1/4"	Pressure Gauge	NA	–	–
Y1†	Front Section	3/8"	Try Cock	–	Plug	–
Y2†	Front Section	3/8"	Try Cock	–	Plug	–

DL – Most Desired Location AL – Alternate Location NA – Not Allowed

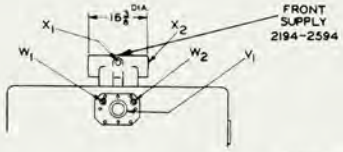
NOTES:
1. Tappings MArked optional will be provided only when specified on the boiler order.
2. Try Cock Tappings are standard for front section and optional for back section.

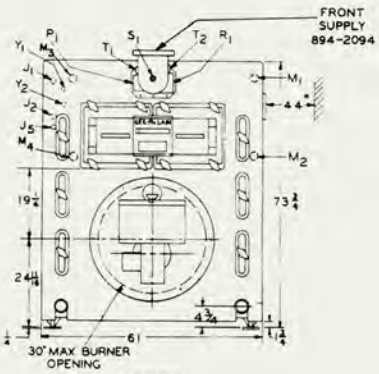
† Do not use these tappings for operating control location on water boilers.
* Furnished with 894 through 2094 steam and water boilers only.
∅ When internal water heater (s) are installed in boiler, use temperature control tapping in heater plate for additional operating (low-limit) control.
◉ Furnished with 994 through 2094 steam boilers only.
▲ Furnished with 894 steam boiler only, and 894 through 2594 water boilers.
∅ Furnished with 2194 through 2594 steam and water boilers only.
◆ Furnished with 2194 through 2594 steam boilers only.
• For 894 and 994 steam boilers, one Steam Safety Valve is furnished; 1094 through 2594 steam boilers are furnished with two Steam Safety Valves.
For 894 through 1994 water boilers, one Pressure Relief Valve is furnished; 2094 through 2594 water boilers are furnished with two Pressure Relief Valves.

Dimensions

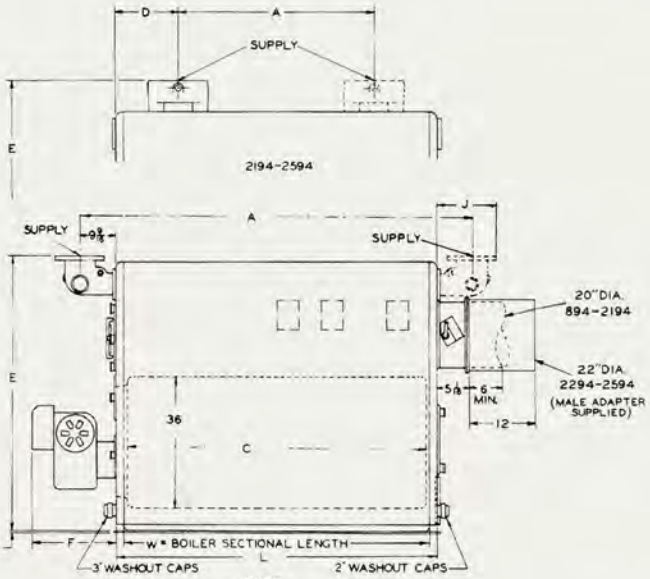
Boiler No.	Water		Steam		A	B		C	D		E	F		J	L	W
	Supply Outlet No. & Size	Return Inlet Size	Supply Outlet Size	Return Inlet Size	Steam Only	Water	Steam		Water	Steam		Light Oil	Gas & Gas-Oil	Steam Only		
894	1-6"	6"	1-8"	6"	-	$7^{11/16}$	$7^{11/16}$	45	-	-	76	$29^{1/2}$	25	-	$52^{1/2}$	51
994	1-6"	6"	2-8"	6"	$77^{5/8}$	$7^{11/16}$	$7^{11/16}$	51	-	-	76	$29^{1/2}$	25	$16^{3/8}$	$58^{1/2}$	57
1094	1-6"	6"	2-8"	6"	$83^{5/8}$	$7^{11/16}$	$7^{11/16}$	57	-	-	76	$21^{1/4}$	25	$16^{3/8}$	$64^{1/2}$	63
1194	1-6"	6"	2-8"	6"	$89^{5/8}$	$7^{11/16}$	$7^{11/16}$	63	-	-	76	$24^{15/16}$	25	$16^{3/8}$	$70^{1/2}$	69
1294	1-6"	6"	2-8"	6"	$95^{5/8}$	$7^{11/16}$	$7^{11/16}$	69	-	-	76	$24^{15/16}$	25	$16^{3/8}$	$76^{1/2}$	75
1394	1-8"	8"	2-8"	6"	$101^{5/8}$	$8^{3/8}$	$7^{11/16}$	75	-	-	76	$24^{15/16}$	25	$16^{3/8}$	$82^{1/2}$	81
1494	1-8"	8"	2-8"	6"	$107^{5/8}$	$8^{3/8}$	$7^{11/16}$	81	-	-	76	$24^{15/16}$	$30^{1/4}$	$16^{3/8}$	$88^{1/2}$	87
1594	1-8"	8"	2-8"	6"	$113^{5/8}$	$8^{3/8}$	$7^{11/16}$	87	-	-	76	$24^{15/16}$	$30^{1/4}$	$16^{3/8}$	$94^{1/2}$	93
1694	1-8"	8"	2-8"	6"	$119^{5/8}$	$8^{3/8}$	$7^{11/16}$	93	-	-	76	$24^{15/16}$	$30^{1/4}$	$16^{3/8}$	$100^{1/2}$	99
1794	1-8"	8"	2-8"	6"	$125^{5/8}$	$8^{3/8}$	$7^{11/16}$	99	-	-	76	$24^{15/16}$	$30^{1/4}$	$16^{3/8}$	$106^{1/2}$	105
1894	1-8"	8"	2-8"	6"	$131^{5/8}$	$8^{3/8}$	$7^{11/16}$	105	-	-	76	$24^{15/16}$	$30^{1/4}$	$16^{3/8}$	$112^{1/2}$	111
1994	1-8"	8"	2-8"	6"	$137^{5/8}$	$8^{3/8}$	$7^{11/16}$	111	-	-	76	$30^{3/4}$	$30^{1/4}$	$16^{3/8}$	$118^{1/2}$	117
2094	1-8"	8"	2-8"	6"	$143^{5/8}$	$8^{3/8}$	$7^{11/16}$	117	-	-	76	$30^{3/4}$	$30^{1/4}$	$16^{3/8}$	$124^{1/2}$	123
2194	1-10"	10"	2-10"	6"	72	$8^{3/8}$	$7^{11/16}$	123	$17^{1/4}$	$29^{1/4}$	$82^{1/2}$	$30^{3/4}$	$30^{1/4}$	-	$130^{1/2}$	129
2294	1-10"	10"	2-10"	6"	78	$8^{3/8}$	$7^{11/16}$	129	$17^{1/4}$	$29^{1/4}$	$82^{1/2}$	$30^{3/4}$	$30^{1/4}$	-	$136^{1/2}$	135
2394	1-10"	10"	2-10"	6"	84	$8^{3/8}$	$7^{11/16}$	135	$17^{1/4}$	$29^{1/4}$	$82^{1/2}$	$37^{3/4}$	$37^{3/4}$	-	$142^{1/2}$	141
2494	1-10"	10"	2-10"	6"	90	$8^{3/8}$	$7^{11/16}$	141	$17^{1/4}$	$29^{1/4}$	$82^{1/2}$	$37^{3/4}$	$37^{3/4}$	-	$148^{1/2}$	147
2594	1-10"	10"	2-10"	6"	96	$8^{3/8}$	$7^{11/16}$	147	$17^{1/4}$	$29^{1/4}$	$82^{1/2}$	$37^{3/4}$	$37^{3/4}$	-	$154^{1/2}$	153

*All 6" supply outlets are tapped–all 8" and 10" supply outlets are flanged. 6" return is tapped.

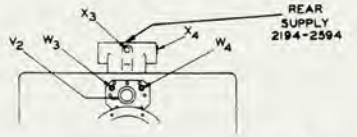


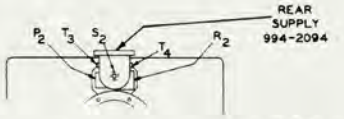


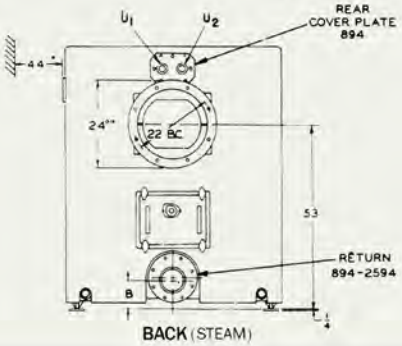
FRONT



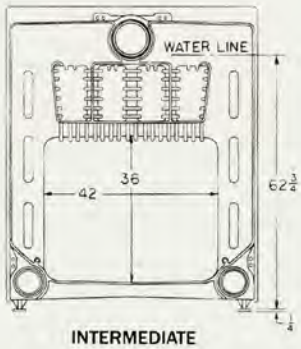
SIDE





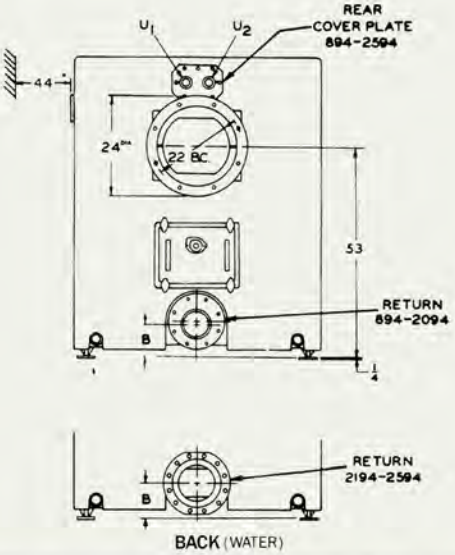


BACK (STEAM)



INTERMEDIATE

*Minimum clearance for tankless heater.



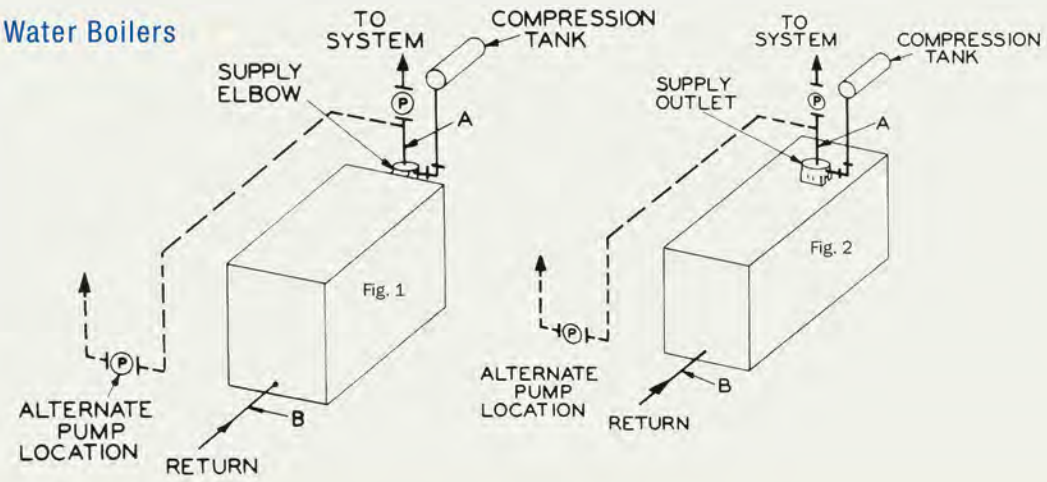
BACK (WATER)

94 Output 2,028-6,970 MBH (60-208 HP)

- 3 pass heat exchange design for maximum heat transfer
- Approved for heavy oil

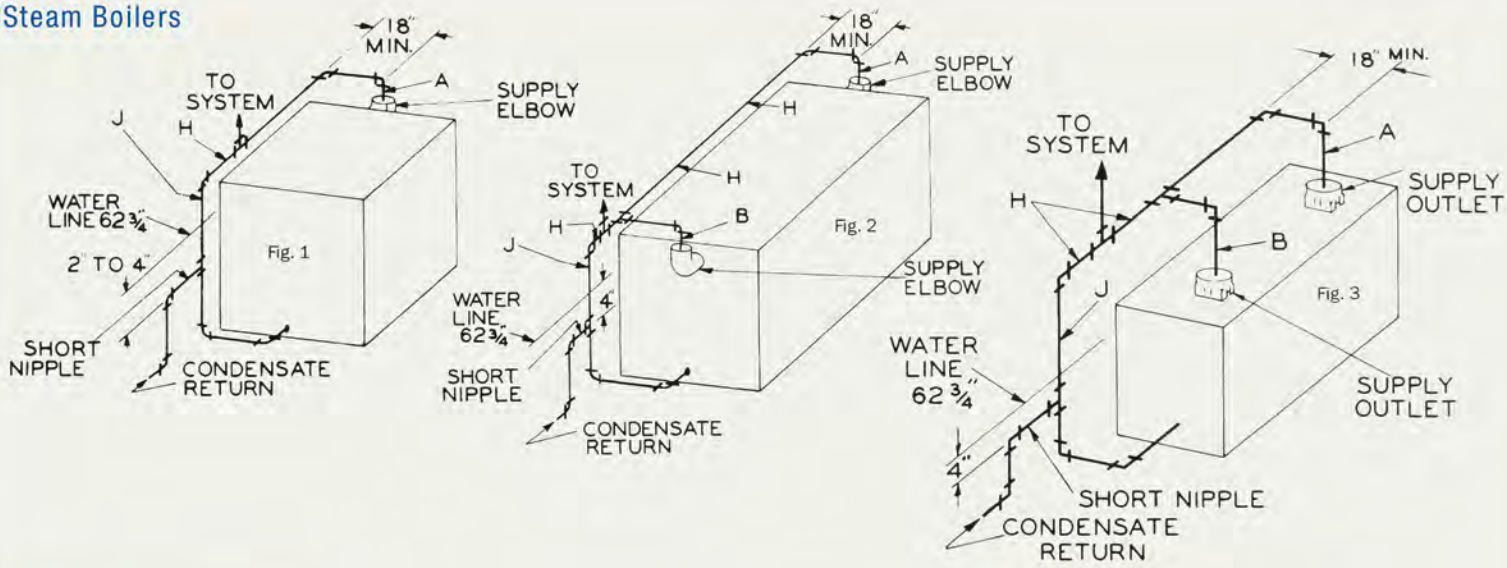
	Oil	Gas
Combustion	84%	81%
Thermal	83%	81%

Water Boilers





Steam Boilers



Standard Equipment

All Boilers

Insulated Flush Jacket
Flue Collar with Built-in Breeching Damper
Front Cleanout Doors and Wing Nuts
Front Cleanout Plates and Wing Nuts
Back Access Door
Flue Brushes and Handles
TwoClose Nipples and Caps for Washout Tappings on Front Section
Supply Elbow(s) or Top Outlet(s)

Water Boilers

ASME Safety Relief Valve
Combination High-Limit and Low-Limit Control
Combination Pressure-Temperatures-

Steam Boilers

ASME Side Outlet Safety Valve
Low-Limit and High-Limit Pressure Controls
4.2" Steam Pressure Gauge
Syphon
Gauge Glass
Gauge Cocks

Additional Equipment

Optional Equipment

Factory-Assembled Sections (894-2194 only)
Fire-Tested Package Units
Burner Controls
Water Level Controls and Low-Water Cutoffs
Barometric Damper
1.2" Side Inspection Openings with Plugs
80 PSI Working Pressure
Manometer
Tankless Heater(s)
Flame Retention Oil, Gas, or Gas/Oil Burner
Burner Mounting Plate with Refractory

WEIL-McLAIN®
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Building Sealant Recommendations and Surface Preparation Guide for Weatherseal Applications

Weatherseal

Dow Corning has a full line of high-performance primers for sealants. Primers are used to enhance adhesion.

	Dow Corning® 756 SMS Building Sealant	*Dow Corning*® 790 Silicone Building Sealant[1]	*Dow Corning*® 791 Silicone Weatherproofing Sealant	*Dow Corning*® 795 Silicone Building Sealant
Substrate	**Surface Prep**			
Concrete and Masonry				
Brick	Limited Data/Field Test	No Primer	1200 OS/Primer P	Primer P
Concrete	Field Test	No Primer	1200 OS/Primer P	Primer P
Mortar	Primer P	No Primer	Primer P	Primer P
EIFS[2]				
All Manufacturers[3]	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Stone				
Granite	No Primer	No Primer	Limited Data/Field Test	1200 OS/Primer P
Travertine	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Marble[4]	1200 OS/Primer P	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Limestone[8]	1200 OS/Primer P	Limited Data/Field Test	Limited Data/Field Test	Primer P
(Natural Stone) Sandstone[9]	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Primer P
Paints				
Acrylic Latex	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Duracron	No Primer	Limited Data/Field Test	No Primer	1200 OS/Primer P
Polyester Powder Coating[7]	Limited Data/Field Test	1200 OS	No Primer	No Primer
Polyurethane	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Polyvinyl Chloride (PVC)	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Fluoropolymer				
Kynar®	No Primer	Limited Data/Field Test	No Primer	Primer-C OS
Duranar®	No Primer	Limited Data/Field Test	No Primer	Primer-C OS
Duranar Sunstorm®	Limited Data/Field Test	Limited Data/Field Test	No Primer	Primer-C OS
Fluropon®	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Primer-C OS
Metals				
Aluminum – Chromate Conversion, Alodine®	No Primer	Limited Data/Field Test	No Primer	No Primer
Aluminum – Mill Finish	No Primer	1200 OS	1200 OS	1200 OS
Aluminum – Anodized	No Primer	1200 OS	No Primer	No Primer
Copper	Do Not Use	Do Not Use	No Primer	No Primer
Lead	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test

	Dow Corning® 756 SMS Building Sealant	*Dow Corning*® 790 Silicone Building Sealant[1]	*Dow Corning*® 791 Silicone Weatherproofing Sealant	*Dow Corning*® 795 Silicone Building Sealant
Substrate	**Surface Prep**			
Glass[6]				
Coated Glass	No Primer	1200 OS	No Primer	No Primer
Clear Glass	No Primer	No Primer	No Primer	No Primer
Steel				
Red Lead Primer	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Weathered	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Stainless	Limited Data/Field Test	Limited Data/Field Test	1200 OS	1200 OS
Galvanized	No Primer	1200 OS	No Primer	1200 OS/Primer P
Cold Rolled	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test	Limited Data/Field Test
Plastics				
PVC	Limited Data/Field Test	Limited Data/Field Test	1200 OS/Primer P	No Primer
Acrylic	Limited Data/Field Test	Do Not Use	Limited Data/Field Test	Limited Data/Field Test
Polycarbonate	Do Not Use	Do Not Use	Limited Data/Field Test	Limited Data/Field Test

Key: 1200 OS: *Dow Corning*® 1200 OS Primer; PC: *Dow Corning*® Primer-C OS; PP: *Dow Corning*® Primer P; NA: Not applicable
Dow Corning must test all materials for adhesion in structural applications.
Field adhesion tests must be performed at the jobsite to verify sealant adhesion.

[1] When using a primer with *Dow Corning*® 790 Silicone Building Sealant, apply the primer before installing backer rod and allow the primer to dry. Cold weather and porous surfaces require additional drying time.
[2] Do not apply sealant to EIFS finish coat unless approved by EIFS manufacturer.
[3] Cleaning procedures for EIFS systems should be followed.
[4] The extremely porous nature of some marble, particularly white marble, can contribute to the potential for fluid migration into this substrate. Contact a Dow Corning Specialist when working with marble.
[5] Laminated glass with polyvinyl buyvol (PVB) interlayer may delaminate up to 1/4” at the edges when in contact with a sealant.
[6] Do not use *Dow Corning*® 790 Silicone Building Sealant on copper sputter coated glass.
[7] See *Organic Solvent Usage* in the *Dow Corning Americas Technical Manual* (62-1112) for comment.
[8] Some limestone and other porous stone substrates contain iron and other impurities that can interact with *Dow Corning*® 756 SMS Building Sealant, causing discoloration of the sealant and/or substrate. Prior to use, *Dow Corning*® 756 SMS Building Sealant should be tested for compatibility with these substrates using water immersion.

This surface preparation guide is intended to aid in proper selection of surface preparation techniques and primers, if necessary, to gain adhesion that meets Dow Corning’s requirements. The suggestions in this guide are not blanket-approval recommendations; Dow Corning requires all surface prep recommendations in this guide be verified by field or shop adhesion testing and documented prior to starting the project for each substrate/sealant combination. Failure to verify and document adhesion results may result in adhesion loss that is not covered by the Dow Corning Warranty. Recommendations in this guide have been shown to be the best overall recommendations but do not cover every substrate for each material type or finish listed in this guide. Additionally, substrate manufacturers should be contacted to obtain recommendations for proper cleaning solvents for use with their materials. The entire *Weatherproofing* section of the *Dow Corning Americas Technical Manual*, Form No. 62-1112, should be read and understood before proceeding with the evaluations. The following sections within the manual must be followed to verify and document adhesion:

- *Substrate Cleaning Procedure*
- *“Two Cloth” Cleaning Method*
- *Primer Application Procedure*
- *Field Adhesion Testing Procedure*
- *Field Adhesion Hand Pull Test Criteria*
- *Field/Shop Adhesion Log and Sealant Quality Control Logs*

Structural

All structural applications must be tested by the Dow Corning test lab.

	Dow Corning® 795 Silicone Building Sealant	*Dow Corning*® 983 Structural Glazing Sealant	*Dow Corning*® 995 Silicone Structural Sealant	*Dow Corning*® 121 Structural Glazing Sealant
Substrate	**Surface Prep**			
Paints				
Acrylic Latex	Limited Data/Lab Test	Limited Data/Lab Test	Limited Data/Lab Test	Limited Data/Lab Test
Duracron	Primer-C OS	Primer-C OS	Primer-C OS	Primer-C OS
Polyester Powder Coating[1]	Primer-C OS, 1200 OS	Primer-C OS, 1200 OS	No Primer	Primer-C OS
Fluoropolymer				
Kynar®	Primer-C OS	Primer-C OS, 1200 OS	No Primer	Primer-C OS
Duranar®	Primer-C OS	Primer-C OS	Primer-C OS	Primer-C OS
Duranar Sunstorm®	Primer-C OS	Primer-C OS	Primer-C OS	Limited Data/Lab Test
Fluropon®	Primer-C OS	Primer-C OS	Primer-C OS	Limited Data/Lab Test
Metals				
Aluminum – Chromate Conversion, Alodine®	No Primer, 1200 OS	No Primer, 1200 OS	1200 OS	1200 OS
Aluminum – Anodized	No Primer	No Primer, 1200 OS	1200 OS	1200 OS
Glass – Surface to be Glazed to				
Clear	No Primer	No Primer	No Primer	No Primer
Float	No Primer	No Primer	No Primer	No Primer
Laminated[2]	No Primer	No Primer	No Primer	No Primer
Plate	No Primer	No Primer	No Primer	No Primer
Tinted	No Primer	No Primer	No Primer	No Primer
Ceramic Frit Coating	No Primer	No Primer	No Primer	No Primer
Reflective Glass	No Primer	No Primer	No Primer	No Primer
Low E High (T) Glass	No Primer	No Primer	No Primer	No Primer

Key: 1200 OS: *Dow Corning*® 1200 OS Primer; PC: *Dow Corning*® Primer-C OS; PP: *Dow Corning*® Primer P; NA: Not applicable
Dow Corning must test all materials for adhesion in structural applications.
Field adhesion tests must be performed at the shop or jobsite to verify sealant adhesion.

[1] See *Organic Solvent Usage* in the *Dow Corning Americas Technical Manual* (62-1112) for comment.
[2] Laminated glass with polyvinyl buyvol (PVB) interlayer may delaminate up to 1/4” at the edges when in contact with a sealant.

This surface preparation guide is intended to aid in proper selection of surface preparation techniques and primers, if necessary, to gain adhesion that meets Dow Corning’s requirements. The suggestions in this guide are not blanket-approval recommendations; Dow Corning requires all surface prep recommendations in this guide be verified by field or shop adhesion testing and documented prior to starting the project for each substrate/sealant combination. Failure to verify and document adhesion results may result in adhesion loss that is not covered by the Dow Corning Warranty. Recommendations in this guide have been shown to be the best overall recommendations but do not cover every substrate for each material type or finish listed in this guide. Additionally, substrate manufacturers should be contacted to obtain recommendations for proper cleaning solvents for use with their materials. The entire *Weatherproofing* section of the *Dow Corning Americas Technical Manual*, Form No. 62-1112, should be read and understood before proceeding with the evaluations. The following sections within the manual must be followed to verify and document adhesion:

- *Substrate Cleaning Procedure*
- *“Two Cloth” Cleaning Method*
- *Primer Application Procedure*

LIMITED WARRANTY INFORMATION – PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that our products are safe, effective and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

Dow Corning's sole warranty is that our products will meet the sales specifications in effect at the time of shipment.

Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted.

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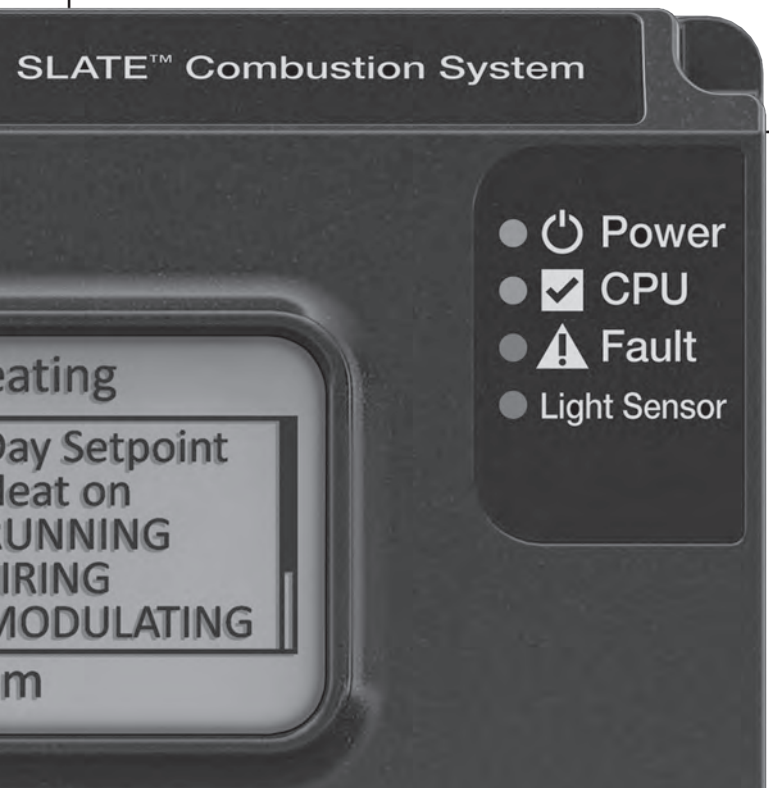
Honeywell

SLATE™

Base Module

R8001A1001

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001A1001 base module provides communications and power supply for the SLATE system, configurable safety for Burner Control, Flame Amps, Fuel Air Ratio, and Limit modules, and programmable logic for Digital and Analog I/O, and Annunciation. SLATE is a combustion system with configurable safety and programmable logic. The system is modular in format and DIN rail mountable. Modules include:

- Base
- Burner Control Module
- Flame Amp Modules
- Fuel Air Ratio Control Module
- Limit Module
- Analog I/O Module
- Digital I/O Module
- Annunciator Module

Features

Within the SLATE system, the base module provides:

- Power to all modules with multiple voltage options
- External communication protocols Modbus/TCP, BACnet MSTP or IP, and web services
- Overall health of the system
- The ability to do remote troubleshooting
- Network identification of the system as a single device
- Web-based pages (both Honeywell provided and designer customized) for Web browser access to the system
- Module identification for the system
- Event log storage for user lockouts, fault history, and user requested events
- Trend logging for user specified data

Specifications

Electrical Ratings:

Input Voltage and Frequency:
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85-264 VAC, 50/60 Hz

Output Voltage:
18 VDC (± 1 VDC)

Power Dissipation:
38W max @ 24V (approx. 12 modules),
45W max @ 85-264V (approx. 14 modules)

Fusing Total Connected Modules: 5A, slow type, non-replaceable

Terminal Ratings: See Table 1.

Terminal	Description	Rating
E100-1	L1 - line voltage hot	---
E100-2	L2 - line voltage common	---
E100-3	PE - Earth Ground	---

Terminal	Description	Rating
E200-1	Alarm (dry contacts)	120 / 240 VAC, 1A pilot duty
E200-2	Alarm (dry contacts)	120 / 240 VAC, 1A pilot duty
E200-3	Unused	---
E200-4	A (BACnet MS/TP)	---
E200-5	B (BACnet MS/TP)	---
E200-6	GND (BACnet MS/TP)	---
E200-7	VAUX +	3.3-24 VDC output, 250mA max
E200-8	VAUX - [a]	3.3-24 VDC output, 250mA max

[a] Do not connect to earth ground.

Table 1. Terminal Ratings.

Environmental Ratings

Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
LCD Operating: 32°F to +150°F (0°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C)

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1

Weight: 2 lb 1 oz (0.94 Kg)

Approvals:

Underwriters Laboratories Inc. Listed, File: MP268.
IRI acceptable.
Federal Communications Commission: Part 15, Class A Emissions.
Must be mounted inside a grounded metal enclosure.

Mounting: DIN Rail (See Fig. 4)

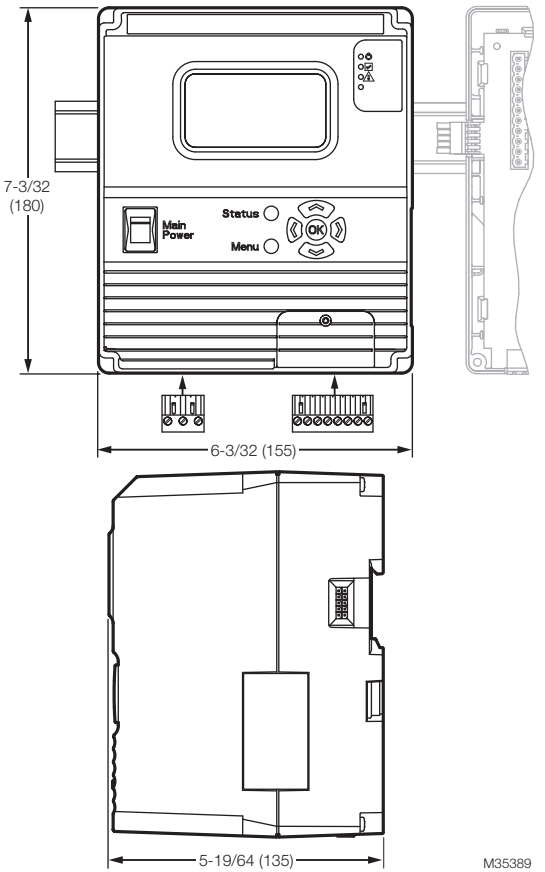


Fig. 1. Dimensions in in. (mm).

Principal Technical Features

The R8001A1001 base module provides communications and power supply for the SLATE system, configurable safety for Burner Control, Flame Amps, Fuel Air Ratio, and Limit modules, and programmable logic for Digital and Analog I/O, and Annunciation.

Communications

The base module provides communications via Modbus IP RS485, BACNet IP/MSTP (RS-485), and Web Services.

User Interface

The menu-driven user interface provides system status and alerts via a dot matrix display on the front of the module. It is controlled by a 7-button keypad.

LED Array

There are three LEDs on the front of the base module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s).

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	Running

Table 2. LED Descriptions.

LCD Screen

The base module LCD screen will show information about various modules and other parts of the combustion system. Use the arrow keys to navigate the items on the LCD screen, then press OK to select one.

In Fig. 2, Burner6 is in Lockout. For additional information, navigate to that menu item and press OK.

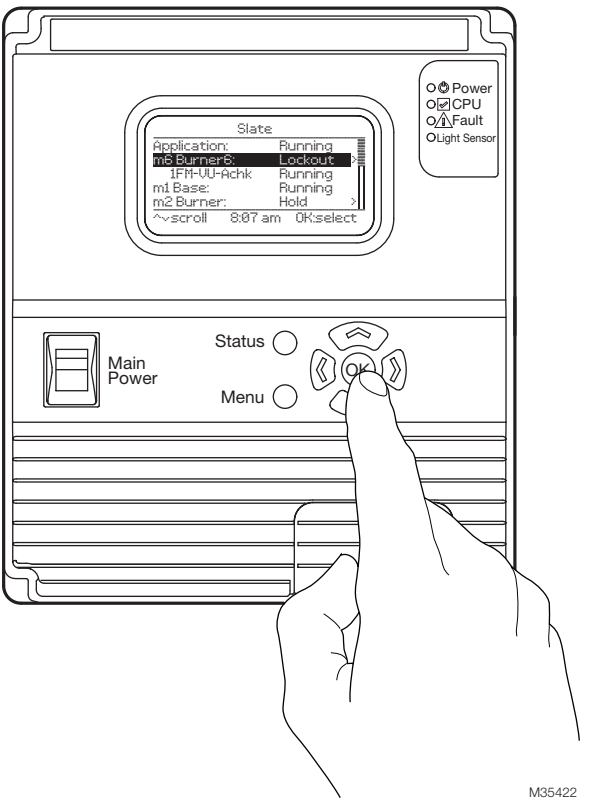


Fig. 2. LCD display showing a fault (Burner6 is in Lockout).

Additional information, as shown in Fig. 3, is displayed. Use this information to troubleshoot the combustion system.

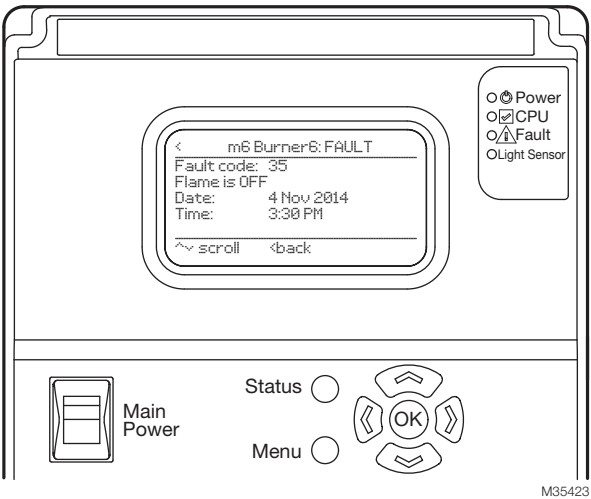


Fig. 3. Additional lockout information.

Light Sensor

SLATE contains a light sensor that is used when the system is exposed to light. This is a power saving feature.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.

Wiring

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death, or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

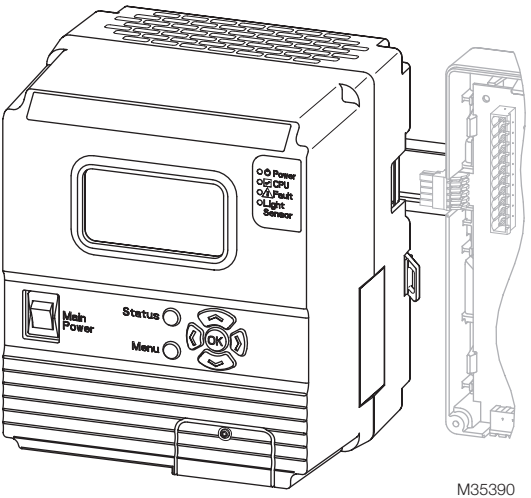


Fig. 4. Installing the Base Module on DIN Rail.

2. Wiring must comply with all applicable codes, ordinances and regulations. See Table 1, Table 3, and “Recommended Grounding Practices” on page 13 for connections and terminals. For DIP switch settings, see “DIP Switches” on page 15.

Note: MS/TP must be wired in a straight line without spurs—no star wiring.

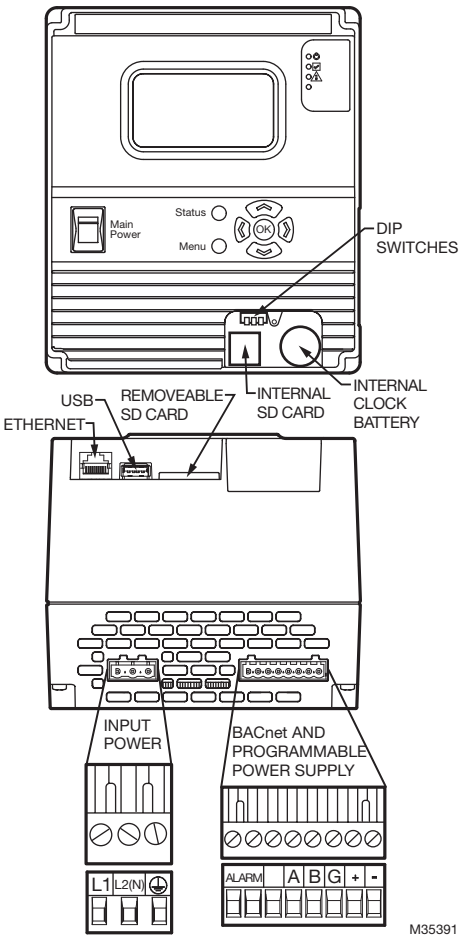


Fig. 5. Base Module inputs and terminals.

3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.
4. The R8001A1001 should not interfere with the proper safety operation of the controls, limits, and interlocks it is monitoring. After installation, check each control, limit, and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS, AND INTERLOCKS.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16, or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Communication lines[a]	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

[a] BACnet MS/TP connections must be wired in daisy chain configuration, 1(a)-1(a), 2(b)-2(b), 3(c)-3(c). The order of interconnection of all the devices is not important. Be aware that the termination DIP switch (number 3) must be used if the SLATE system is at the end of connections over 100 feet.

Table 3. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended wire routing of leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.
- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 1.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interference Regulations of the Canadian Department of Communications.*
3. *For straight gas burner applications, the oil limit and interlock inputs DO NOT need to be jumpered.*
4. *For straight oil burner applications, the gas limit and interlock inputs DO NOT need to be jumpered.*
5. *For combination gas-oil burner applications, a double pole, double throw (dpdt) fuel select switch is required.*
6. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

DIP Switches

The SLATE Base Module has three DIP switches. DIP switches 1 and 2 should be On only if no other MS/TP device providing bias resistors is connected.

DIP switch 3 should be On only if SLATE is the last device in the communication chain.



32-00005-01

For more information and detailed instructions on the SLATE display please refer to the SLATE User Guide document located on our website at http://combustion.honeywell.com/SLATE

Honeywell

Automation and Control Solutions

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Honeywell

SLATE™

Fuel Air Ratio Module

R8001C6001

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001C6001 Fuel Air Ratio module uses the latest technology to control up to 4 SLATE actuators and/or 2 Variable Frequency Drives. The Fuel Air Ratio Control module controls the relationship between fuel, airflow and flue gas recirculation on a power burner.

Features

Within the SLATE system, the fuel air ratio module provides:

- Air-fuel ratio control for up to 4 actuators
- Drive 2 Variable Frequency Drives (VFDs)
- RS-485 Modbus communications to communicate to the actuators and receive feedback
- SLATE actuator torque sizes:
  - 50 in/lb (NEMA 1 and NEMA 4)
  - 150 in/lb (NEMA 1 and NEMA 4)
  - 300 in/lb (NEMA 4)
  - 900 in/lb (NEMA 4)
- Up to 24 points
- Field configurable
- Automated actuator endpoint seeking process
- UL Recognized and NFPA acceptable
- Password protected
- Fault information
- Status of four actuator channels
- Unused VFD terminals (Analog Cells) available for general purpose I/O configuration
- Flue Gas Recirculation (FGR)
- Trim
- Dual Fuel

Safety Features

- Class C operating software system
- Fail-safe feedback
- Curve verification algorithms
- Password protected
- Built in self test
- No slope constraints that would limit the steepness of the curve
- Component anti-swap protection
- Off curve checking algorithm

Specifications

Electrical Ratings
Voltage and Frequency: See Tables 1–5.

Environmental Ratings:
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
Factory Mutual
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting: DIN Rail (See Fig. 2)

Required Components
R8001A1001 SLATE Base Module
R8001S9001 Sub-Base Module

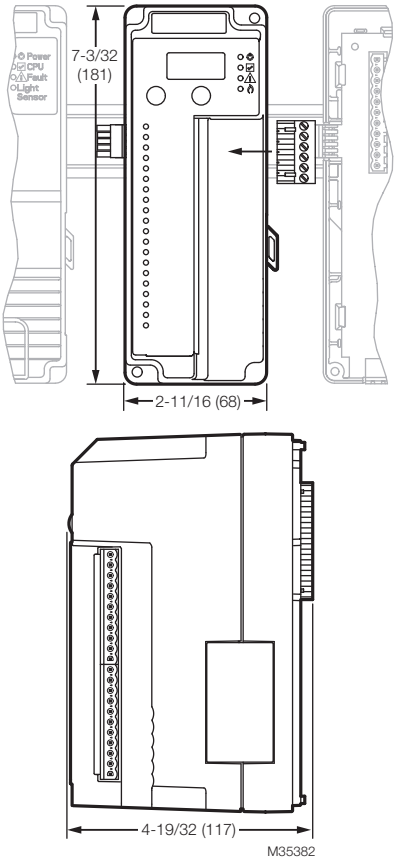


Fig. 1. Dimensions in in. (mm).

Principal Technical Features

The R8001C6001 fuel air ratio module monitors and controls the air-fuel ratio for combustion applications.

LED Array

There are three LEDs on the front of the Fuel Air Ratio module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No Wiresheet (SLATE) loaded
	Green	Running
Fault	Red	Fault
	No light	No fault

Table 1. LED Descriptions.

LED Display

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. They also have three-position LED colors to indicate terminal states as shown in Table 2.

Color	Description
Green	Terminal is on or normal
Red	Fault
No light	Off, not in use, or in power-saving mode

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

Wiring

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

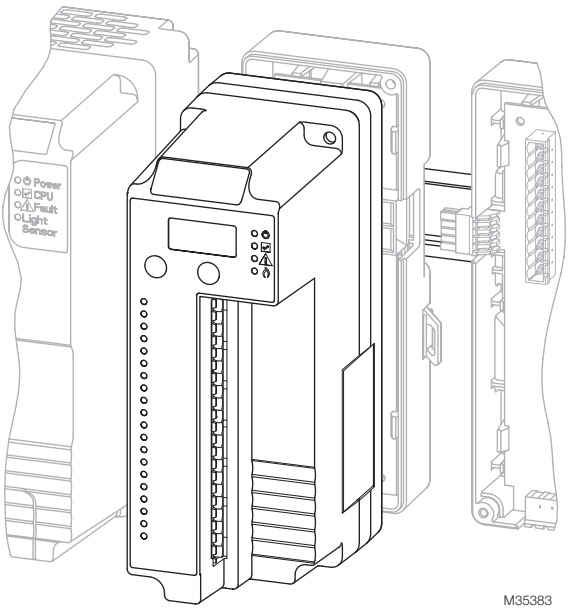


Fig. 2. Installing the Fuel Air Ratio Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.
3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause* interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interference Regulations of the Canadian Department of Communications.*
3. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

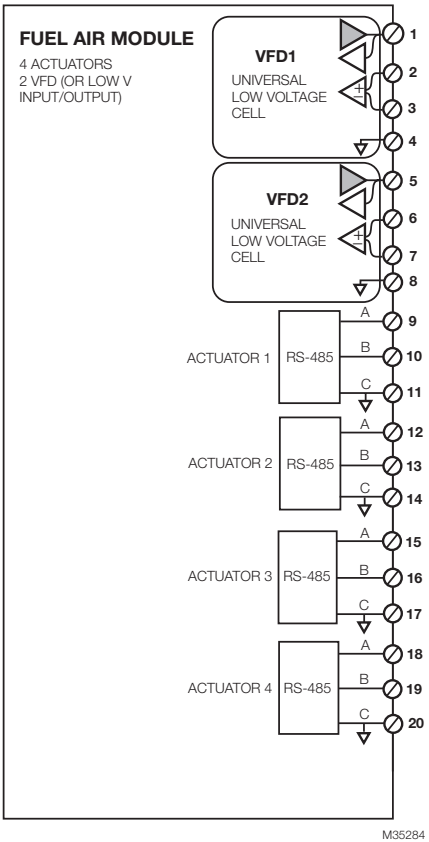


Fig. 3. Wiring diagram for Fuel Air Ratio Module.

Terminal	Description	Rating
1	VFD1 - Cell A (TF1)	See Tables 2-5 for configuration options
2	VFD1 - Cell A (TF2)	See Tables 2-5 for configuration options

Terminal	Description	Rating
3	VFD1 - Cell A (TF3)	See Tables 2-5 for configuration options
4	VFD1 - Cell A (TF4)	See Tables 2-5 for configuration options
5	VFD2 - Cell B (TF1)	See Tables 2-5 for configuration options
6	VFD2 - Cell B (TF2)	See Tables 2-5 for configuration options
7	VFD2 - Cell B (TF3)	See Tables 2-5 for configuration options
8	VFD2 - Cell B (TF4)	See Tables 2-5 for configuration options
9	A1 - A (RS485)	---
10	A1 - B (RS485)	---
11	A1 - C (GND)	---
12	A2 - A (RS485)	---
13	A2 - B (RS485)	---
14	A2 - C (GND)	---
15	A3 - A (RS485)	---
16	A3 - B (RS485)	---
17	A3 - C (GND)	---
18	A4 - A (RS485)	---
19	A4 - B (RS485)	---
20	A4 - C (GND)	---
21	Unused	---
22	Unused	---

Table 3. Terminal Ratings.

Terminal Functions				Min	Typical	Max	Units	
TF1	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out	Range	0.0	-	15.0	VDC	
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50	-	50	uA DC	4 to 20 mA
TF2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
TF3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA

[a] TF1 input terminal is held at constant 2.5VDC over allowable current range.

[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.

Table 4. Specifications for Basic Cell Functions.

Specifications based on worst case over ambient temperatures.

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
TF2 & TF3	Type J	Range	-200.0		1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
TF3 & TF4	Type PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
TF3 & TF4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C

[a] Shielded cable required for reliable operation in noisy environment.
[b] NTC on terminal TF4 is rated down to 0 °C.
[c] Temperatures refer to sense range.

Table 5. Specifications Cell Complex Functions.

	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
TF1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	Allowable output %DC
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Range		2.0	-	1000.0	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1.0	-	Hz	
	Accuracy		-5.0	-	0.0	%	Whichever is greater
			-1.0	-	0.0	Hz	
	PWM In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Frequency		125.0	-	500.0	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution			-	1.0	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

Table 6. Specifications for Cell Frequency Functions.

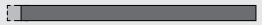
Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Table 7. Suggested Sensor Selection Based on Application.

Application	Recommended Wire Size	Recommended Part Numbers
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 8. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground

path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended wire routing of leadwires

Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 3.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

Maximum wire length:

- The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)
- For Remote Bus data lines, maximum cable length depends on the number of modules connected, the noise conditions and the cable used. The maximum of all interconnecting wires is 4000 feet.



32-00006-03

For more information and detailed instructions on the R8001C6001 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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Honeywell

SLATE™

Limit Control Module

R8001L8001

INSTALLATION INSTRUCTIONS





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Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001L8001 SLATE Limit Control Module is part of the SLATE Combustions System. The SLATE Limit Control Module provides the ability to bring in any type of analog signal and create limits on either pressure or temperature without needing a UDC Controller.

Features

- 12 limit blocks with each block monitoring any sensor or pair of sensors
- One limit module for multiple burner controls
- 4 sensors available for Limit Block use (2 sets of redundant safety inputs)
- Unused Analog Cells available for general purpose I/O configuration
- Redundant limit relay output

Specifications

Electrical Ratings:
See Table 3–Table 7.

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1

Weight: 2 lb 1 oz (0.94 Kg)

Approvals

Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting

DIN Rail (See Fig. 2)

Required Components

R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module
R8001B2001 SLATE Burner Control Module

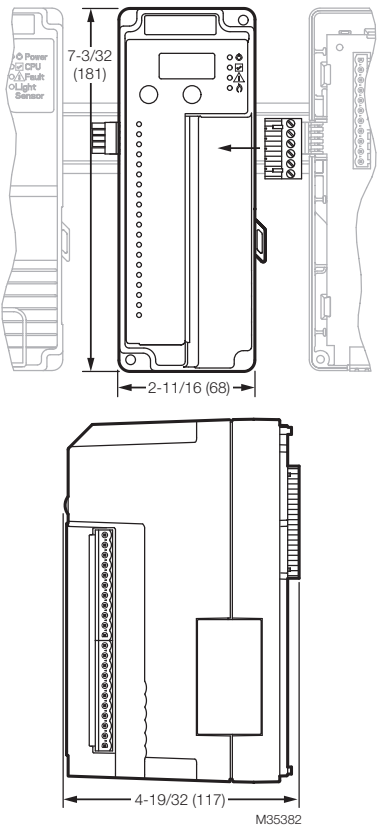


Fig. 1. Dimensions in in. (mm).

LED Array

There are three LEDs on the front of the Limit Control Module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	No fault

Table 1. LED Descriptions.

LED Displays

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. They also have three-position LED colors to indicate terminal states as shown in Table 2.

Color	Description
Green	Terminal is on or normal
Red	Fault
No light	Off, not in use, or in power-saving mode

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

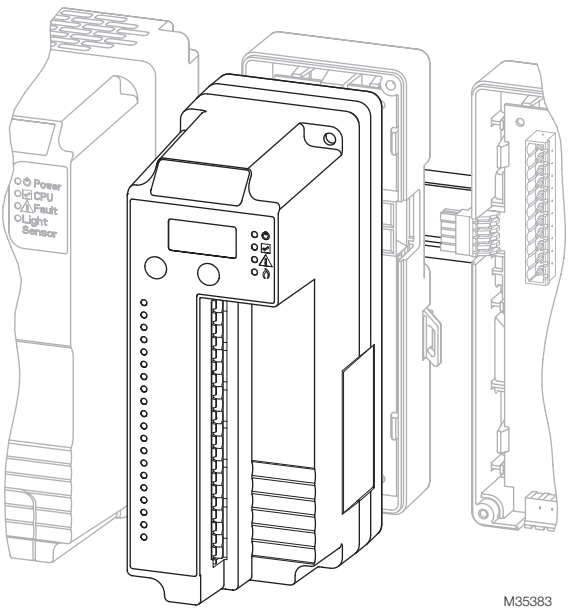


Fig. 2. Installing the Limit Control Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.

3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interfeence Regulations of the Canadian Department of Communications.*
3. *For combination gas-oil burner applications, a double pole, double throw (dpdt) fuel select switch is required.*
4. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

Wiring

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death, or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

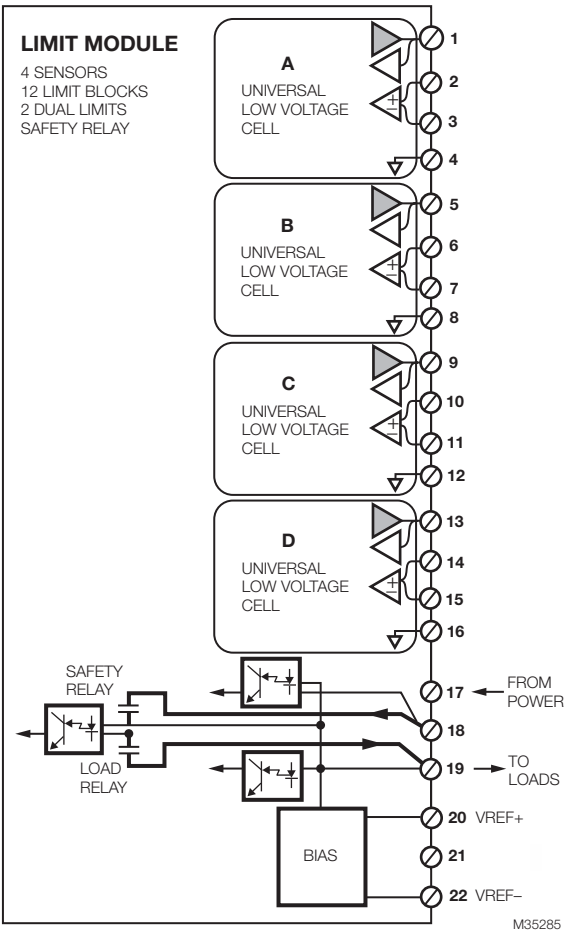


Fig. 3. Wiring diagram for Limit Control Module.

Terminal	Description	Rating
1	Cell A (TF1)	See Table 4–7 for configuration options
2	Cell A (TF2)	See Table 4–7 for configuration options
3	Cell A (TF3)	See Table 4–7 for configuration options
4	Cell A (FT4)	See Table 4–7 for configuration options
5	Cell B (TF1)	See Table 4–7 for configuration options
6	Cell B (TF2)	See Table 4–7 for configuration options
7	Cell B (TF3)	See Table 4–7 for configuration options
8	Cell B (TF4)	See Table 4–7 for configuration options
9	Cell C (TF1)	See Table 4–7 for configuration options
10	Cell C (TF2)	See Table 4–7 for configuration options
11	Cell C (TF3)	See Table 4–7 for configuration options
12	Cell C (TF4)	See Table 4–7 for configuration options
13	Cell D (TF1)	See Table 4–7 for configuration options
14	Cell D (TF2)	See Table 4–7 for configuration options
15	Cell D (TF3)	See Table 4–7 for configuration options
16	Cell D (TF4)	See Table 4–7 for configuration options
17	Unused	---
18	Safety Relay (dry contacts)	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
19	Safety Relay (dry contacts)	(see Terminal 18 above)
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85-264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Terminal 20 above)

Table 3. Terminal Ratings.

Note: only one configuration option per cell is allowed for cells configured as a Limit Block.

Terminal Functions				Min	Typical	Max	Units	
TF1	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out	Range	0.0	-	15.0	VDC	
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50.0	-	50.0	uA DC	4 to 20 mA
TF2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
TF3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5		1.5	%	0 to 25 mA

[a] TF1 input terminal is held at constant 2.5VDC over allowable current range.

[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.

Table 4. Specifications for Basic Cell Functions.

Specifications based on worst case over ambient temperatures.

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
TF2 & TF3	Type J	Range	-200.0		1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
TF3 & TF4	Type PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
TF3 & TF4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C

[a] Shielded cable required for reliable operation in noisy environment.
[b] NTC on terminal TF4 is rated down to 0 °C.
[c] Temperatures refer to sense range.

Table 5. Specifications Cell Complex Functions.

	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
TF1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	Allowable output %DC
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Range		2.0	-	1000.0	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1.0	-	Hz	
	Accuracy		-5.0	-	0.0	%	Whichever is greater
			-1.0	-	0.0	Hz	
	PWM In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Frequency		125.0	-	500.0	Hz	
	Min. “on” pulse width (low %DC)		-	50	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution			-	1.0	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

Table 6. Specifications for Cell Frequency Functions.

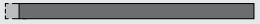
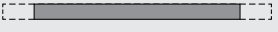
Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Table 7. Suggested Sensor Selection based on Application.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 8. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.

3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 2.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock).



32-00007-03

For more information and detailed instructions on the R8001L8001 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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SLATE™

Digital I/O Module

R8001D4001

INSTALLATION INSTRUCTIONS





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Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001D4001 SLATE Digital I/O module is part of the SLATE Combustion System. The SLATE Digital I/O module offers a universal 14 opto inputs or 6 relays for a wide variety of applications needing additional logic.

Features

- Automatically adapts to 24VDC or 24VAC to 240VAC (one voltage per module)
- Configurable input or relay output format
  - Up to 14 opto inputs
  - Up to 6 relay outputs

Specifications

Electrical Ratings:
Input Voltage and Frequency:
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85-264 VAC, 50/60 Hz
Maximum Total Connected Load: 2000 VA
Fusing Total Connected Load: 15A Fast Blow, type SC or equivalent

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 2)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

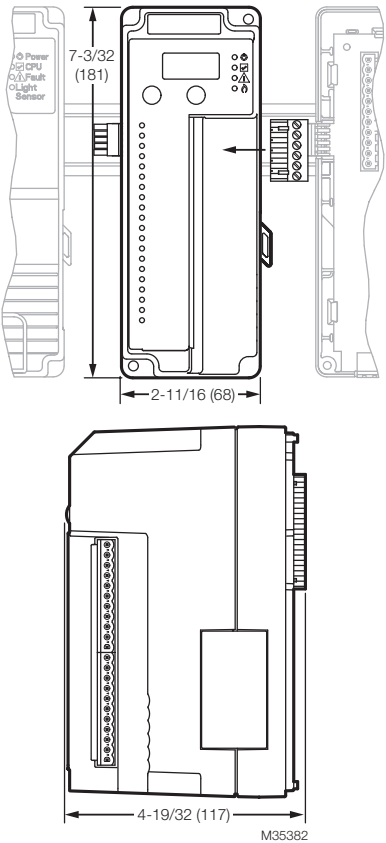


Fig. 1. Mounting dimensions of Digital I/O Module in in. (mm).

Principal Technical Features

The SLATE Digital I/O module offers a universal 14 opto inputs or 6 relays for a wide variety of applications needing additional logic.

LED Array

There are four LEDs on the front of the digital I/O module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s). There are also nine banks of LEDs for the digital terminals. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	Running

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating the module number of the SLATE system. The LED colors indicate the terminal state as shown in Table 2.

Color	Description
Green	Terminal is on
Red	Fault
No light	Not in use

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have a Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

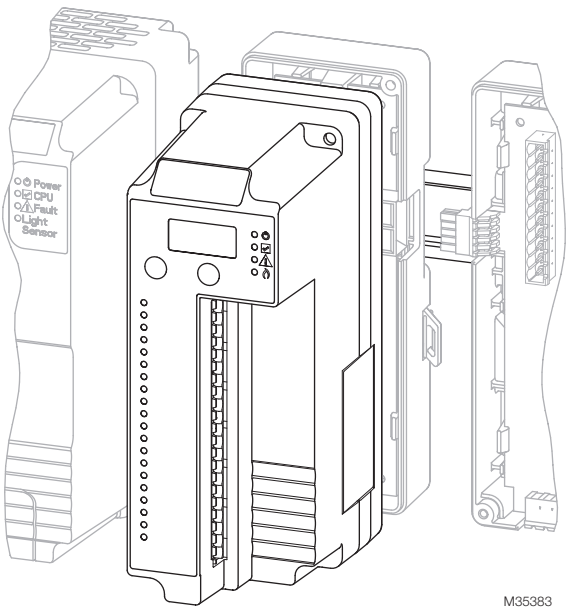


Fig. 2. Installing the Limit Control Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.

3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interference Regulations of the Canadian Department of Communications.*

Wiring

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death, or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

Terminal	Description	Rating
1	Unused	---
2	Unused	---
3	Unused	---
4	K1 Relay Dry Contacts	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC

Terminal	Description	Rating
5	K1 Relay Dry Contacts	(see Terminal 4 above)
6	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
7	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
8	K2 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
9	K2 Relay Dry Contacts or Input	(see Terminal 8 above)
10	K3 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
11	K3 Relay Dry Contacts or Input	(see Terminal 10 above)
12	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
13	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
14	K4 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
15	K4 Relay Dry Contacts or Input	(see Terminal 14 above)
16	K5 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)

Terminal	Description	Rating
17	K5 Relay Dry Contacts or Input	(see Terminal 16 above)
18	K6 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
19	K6 Relay Dry Contacts or Input	(see Terminal 18 above)
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85–264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Terminal 20 above)

Note: only one voltage can be used per module (same at all terminals).

Table 3. Terminal Ratings.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 4. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended wire routing of leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.
- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 3.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

Maximum wire length:

- The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)
- For remote reset leadwires, maximum length to remote pushbutton is 1000 feet.
- For Remote Bus data lines, maximum cable length depends on the number of modules connected, the noise conditions and the cable used. The maximum of all interconnecting wires is 4000 feet.

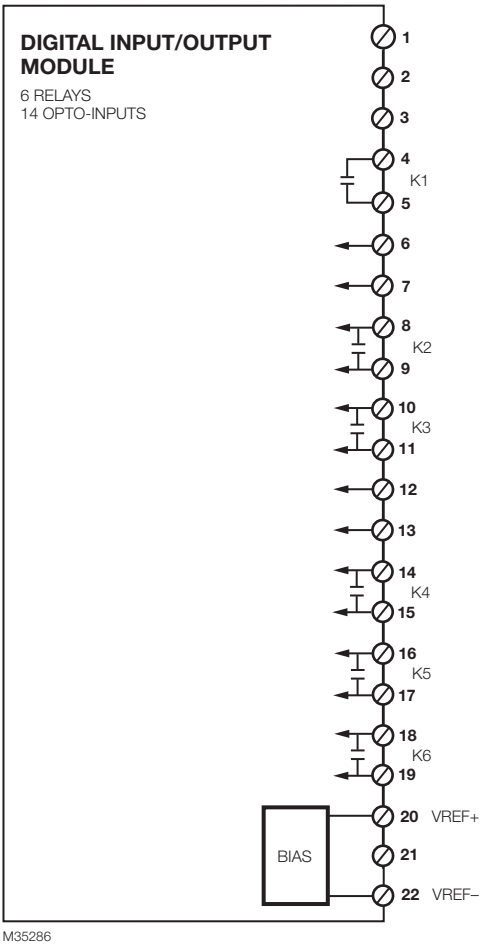


Fig. 3. Wiring diagram for limit control module.



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For more information and detailed instructions on the R8001D4001 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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SLATE™

Analog I/O Module

R8001U3001

INSTALLATION INSTRUCTIONS





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Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001U3001 SLATE Analog I/O module provides analog input and output capability for all combustion applications.

Features

- 4 analog cells per module
- Multiple combination of analog functionality for each cell
- Supported sensors include voltage, current, PWM, tach, RTD, NTC, and thermocouple

Specifications

Electrical Ratings:
See Table 3–Table 7

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: Refer to Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 2)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

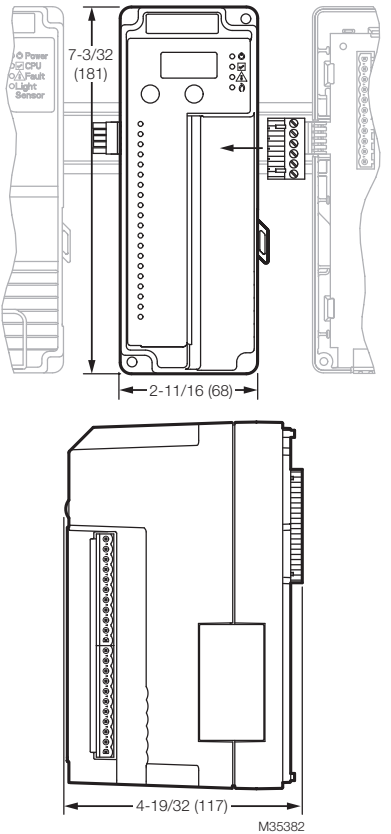


Fig. 1. Mounting dimensions of analog I/O module in in. (mm).

Principal Technical Features

The R8001U3001 analog I/O module provides analog input and output capability for all combustion applications.

LED Array

There are three LEDs on the front of the analog I/O module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s). There are also four banks of LEDs for the analog cells. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	No fault

Table 1. LED Descriptions.

LED Displays

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. They also have three-position LED colors to indicate terminal states as shown in Table 2.

Color	Description
Green	Terminal is on or normal
Red	Fault
No light	Off, not in use, or in power-saving mode

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

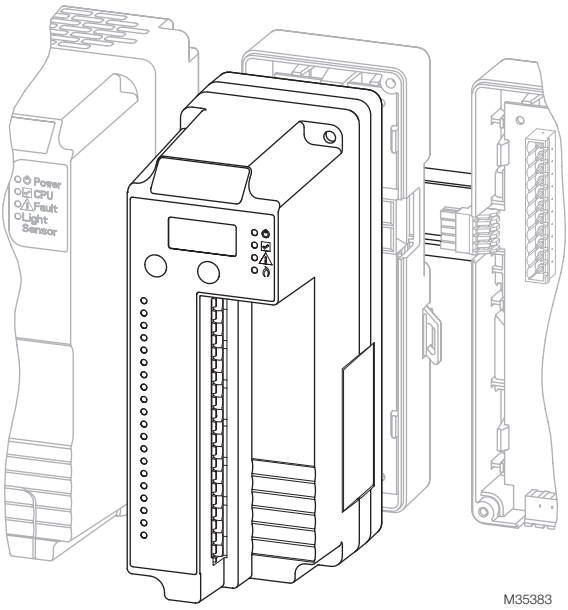


Fig. 2. Installing the Analog I/O Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.

3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

IMPORTANT

1. *This equipment generates, uses and can radiate radiofrequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*

2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interfeence Regulations of the Canadian Department of Communications.*
3. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

Wiring

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death, or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

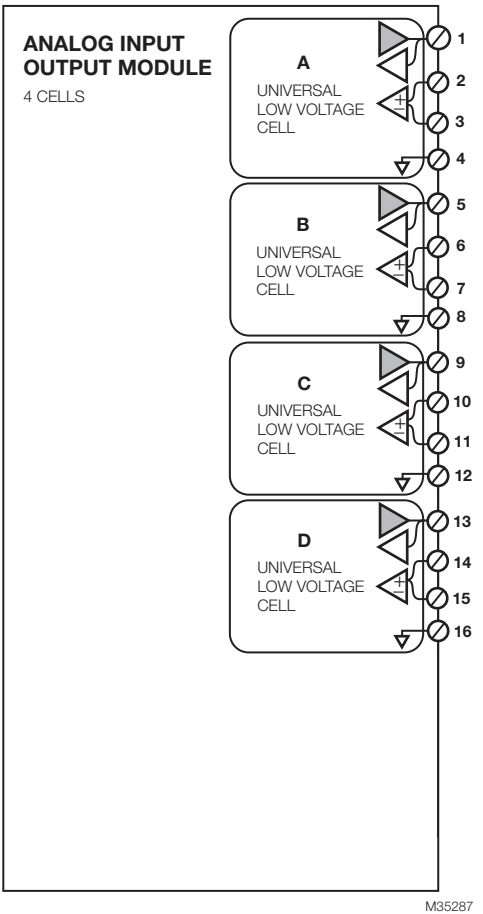


Fig. 3. Wiring diagram for Analog I/O Module.

Terminal	Description	Rating
1	Cell A (TF1)	See Tables Table 4-Table 7 for configuration options
2	Cell A (TF2)	See Tables Table 4-Table 7 for configuration options
3	Cell A (TF3)	See Tables Table 4-Table 7 for configuration options
4	Cell A (TF4)	See Tables Table 4-Table 7 for configuration options
5	Cell B (TF1)	See Tables Table 4-Table 7 for configuration options
6	Cell B (TF2)	See Tables Table 4-Table 7 for configuration options
7	Cell B (TF3)	See Tables Table 4-Table 7 for configuration options
8	Cell B (TF4)	See Tables Table 4-Table 7 for configuration options
9	Cell C (TF1)	See Tables Table 4-Table 7 for configuration options
10	Cell C (TF2)	See Tables Table 4-Table 7 for configuration options
11	Cell C (TF3)	See Tables Table 4-Table 7 for configuration options
12	Cell C (TF4)	See Tables Table 4-Table 7 for configuration options
13	Cell D (TF1)	See Tables Table 4-Table 7 for configuration options
14	Cell D (TF2)	See Tables Table 4-Table 7 for configuration options
15	Cell D (TF3)	See Tables Table 4-Table 7 for configuration options
16	Cell D (TF4)	See Tables Table 4-Table 7 for configuration options
17	Unused	---
18	Unused	---
19	Unused	---
20	Unused	---
21	Unused	---
22	Unused	---

Table 3. Terminal Ratings.

Specifications based on worst case over ambient temperatures.

Terminal Functions				Min	Typical	Max	Units	
TF1	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out	Range	0.0	-	15.0	VDC	
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50.0	-	50.0	uA DC	4 to 20 mA
TF2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
TF3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA

[a] TF1 input terminal is held at constant 2.5VDC over allowable current range.

[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.

Table 4. Specifications for Basic Cell Functions.

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
TF2 & TF3	Type J	Range	-200.0	-	1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
TF3 & TF4	PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
TF3 & TF4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C

[a] Shielded cable required for reliable operation in noisy environment.
[b] NTC on terminal TF4 is rated down to 0 °C.
[c] Temperatures refer to sense range.

Table 5. Specifications Cell Complex Functions.

	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
TF1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	Allowable output %DC
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Range		2	-	1000	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1	-	Hz	
	Accuracy		-5.0	-	0	%	Whichever is greater
			-1	-	0	Hz	
	PWM In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Frequency		125	-	500	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution		-	1.0	-	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

Table 6. Specifications for Cell Frequency Functions.

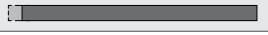
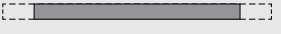
Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Table 7. Suggested Sensor Selection Based on Application.

Application	Recommended Wire Size	Recommended Part Numbers
Analog Cell terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 8. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 3.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)



32-00009-01

For more information on the R8001U3001 and the entire SLATE system please refer to the SLATE User Guide document located on our website at http://combustion.honeywell.com/SLATE

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SLATE™

Burner Control Module

R8001B2001

INSTALLATION INSTRUCTIONS





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Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001B2001 Burner Control module provides flame safeguard controls for a variety of applications within the SLATE system. It can be configured as a primary or programmer, semi-automatic or fully automatic.

Features

- Provides 24 VDC or 24 to 240 VAC flame safeguard
- Valve proving
- Parameters and behaviors that allow emulation of 7800 and SOLA Series flame safeguards
- Dual fuels capability
- Configurable safety
- Safety relay

Specifications

Electrical Ratings:
Voltage and Frequency:
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85-264 VAC, 50/60 Hz
Maximum Total Connected Load: 2000 VA
Fusing Total Connected Load: 15A Fast Blow, type SC or equivalent

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 2)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

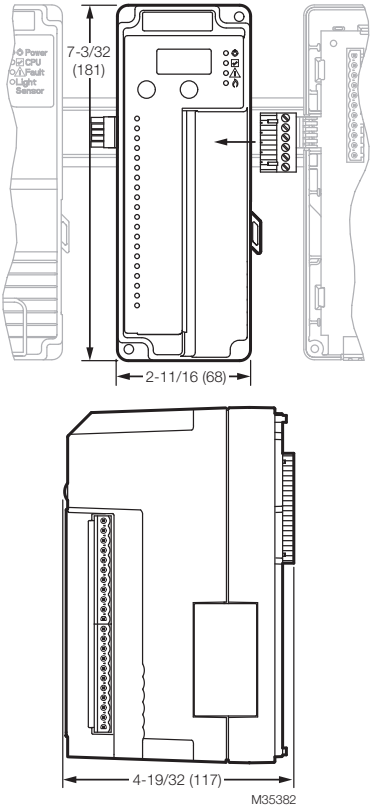


Fig. 1. Dimensions in in. (mm).

Principal Technical Features

The R8001B2001 SLATE Burner Control module provides the SLATE combustion system with flame safeguard capability.

LED Array

There are four LEDs on the front of the burner control module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s). See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	No fault
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Displays

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. They also have three-position LED colors to indicate terminal states as shown in Table 2.

Color	Description
Green	Terminal is on or normal
Red	Fault
No light	Off, not in use, or in power-saving mode

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE Burner Control have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

There are also 22 LEDs for each of the burner control module terminals.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

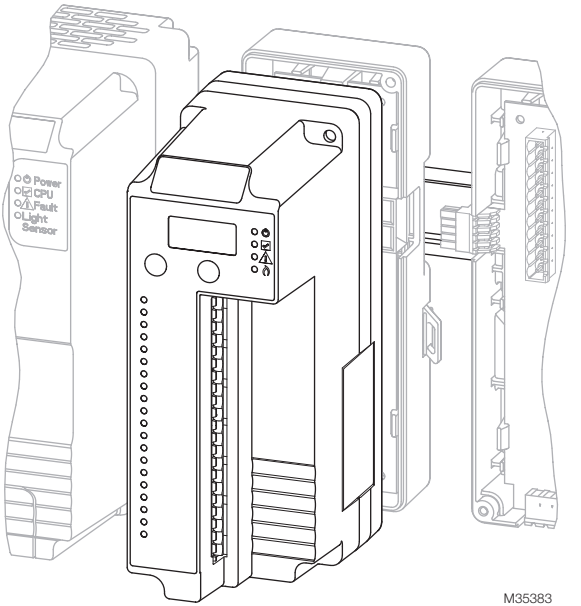


Fig. 2. Installing the Burner Control Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.
3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.
4. The R8001B2001 should not interfere with the proper safety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interfeence Regulations of the Canadian Department of Communications.*
3. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

Wiring

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

Terminal	Description	Rating
1	Unused (reserved for future use)	---
2	Unused (reserved for future use)	---
3	Unused	---
4	K1 Relay Dry Contacts (Burner / Fan Motor)	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC

Terminal	Description	Rating
5	K1 Relay Dry Contacts	(see above)
6	Pilot Valve Hold (PVH)	24VDC (0.5mA), 24-240VAC (0.2mA)
7	Manual Open Switch (MOS)	24VDC (0.5mA), 24-240VAC (0.2mA)
8	Purge Position Proven (PPP)	24VDC (0.5mA), 24-240VAC (0.2mA)
9	Main Valve 2 (MV2)	120VAC (see Table 2), 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
10	Lightoff Position Proven (LPP)	24VDC (0.5mA), 24-240VAC (0.2mA)
11	Main Valve 1 (MV1)	120VAC (see Table 2), 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
12	Limit and Control Input (LCI) / Fuel (F) 2	24VDC (0.5mA), 24-240VAC (0.2mA)
13	Limit and Control Input (LCI) / Fuel (F) 1	24VDC (0.5mA), 24-240VAC (0.2mA)
14	Pre-Ignition Interlocks (PII)	24VDC (0.5mA), 24-240VAC (0.2mA)
15	Pilot Valve (PV)	120VAC (see Table 2), 4A (0.5 PF), 20A inrush @ 240VAC, 1A cont, 5A inrush @ 24VDC
16	Interrupted Air Switch (IAS)	24VDC (0.5mA), 24-240VAC (0.2mA)
17	Ignition (IGN)	120VAC (see Table 2), 4A (0.2 PF) @ 240VAC, 1A cont, 5A inrush @ 24VDC
18	Valve Proving Switch (VPS)	24VDC (0.5mA), 24-240VAC (0.2mA)

Terminal	Description	Rating
19	Lockout Interlocks (ILK)	24VDC (0.5mA), 24-240VAC (0.2mA)
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85-264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Vref+ above)

Note: only one voltage can be used per module (same at all terminals).

Table 3. Terminal Ratings.

Combination	Pilot Valve	Ignition	MV1 & MV2
1	C	no load	E
2	B	no load	E
3	E	A	E
4	D	A	E
5	D	A	D

Load Table Key	
A	4.5 A Ignition
B	4.5 A plus 50 VA Pilot Duty
C	180 VA Ign plus motor valves with: 660 VA inrush, 360 VA open, 250 VA hold
D	2 A Pilot Duty
E	65 VA Pilot Duty plus motor valves with: 3850 VA inrush, 700 VA open, 250 VA hold

Table 4. Combinations for PV, IGN, MV1 & MV2 Terminals.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 5. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended wire routing of leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.
- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 3.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

Maximum wire length:

- The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)
- For remote reset leadwires, maximum length to remote pushbutton is 1000 feet.
- For Remote Bus data lines, maximum cable length depends on the number of modules connected, the noise conditions and the cable used. The maximum of all interconnecting wires is 4000 feet.

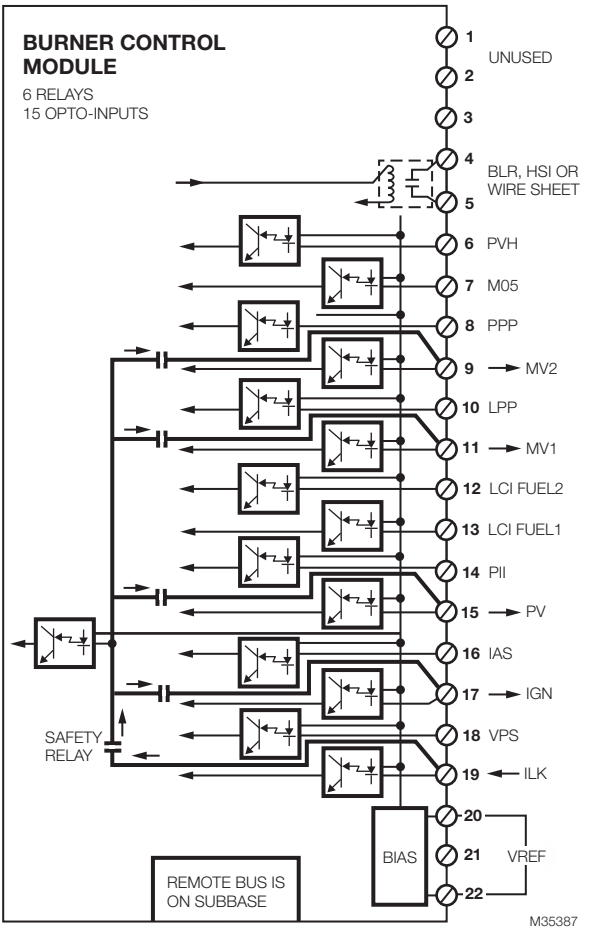


Fig. 3. Wiring diagram for Burner Control Module.



For more information on the R8001B2001 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://www.combustion.honeywell.com/SLATE

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Automation and Control Solutions

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Honeywell

SLATE™

Annunciator Module

R8001N7001

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001N7001 SLATE Annunciator Module is designed to monitor the status of a series string of limit, control, and interlock contacts for a commercial or industrial burner within the SLATE system. The R8001N7001 Annunciator Module acts as a system monitor and enhances fault and status messages of the R8001B2001 SLATE Burner Control Module.

Features

- 14 opto inputs
- Provides status of multiple inputs that are connected as a string of interlocks for diagnostic and monitoring purposes
- 1 relay output
- Automatically adapts to 24 VDC or 24 VAC to 240 VAC (one voltage per module)

Specifications

Electrical Ratings:
Voltage and Frequency:
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz
Maximum Total Connected Load: 2000 VA
Fusing Total Connected Load: 15A Fast Blow, type SC or equivalent

Environmental Ratings:
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 2)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module
R8001B2001 SLATE Burner Control Module

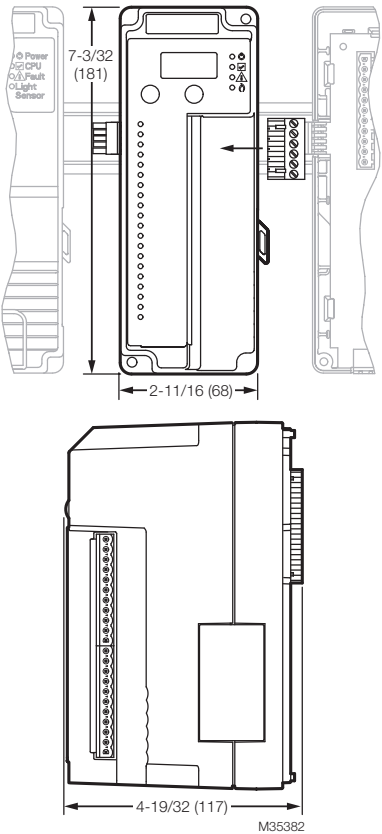


Fig. 1. Dimensions in in. (mm).

Principal Technical Features

The R8001N7001 Annunciator Module is designed to monitor the status of a series string of limit, control, and interlock contacts for a commercial or industrial burner within the SLATE system. The R8001N7001 acts as a system monitor and enhances fault and status messages of the R8001B2001 burner control module.

LED Array

There are four LEDs on the front of the burner control module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s). There are also 18 LEDs for each of the annunciator module terminals. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power.
	Green	System has power.
CPU	Red	No Wiresheet (SLATE) loaded. Remove Limit System Status).
	Green	Running
Fault	Red	Fault
	No light	Running

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating the module number of the SLATE system. The LED colors indicate the terminal state as shown in Table 2.

Color	Description
Green	Terminal is on
Red	Fault
No light	Not in use

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have a Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Installation

⚠ WARNING

Fire or Explosion Hazard Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.

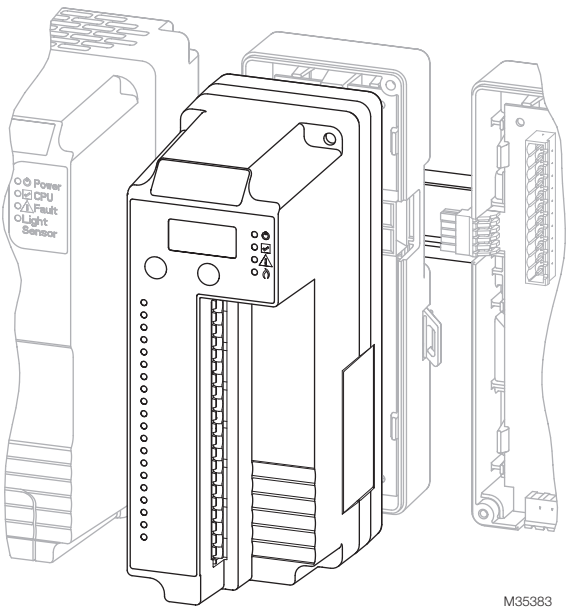


Fig. 2. Installing the Annunciator Module on the Sub-Base Module.

2. Wiring must comply with all applicable codes, ordinances and regulations.

3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interference Regulations of the Canadian Department of Communications.*
3. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

Wiring

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

Terminal	Description	Rating
1	Unused	---
2	Unused	---
3	Unused	---
4	K1 Relay Dry Contacts	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
5	K1 Relay Dry Contacts	(see above)
6	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
7	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
8	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
9	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
10	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
11	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
12	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
13	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
14	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
15	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
16	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
17	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
18	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
19	Input	24VDC (0.5mA), 24-240VAC (0.2mA)

Terminal	Description	Rating
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85-264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Vref+ above)

Note: only one voltage can be used per module (same at all terminals).

Table 3. Terminal Ratings.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 4. Recommended Wire Sizes and Part Numbers.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground (Base, Rectification Flame Amp Module, other modules optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended wire routing of leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.
- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 3.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of SLATE modules.

Maximum wire length:

- The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)
- For remote reset leadwires, maximum length to remote pushbutton is 1000 feet.
- For Remote Bus data lines, maximum cable length depends on the number of modules connected, the noise conditions and the cable used. The maximum of all interconnecting wires is 4000 feet.

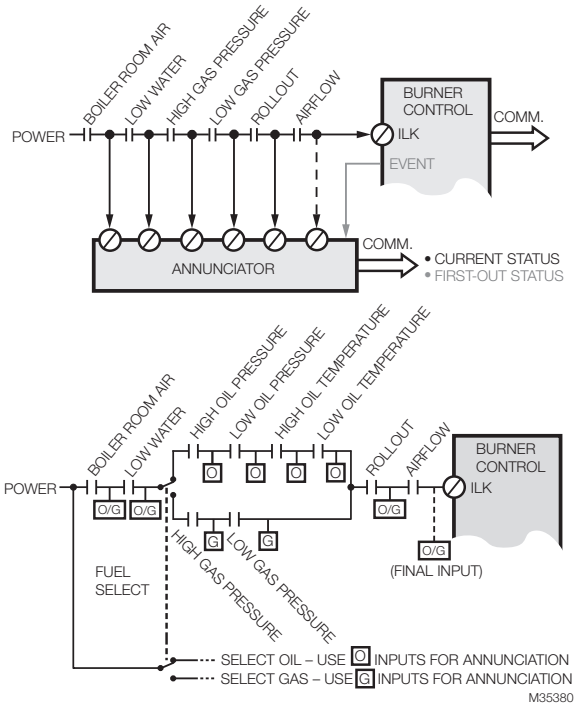


Fig. 3. Wiring diagram for Annunciator Module.

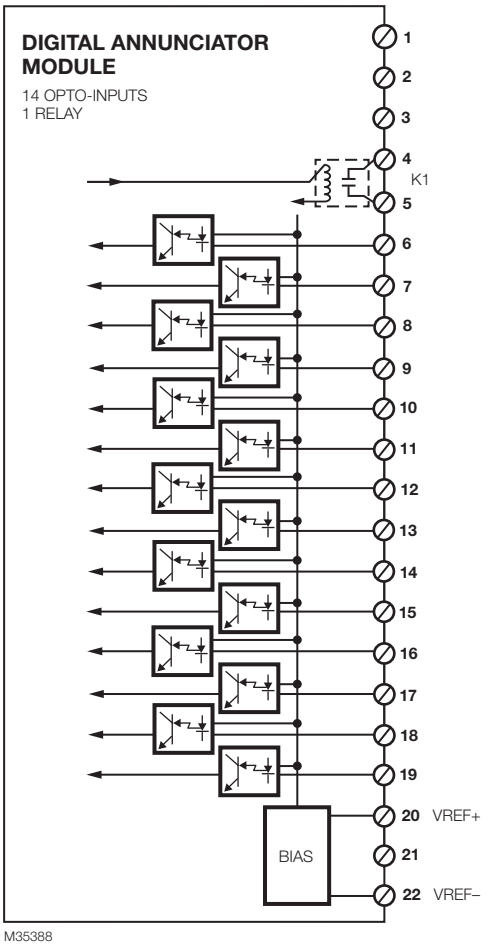


Fig. 4. Annunciator Module terminals.



32-00012-01

For more information and detailed instructions on the R8001N7001 and the SLATE display please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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Honeywell

SLATE™

Color Touch Screen Display

R8001K5001

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001K5001 SLATE Color Touch Screen Display provides users with the ability to create vivid application displays using web technology. The screen is web enabled and with the SLATE Web Editor tool creating screens is simple and easy.

Features

- Display screens are web pages served from SLATE Base Module
- Integrated view of SLATE system
- Standard Honeywell pages for Burner Control, Fuel Air Ratio, Limit and Base modules

Specifications

Electrical Ratings:
Voltage and Frequency: 24 VAC, 50/60 Hz

Environmental Ratings
Ambient Temperature:
Operating: 32° F to 158° F (0° C to 70° C)
Shipping: -40° F to 158° F (-40° C to 70° C)

Humidity: 95% continuous, noncondensing.

Dimensions: See Fig. 1.

Weight: 1 lb 5 oz (0.6 Kg)

Panel Mounting
The display can be mounted through a cutout in the panel door, using four #4 thread-forming Plastite screws. See Fig. 3.

For standard panel thicknesses of 0.060”–0.090” Honeywell recommends screw length of 3/8”. See Fig. 2 for hole spacing.

Required Components
R8001A1001 SLATE Base Controller

Power Plug Recommendations

The SLATE 7 inch color touch screen display will not come with a power plug connector. The following are recommendations for the power connection. See Fig. 4 for plug locations.

- 24VAC Wall Plug-in Transformer
  (Input Voltage: 120VAC, 60HZ – Output Voltage: 24VAC ±5%).
  Honeywell p/n 32006131 or equivalent.
- 18AWG wire
- Plug-in connectors (or equivalent):
  - Phoenix - p/n 1757019
  - EBY Electro - p/n EB1508-02-500
  - Dinkle – p/n 2ESDV-02P
  - Molex – p/n 0395300002

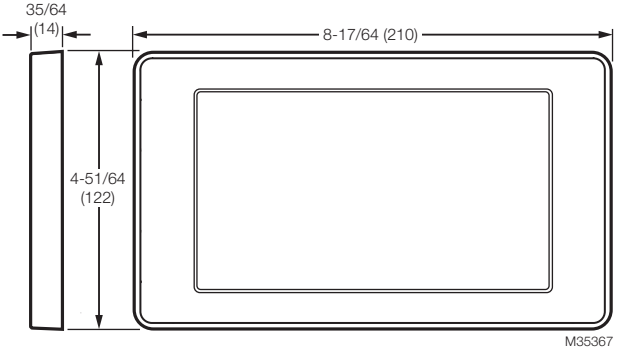


Fig. 1. Dimensions in in. (mm).

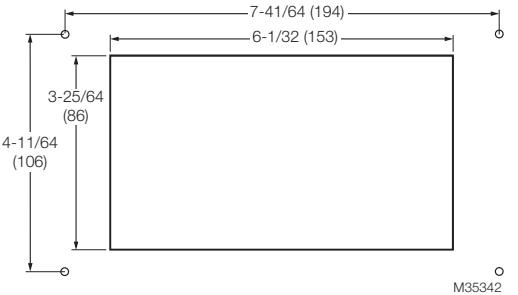


Fig. 2. Mounting dimensions of color touch screen display in in. (mm).

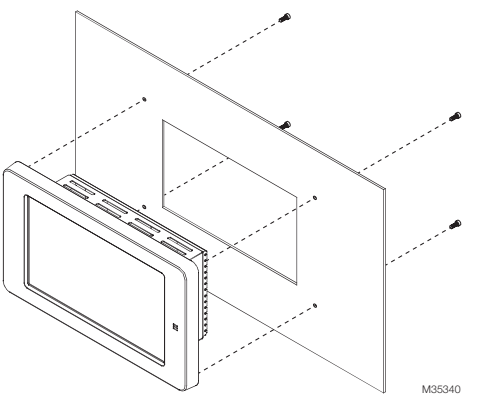


Fig. 3. Panel mounting of color touch screen display.

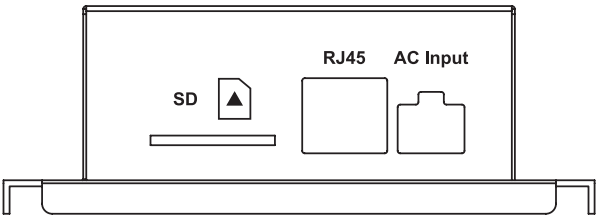


Fig. 4. Touch screen display inputs.

Note: SD card slot for future display firmware updates.

Principal Technical Features

The R8001K5001 color touch screen display provides a web-based user interface for viewing system status, and viewing, creating, or modifying configurations.

Communications and Networking

The R8001K5001 color touch screen display interfaces directly with the SLATE system using a standard Ethernet connection, and can connect directly to the Base module or via an Ethernet switch.

The R8001K5001 color touch screen display locates all base modules on an IP subnet using a subnet broadcast message, and once located allows users to select one to initiate a connection to that SLATE system.

User Interface and Technology

The R8001K5001 color touch screen display is based on the Google Chrome™ browser and supports HTML5.

A double tap on any web screen activates the Home, Back, and Help buttons, URL address bar, plus other controls that are

normally hidden from view. Double tapping again deactivates these controls.

For creating web screens, download the SLATE Web Editor Tool from our website at http://combustion.honeywell.com/SLATE.

Installation

⚠ WARNING

Fire or Explosion Hazard Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Wiring must comply with all applicable codes, ordinances and regulations.

32-00013-01

IMPORTANT

1. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.*
2. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interference Regulations of the Canadian Department of Communications.*

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or equipment damage.

Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.

For more information and detailed instructions on the SLATE display please refer to the SLATE User Guide document located on our website at http://combustion.honeywell.com/SLATE

Honeywell

Automation and Control Solutions

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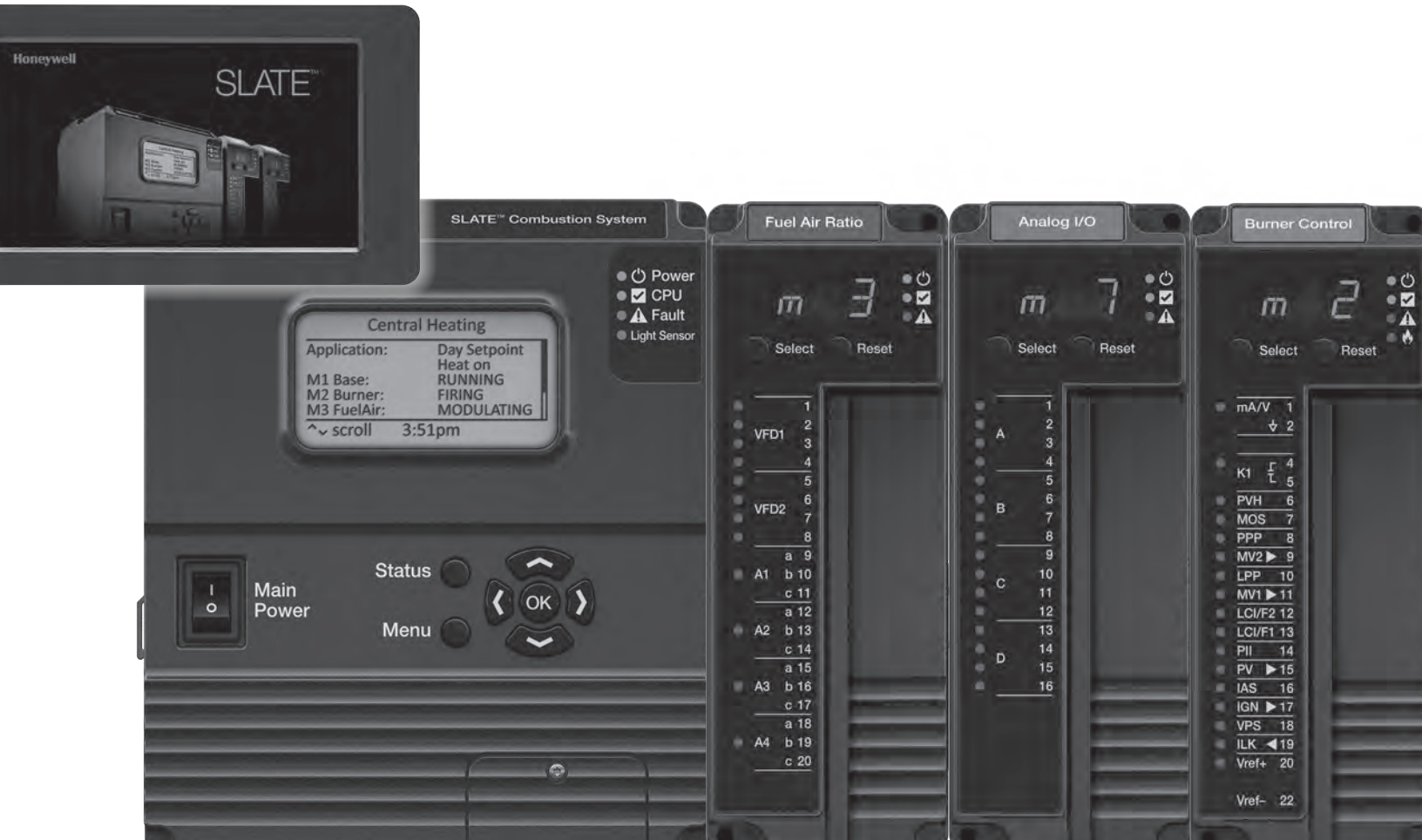
Honeywell

SLATE™

Integrated Combustion Management System

R8001 Series

USER GUIDE



Congratulations on selecting SLATE. SLATE is a revolutionary new combustion system that combines configurable combustion safety with programmable logic in one single platform. SLATE can easily be customized for almost any requirement or application- offering virtually limitless development opportunities with a far less complexity.

SLATE streamlines and simplifies the product development process, allowing customers to bring unique solutions to market in a matter of weeks instead of months.

This User's Guide is designed to guide you through designing and implementing a SLATE system.

Scan for more information

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Chapter 1: Getting to Know SLATE



Introduction

SLATE is a modular control that integrates configurable safety devices with user-programmable logic, inputs and outputs. Its purpose is to allow equipment manufacturers to create a customized controller by selecting modules and I/O specifically for that equipment and then designing a customized control program to make them work together. The SLATE modules mount on a DIN rail via a sub-base and each includes side by side plugs and jacks to interconnect adjacent modules.

In previous conventional control systems, a control panel often contains a PLC combined with separate safety devices such as burner controls. In this case, the safety devices are separately responsible for the operation and safety of critical equipment. This is maintained also in the SLATE design: safety modules operate as discrete and self contained safety controls. In the previous conventional control systems, the data produced by the safety modules is connected to what the control is doing. Or if the control includes communication, then the programmable logic may capture and interpret this using specialized customer software. In SLATE all safety module status data and all non-safety control of safety modules (such as burner control call-for-hear signal) is fully integrated into the programmable logic. It is one system, even though the safety modules are independent.

The SLATE Base Module provides communication and user-programmable logic, and non-safety digital and analog I/O modules provide inputs and outputs for that logic. The programmable logic can be used to create any non-safety features needed by the equipment that the SLATE device is controlling. This allows a SLATE application designer to implement customized and differentiating features in their controller. The accompany this, SLATE also includes a completely configurable touch screen display.

The configurable SLATE Safety Modules are:

- Burner Control Module
- Flame Amp Modules
- Fuel Air Ratio Control Module
- Limit Module

The programmable SLATE modules are:

- Digital I/O Module
- Analog I/O Module
- Annunciator Module

SLATE Modules and Accessories

The following are the SLATE part numbers.

Honeywell OS Number	SLATE Description
R8001A1001	Base Module
R8001B2001	Burner Control Module includes wiring terminals
R8001C6001	Fuel Air Ratio Control Module includes wiring terminals
R8001L8001	Limit Module includes wiring terminals
R8001N7001	Annunciator Module includes wiring terminals
R8001D4001	Digital I/O Module includes wiring terminals
R8001U3001	Analog I/O Module includes wiring terminals
R8001V1031	Rectification Flame Amp Module with Ampli-check includes wiring terminals
R8001S1071	UV Flame Amp Module with Ampli-check includes wiring terminals
R8001S1051	UV Flame Amp Module with Shutter- check includes wiring terminals
R8001F1091	UV/Visible Flame Amp Module with Ampli-check includes wiring terminals
R8001F1041	Infrared Flame Amp Module with Ampli-check includes wiring terminals
R8001 S9001*	Sub-base assembly for all SLATE modules
R8001M1050	SLATE 50 in/lb actuator with NEMA 1 enclosure
R8001M4010	SLATE 150 in/lb actuator with NEMA 1 enclosure
R8001M1150	SLATE 50 in/lb actuator with NEMA 4 enclosure
R8001M4150	SLATE 150 in/lb actuator with NEMA 4 enclosure
R8001K5001	7” Color Touch Screen Display does not include power transformer or connectors. Please refer to those OS numbers
SLATE AX TOOL	PC tool for programming, configuring and designing the SLATE system
32006131-001	SLATE Display Power Transformer
32008001-002	Connector bag assembly for sub-base and power connector for SLATE display. Connectors for sub-base can be used for remote start and remote flame amp.
50096820-001	Umbilical cord to allow continuation of a SLATE system while attached to a single power supply to additional DIN rail

* Needed for all SLATE modules other than the Base for communications and assembling on the DIN Rail.

Maxon’s Dura Step 300 and 900 in/lb actuators can be used with the SLATE system and need to be configured for SLATE. To purchase Maxon Dura Step actuators, please contact your Maxon sales representative.

Installation

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be trained and experienced flame safeguard service technician.
4. After installation is complete, check out the product operation as provided in the instructions.

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

To prevent possible hazardous burner operation, verify safety requirements each time a control is installed on a burner.

⚠ WARNING

Electrical Shock Hazard
Can cause serious injury or death.

Disconnect the power supply before beginning installation. More than one power supply disconnect may be required.

Approvals

Underwriters Laboratories Inc. Listed, File: MP268
Factory Mutual
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

This document provides installation instructions. Other applicable publications are:

Publication Number	Product
32-00005	R80001A1001 SLATE Base Module Installation Instructions
32-00006	R8001C6001 SLATE Fuel Air Module Installation Instructions
32-00007	R8001L8001 SLATE Limit Module Installation Instructions
32-00008	R8001D4001 SLATE Digital Module Installation Instructions
32-00009	R8001U3001 SLATE Analog Module Installation Instructions

Publication Number	Product
32-00010	R8001B2001 SLATE Burner Control Module Installation Instructions
32-00012	R8001N7001 SLATE Annunciator Module Installation Instructions
32-00013	R8001K5001 SLATE Color Touch Screen Display Installation Instructions
32-00019	R8001S1071 SLATE UV Flame Amp Module with Ampli-Check Installation Instructions
32-00020	R8001S1051 SLATE UV Flame Amp Module with Shutter-Check Installation Instructions
32-00021	R8001F1041 SLATE IR Flame Amp Module with Ampli-Check Installation Instructions
32-00023	R8001F1091 SLATE UV/Visible Flame Amp Module with Ampli-Check Installation Instructions
32-00024	R8001V1031 SLATE Rectification Flame Amp Module with Ampli-Check Installation Instructions
32-00025	R8001S9001 SLATE Sub-Base Installation Instructions
32M-06009	SLATE Low Torque Actuator Series Technical Catalog
02-00062	SLATE Product Brochure

SLATE Modules

A SLATE system is an array of modules mounted together on one DIN rail that work together to implement a control device for specific equipment. The minimum number of modules that can be used is two and the maximum is twelve, depending on the types of modules and their demand for power. The basic categories of modules are:

SLATE Base Module R8001A1001/U

A SLATE Base Module is always the leftmost module on the DIN rail. There can only be one base per rail. All other module types may occur more than once. The SLATE Base Module provides:

- Power for all of the modules
- External communication (if any; it is not required) either via a 10BASE-T connector for Ethernet-based protocols and/or via a RS-485 3 wire connector for Modbus or BACNet/MSTP protocols and web services.
- Storage of data for device configuration and initialization.
- Real time clock and event logging.
- The SLATE control program.

Most of the SLATE modules are passive; the primary active component in a SLATE system is the control program in the SLATE Base Module, which is typically responsible for making everything else operate.

SLATE modules may contain complex behaviors but they wait for something outside of themselves to trigger the process of doing something useful.

- An I/O module will measure and condition its input signals, but it needs to be told what to do and it doesn't *use* the results, it provides them for some other module or external device to use.
- An I/O module will drive its outputs, but only if something else tells it what output signal to produce.
- A burner control module knows how to start up and operate a burner, but only if something else requests this via a call-for-heat.
- A fuel-air control will modulate, but only if something else indicates the desired firing rate.

The primary active component is the control program, which responds to stimuli and tells other SLATE modules what to do by writing to the registers that control them.

Configurable Safety Modules

The safety modules in a SLATE control are:

SLATE Burner Control Module R8001B2001/U

The SLATE Burner Control provides flame safeguard controls for a variety of applications within the SLATE system. It can be configured as a primary or programmer, semi-automatic, or fully automatic. The Burner Control Module provides 24 VDC to 24 VAC to 240 VAC flame safeguard, valve proving, parameters, and behaviors that emulate the 7800 and Sola series flame safeguard, and dual fuel capability.

SLATE Flame Amplifier Modules

- R8001V1031/U Rectification with Dynamic Ampli-Check
- R8001F1041/U Infrared with Dynamic Ampli-Check
- R8001S1071/U Ultra Violet with Dynamic Ampli-Check
- R8001S1051/U Ultra Violet with Shutter- Check
- R8001F1091/U Ultra Violet/Visible Light with Ampli-Check

The Flame Sensor modules for a burner control belong to and are operated by the parent safety module to implement some of its safety-related inputs and outputs. These Flame Amp modules are configured as part of the parent's safety modules configuration. Flame amp modules can be mounted on the DIN rail or can be mounted remotely, such as to put a flame module close to its flame sensor.

SLATE Fuel Air Ratio Control R8001C6001 and Actuators

(R8001M1050- 50 in/lb NEMA 1, R8001M1150- 150 in/lb NEMA 1, R8001M4050- 50 in/lb NEMA 4, and R8001M4150 NEMA 4 Durastep actuators in 300 in/lb and 900 in/lb may also be used.)

The SLATE Fuel Air Ratio Control Module controls the relationship between fuel, airflow, and flue gas recirculation on a power burner. It provides control for up to 4 SLATE actuators and/or 2 Variable Frequency Drives (VFD).

SLATE Limit Module R8001L8001/U

The SLATE Limit Control Module provides the ability to utilize any type of analog signal and create safety limits on pressure or temperature or both.

SLATE safety modules cannot be programmed; only the SLATE Base provides this feature. The basic behavior of each safety module is fixed but can be adapted to various purposes by changing configuration parameters. The SLATE Burner Control will have 70 parameters to tune and select behaviors. Examples of these parameters include:

- Timings such as prepurge, ignition, and postpurge times.
- The type of ignition such as pilot or direct.
- The response to flame failure such as lockout, recycle, or recycle with a delay.

The inputs and outputs on a safety module are available to the control parameters and status registers that are available to the control program. Each of these also has a dedicated purpose. A few examples, for a burner control:

- Parameter: the call for heat request (a non-safety signal which typically would come from the control program)
- Status: the current burner state (e.g. Standby, Prepurge, Ignition, Firing)
- Status: the elapsed time of the current state

Programmable Logic

A SLATE system also provides configurable I/O modules that provide inputs and outputs for use by the control program. Those modules are:

SLATE Analog Module R8001U3001/U

The SLATE Analog Module provides a variety of different combinations of analog input and output types; 0-10 VDC inputs or outputs, 4-20 mA inputs or outputs, Thermocouples type J and K, RTD, 3 wire NTC, Pulse Width Modulation, and Tachometer.

SLATE Digital Module R8001D4001/U

The SLATE Digital module provides 14 opto inputs or 6 relay outputs.

SLATE Annunciator Module R8001N7001/U

The SLATE Annunciator module is designed to monitor the status of a series string of limit, control, and interlock contacts for a commercial or industrial burner. The Annunciator Module acts as a system monitor and enhances fault and status messages of the SLATE Burner Control Module.

A SLATE control program resides and is executed with the SLATE Base Module. To create a control program the user utilizes a "wire sheet" (part of the Honeywell SLATE tool) that resides on a computer. The programming is performed by dragging-and-dropping function blocks onto an editing screen, dragging lines between the blocks to interconnect them, and opening a block's properties to setup its behavior.

When a wire sheet input block is used, the user can attach it either to the data from an input terminal of any SLATE module, or to a source of data from internal logic such as the burner status information provided by a burner control.

When a wire sheet output block is used, the user can attach it either to control an output terminal of a SLATE I/O module, or to send data to the internal logic of another module such as the call for heat request for a burner control.

More information on programming using the Honeywell SLATE Tool is located in Chapter 2.

Communication

The SLATE Base Module can provide communication with a display, some other device or a building management or industrial control system, or all of these simultaneously.

Blocks placed on the wire sheet provide “points” within the SLATE device that are accessible via the connected external communication protocol. Thus the control program can operate according to inputs from the outside world or provide outputs to the outside world.

Although SLATE is assembled from modules, when finished and installed on a particular piece of equipment the SLATE modules appear to be a single device that operates that piece of equipment. From the external protocol’s viewpoint, all of the points in the SLATE device reside at a single address.

Support is provided for the following protocols:

- BACnet/IP via 802.3i 10BASE-T
- BACnet/ MSTP via RS-485
- Modbus RTU/IP via 802.3i 10BASE-T
- Modbus RTU/485 vis RS-485
- Web browser access (httpd) via 802.3i 10BASE-T

The illustration below shows three SLATE devices:

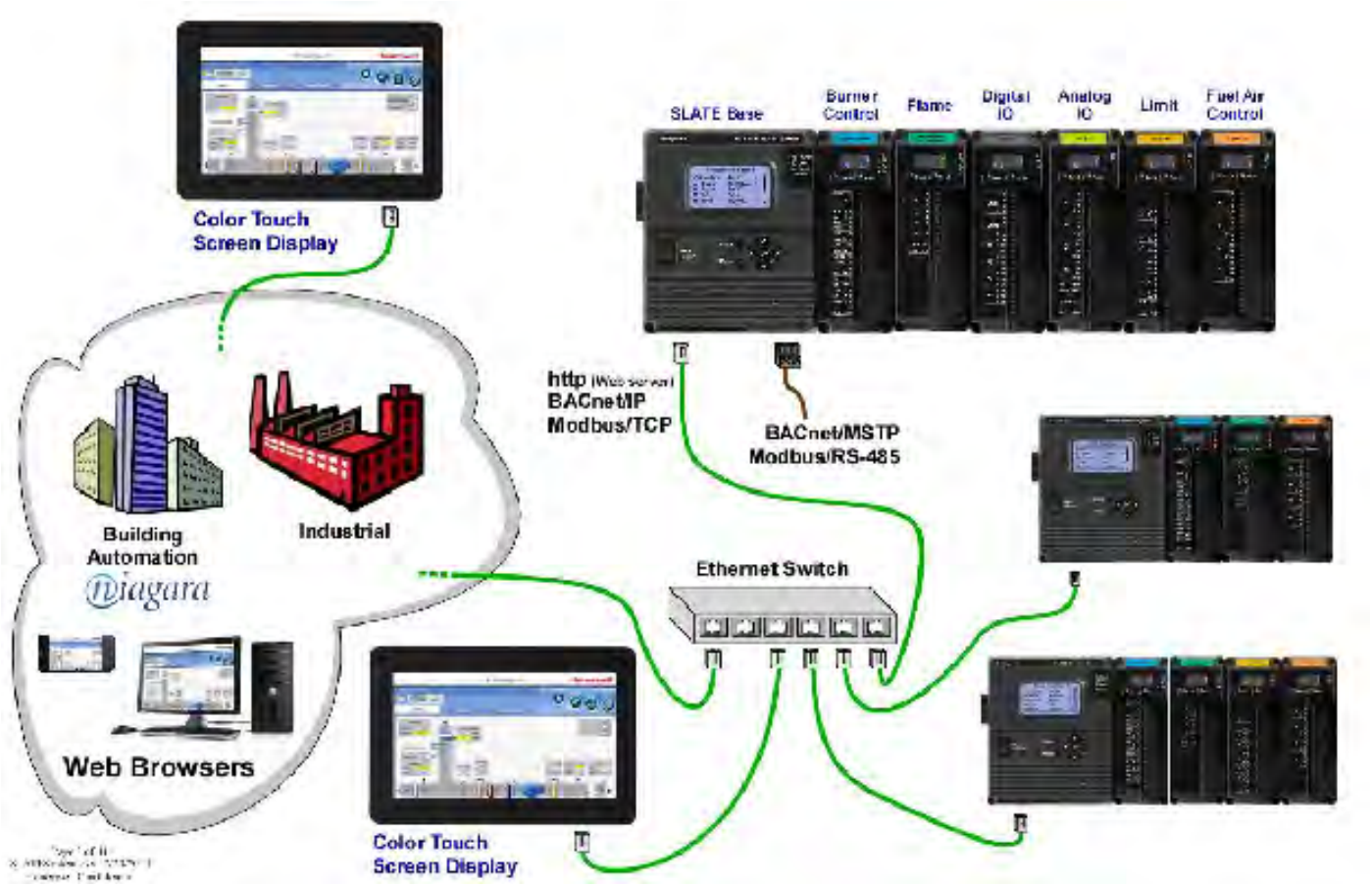


Fig. 1. 3 examples of SLATE devices.

Design Life-Cycle Overview

This section provides a summary of how the Honeywell SLATE Tools and other tools are used in the process of creating a new SLATE device.

Honeywell SLATE Tool

The SLATE systems will use a profiled version of the Niagara AX software as its primary PC-based programming tool for the user. The profiled version provides an environment that is relevant to the SLATE needs; the wire sheet.

The SLATE Designer

In the descriptions below, a user setting up a SLATE device for a particular purpose is called the designer. Typically the designer will be an engineer who works for an OEM or Systems Integrator and is using SLATE to create a control for some equipment. The wire sheet program the designer creates is called the SLATE Control Program.

Skills Needed

Setting up a control program for a SLATE device will inevitably require an understanding of SLATE-related concepts and details.

Mastering these concepts will require at least a good tutorial and some hours of training. Below is a partial list of topics.

- The behavior and configuration of SLATE Safety modules
- The I/O that is available on various SLATE modules
- How a SLATE Control Program is developed, which includes:
  - An understanding of the “wire sheet” design techniques
  - Familiarity with all of the wire sheet blocks
- How to connect wire sheet logic to:
  - Physical inputs and outputs
  - Other internal data in a SLATE module
- How to provide external network connections to the outside world
- How to export the design into a PC file or “kit”
- How to load the design into a SLATE device for testing
- How to use kits and the SLATE Loader in a production environment

Select the Modules

The designer thoroughly understands the equipment that SLATE will control: the switches, blowers, dampers, sensors, burner, etc. All of these and also the procedures for how these should operate are in the designer’s domain. With this background and also with knowledge of what each kind of SLATE module can do, the designer selects modules to be used and determines how each of them will be connected to the equipment.

In the illustration below, the background schematic represents that equipment, and the screw terminals and lines indicate the designer has chosen SLATE modules based on the types of electrical devices that need to be monitored or controlled in that equipment. For an actual design the designer might use a schematic diagram, a list, or a form to record the choices.

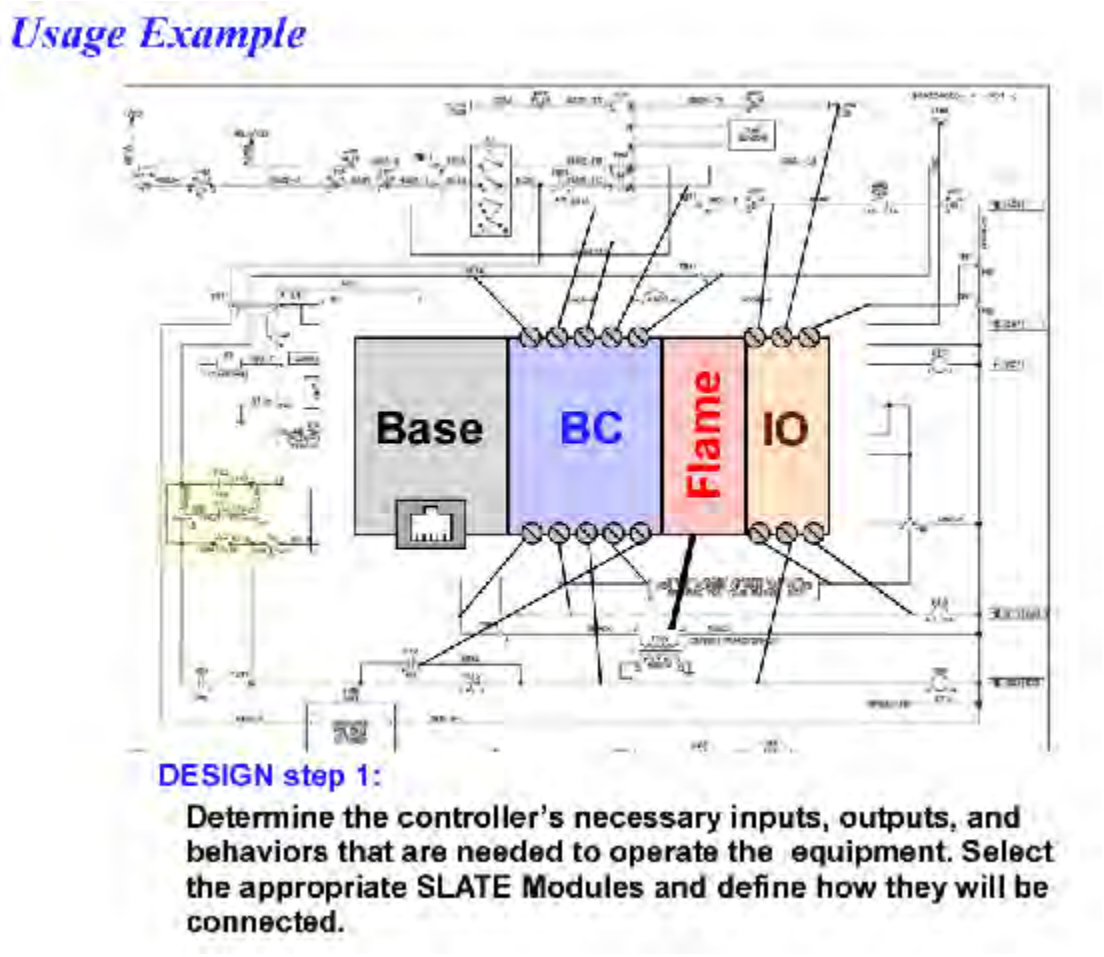


Fig. 2. SLATE usage examples.

Implement the Design

The wire sheet program editing environment is used to create the control program for the equipment. Blocks representing inputs, outputs, and behavior are dragged-and-dropped onto it and then interconnected by dragging “wires” (lines) between them. That step is represented in Fig. 3 along with a list of some of the types of blocks that are available.

The other task performed within the tool is setting up the configuration data for non-programmable devices, such as the SLATE Burner Control Module. This consists of a set of dialog boxes that present choices via drop-down lists, fill-in the blanks, check boxes and other similar techniques.

The results are one block of Program Data (see Fig. 3) that describes the Control Program and blocks of Configuration Data

for each of the safety modules that contain the configuration settings.

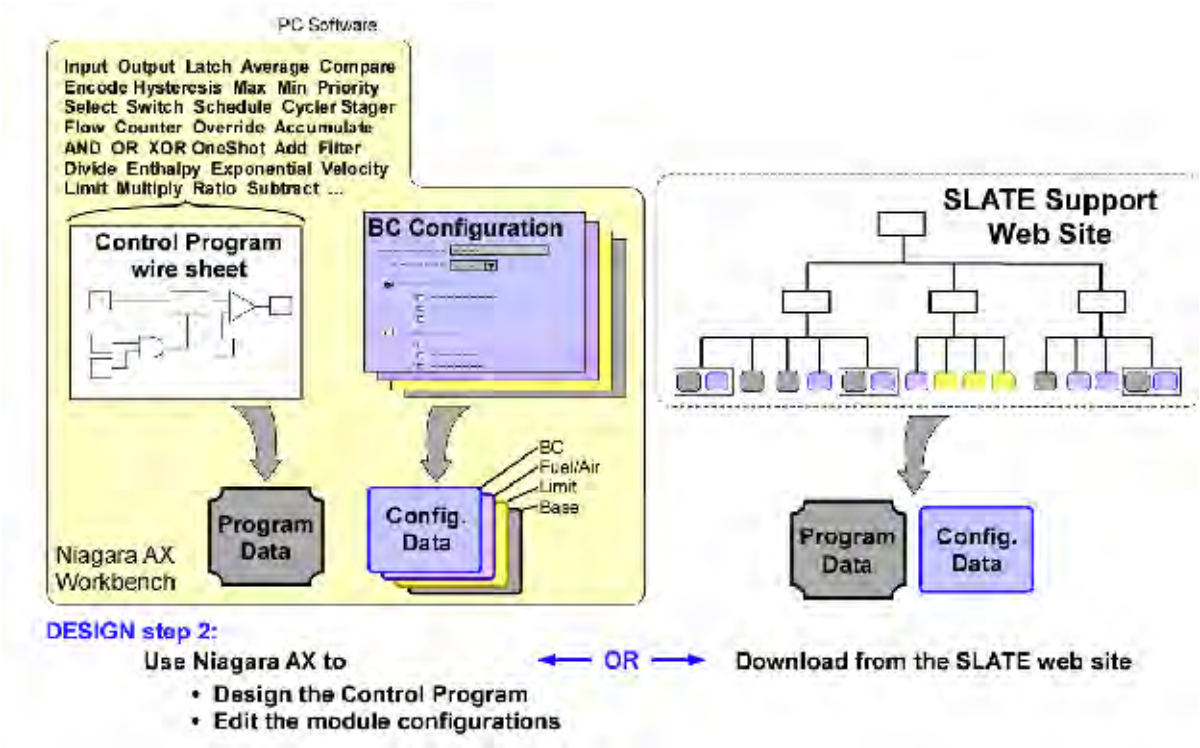


Fig. 3. SLATE program data block.

Other Design-Related Actions

Fig. 4 shows other activities performed by the designer as part of creating a SLATE device.

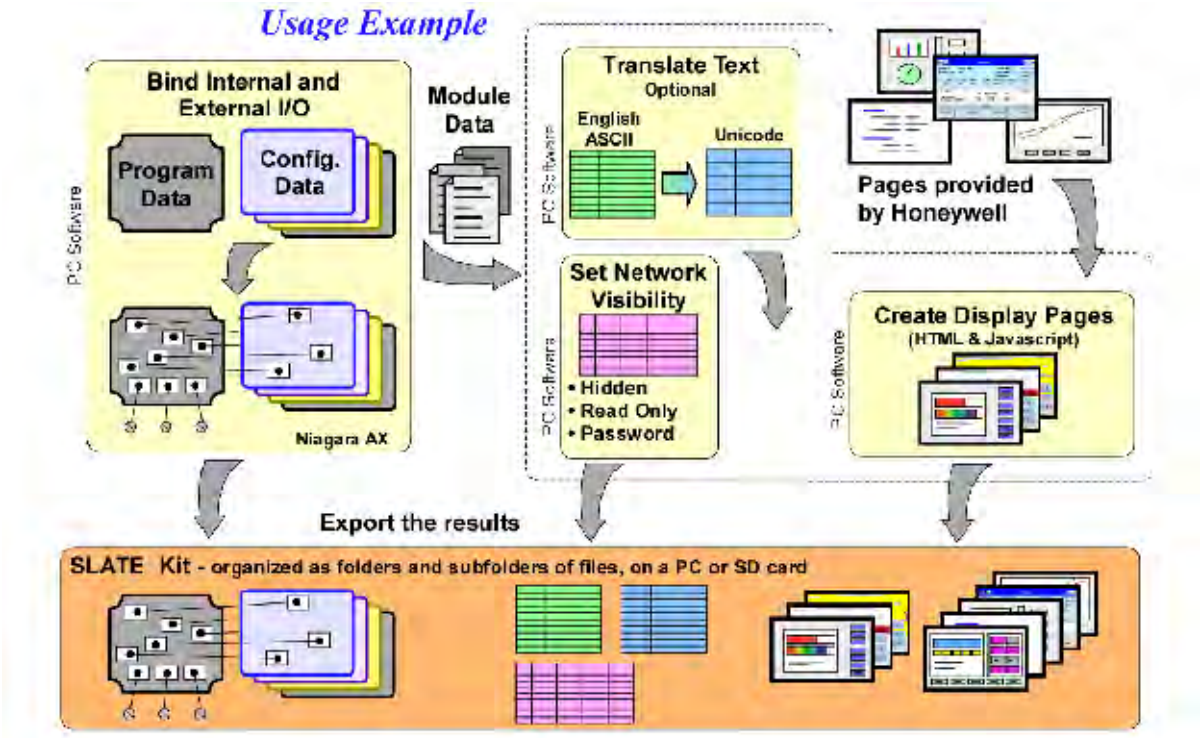


Fig. 4. SLATE other design tasks.

Binding Internal and External I/O

Binding is the process of defining the actual screw terminals or registers in the SLATE modules that will be used by the program logic. It is done within the wire sheet programming environment. It may be done as-you-go, or as a separate step. It is shown separately above. An example of this is a canned program that is downloaded from the SLATE web site that is modified, if needed, and then bound to the actual I/O needed by the equipment.

Text Translation

The text used by SLATE modules to label and describe parameters and their values can be translated into some other language. This is optional. When this is done, the Honeywell-standard English language text is still preserved and available as an option, for use by Honeywell support personnel.

Network Visibility

Simply using any SLATE module will create many network-visible inputs and outputs in a SLATE device and the designer can create others via wire sheet programming. All of these network inputs and outputs (or "points") can be filtered to make them hidden and remove them from visibility to the communication protocols. For example, of the hundreds of points that are available, a particular application design may prefer to reveal only a dozen or so as items that represent the equipment and that are useful to the site where the equipment is installed. Each point that is potentially writable can be set to a Read-Only condition, or a password can be applied, and/or range limits can be set. These choices are made via a form that is available in the Honeywell SLATE Tool as part of creating a control program.

Display Screens

The display screens installed in a SLATE device are web pages and the SLATE Base Module implements a web server to provide these pages to the SLATE display or any web browser, such a browser in a PC or smart device. Honeywell provides a set of display screens for each of the modules that a designer can use as-is or adapt or replace using a different design. The designer also creates screens for the wire sheet programmable logic to represent the status of the controlled equipment.

Export the Results

All of the data created by the designer is exported along with mandatory data provided by Honeywell to create a SLATE Kit File. A Kit File is a single file implemented as a .zip file, containing a folder structure with files in a specific form that is compatible with the SLATE device. The name of the kit is chosen to reflect the purpose of the design; for example it might be named for a particular model of boiler, furnace, air handler, or whatever the design is intended to control.

Verification of Safety Data for Each Module

An important part of a SLATE design is the verification process for safety configuration data. Whenever safety data is changed for any reason, a safety device will enter a "risks addressed" (i.e. shutdown) state until that change has been verified. Verification consists of reviewing each data item without changing it and then, instead of sending a "read" or a "write" command to the module, a "verifying" message is sent. That is, SLATE safety devices recognize those as distinct messages.

The process of verification includes pressing the "Select" button on the module; confirming that the one being verified is the intended module within the intended device, because a SLATE display can be connected to different SLATE devices and a SLATE device can contain multiple safety modules. Verification requires a SLATE password.

After an entire design is verified, it is possible to save the verification status and load it with the kit (see below) so that an OEM or Systems Integrator does not have to re-verify the same design over and over again each time the design is replicated.

Load the SLATE Device

When loading the Kit into a SLATE Device:

1. Assemble all required modules on the DIN rail.
2. Apply power to the SLATE control.
3. Connect a PC that is running the SLATE Loader program to the SLATE Base Module using a standard Ethernet cable.
4. Select the desired Kit from a drop-down menu (after the first time it will remain selected and this must be done only if it needs to be changed).
5. Click Select to send the Kit to the SLATE control.

The kit is then loaded into the SLATE modules and when this succeeds a "Pass" indication is provided, or if it fails then the reason is logged.

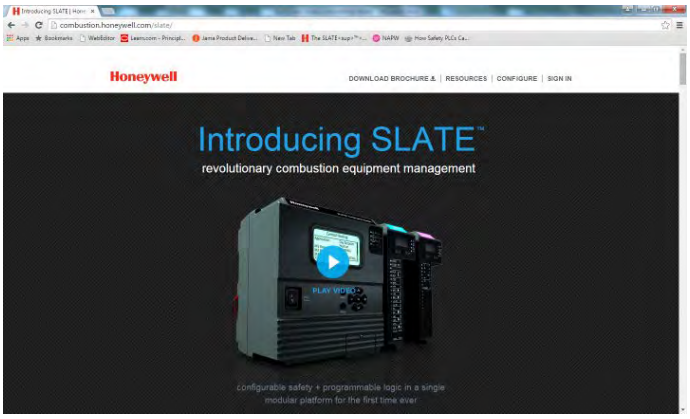
Chapter 2: Using the Honeywell SLATE AX Tool

Overview

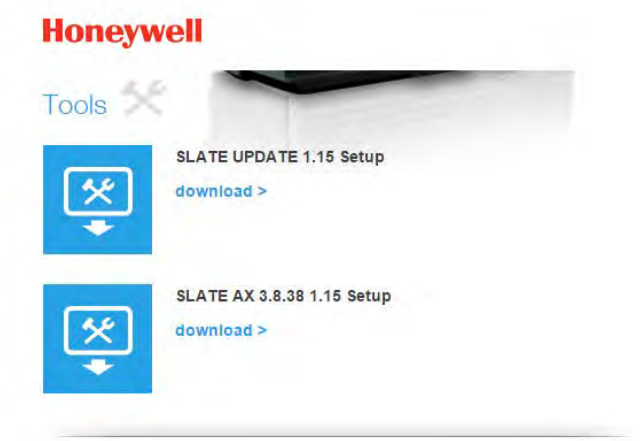
The SLATE AX Tool is the software application to configure SLATE configurable modules, program application logic using function block programming and design application screens for your graphical display.

Obtaining the Software

1. Go to the SLATE Website (combustion.honeywell.com/SLATE) to the Resources section. Click on Resources. See figure below:

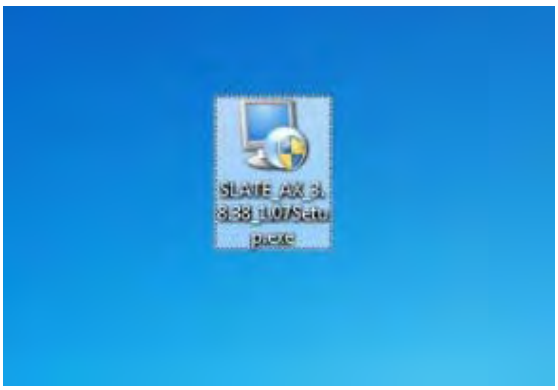


2. You will be prompted to enter a user name and password. If you are a user of customer.honeywell.com you will be able to enter those credentials into the system. You will need to utilize a Chrome browser.
3. Once you are logged in the select the Resources the following web page is displayed. Click on the software section and download.



Installing the Software

1. Download the file to a folder or your PC desktop. There will be a SLATE _AX_XX_XX (depending on the current version level) Setup.exe icon (or file if you selected a folder.)



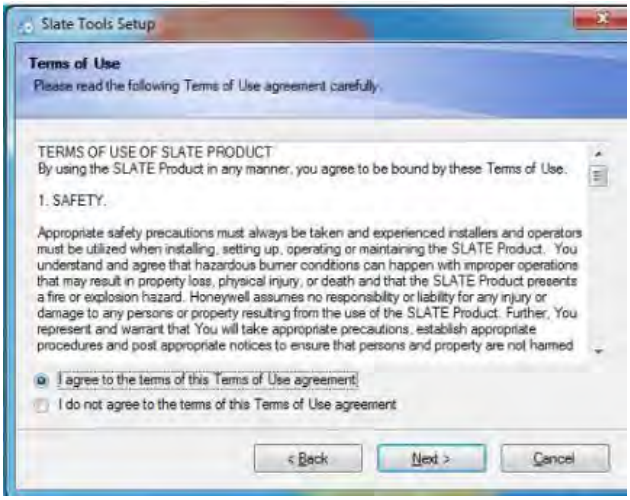
2. Double click on the above icon and allow the setup to install on your computer. This may take several seconds before the install program starts. The following screen is displayed that will begin the SLATE AX installation.



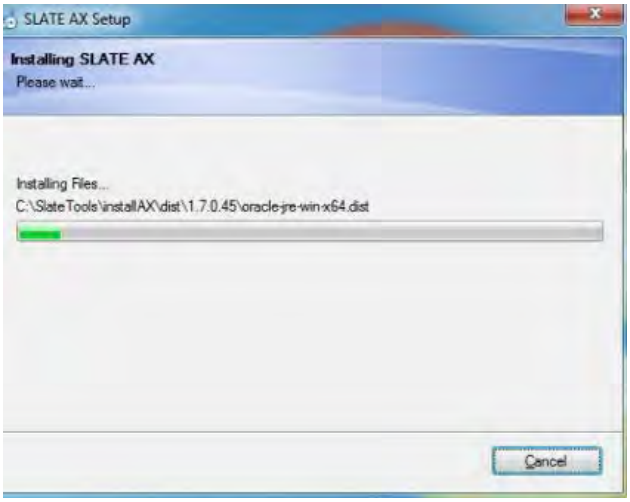
3. Press the Next button to begin the installation. The following screen will be displayed and you will be asked if you agree to

the terms of the Licensing Agreement and the Terms of Use. Please click the “I agree” button to both of these requests.

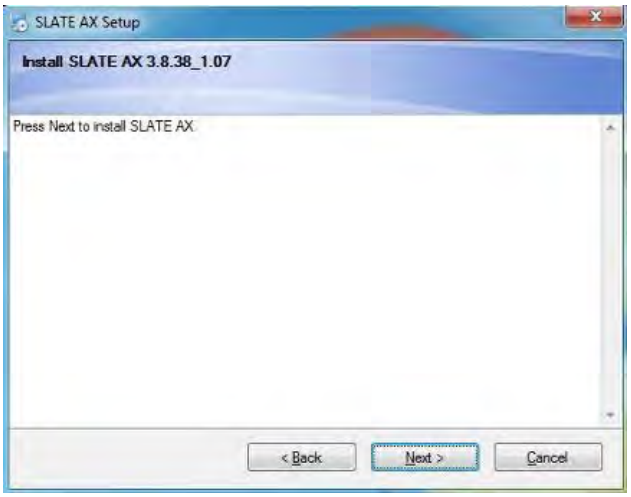




The SLATE AX Tool will start installing. You should see the following screen:



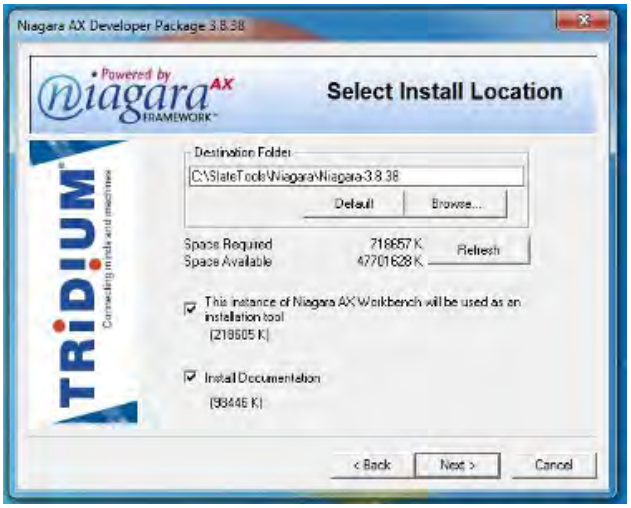
4. When you see the following screen, please press the Next button to continue installing the tool.



5. Click Next to continue.



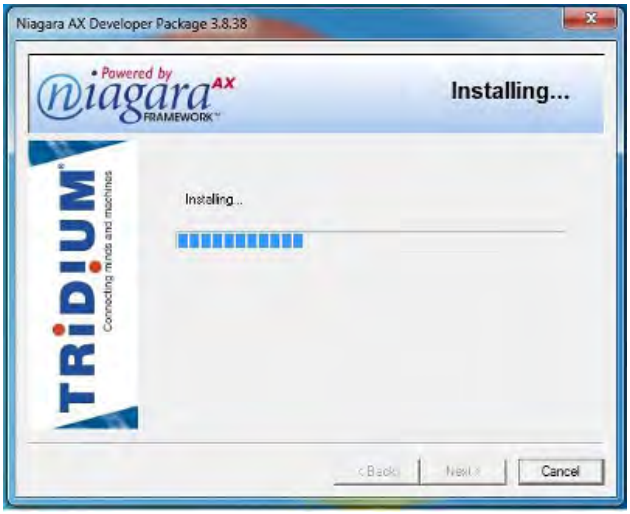
You will then see the following screen:



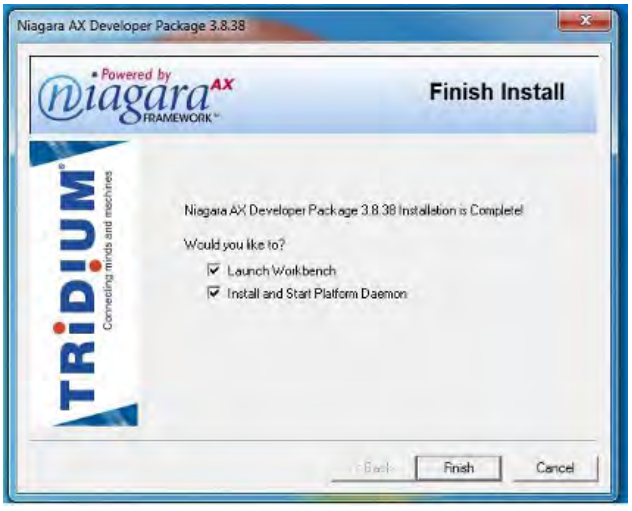
6. Do not change the destination folder location or uncheck any items. Please click Next



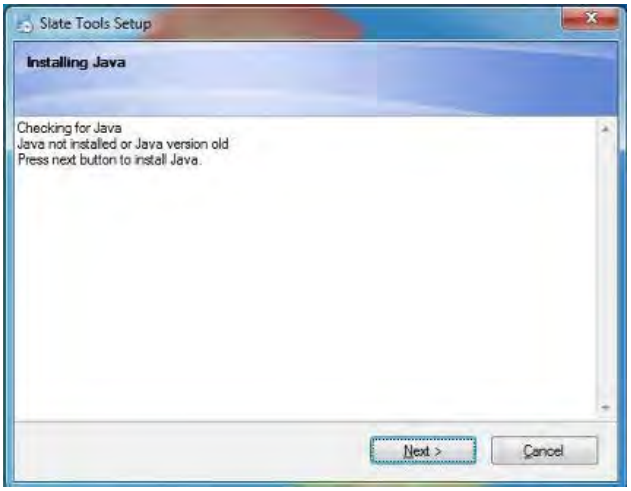
7. Again, do not change anything on the screen and click Next.



The setup program will being installing the SLATE AX software.



8. When you see this screen please do not change anything. Press Finish.
9. You will then see the following screen that will contain your host ID you will need for licensing. Please send the host ID (Win-XXXX-XXXX-XXXX) information for licensing as previously noted above. If your computer doesn't have Java or an older version the installation program will install a new version onto your computer. If you see this screen please press Next to install.





When this screen appears, do not change any settings and click Install to continue.



Please wait while the installation of Java is complete.

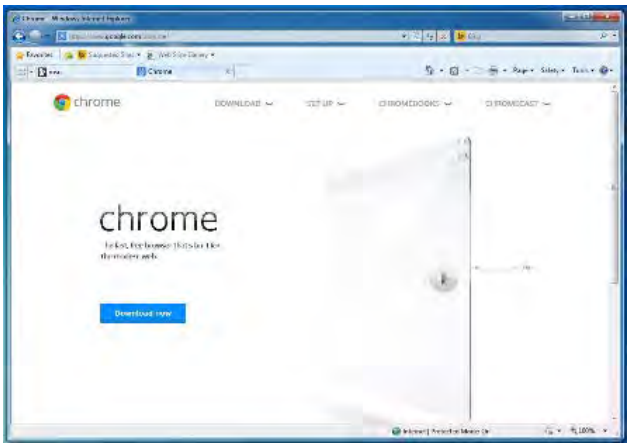


10. When installation is complete, this screen will be displayed. Please press Close to continue.



The SLATE AX Tool has been successfully installed. Please press Finish to close the installation program.

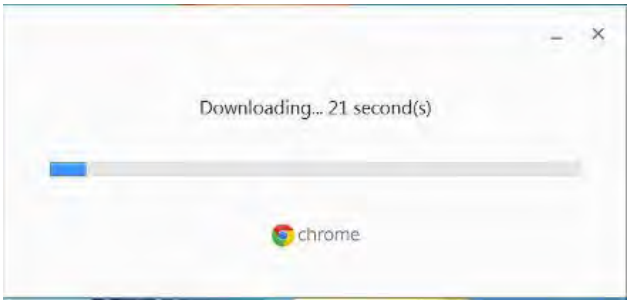
The SLATE AX Tool utilizes the Chrome browser. If you don't have Chrome, please open your web browser and type the following address: www.google.com/chrome. When the web page load, locate the "Download now" button and follow the instructions.



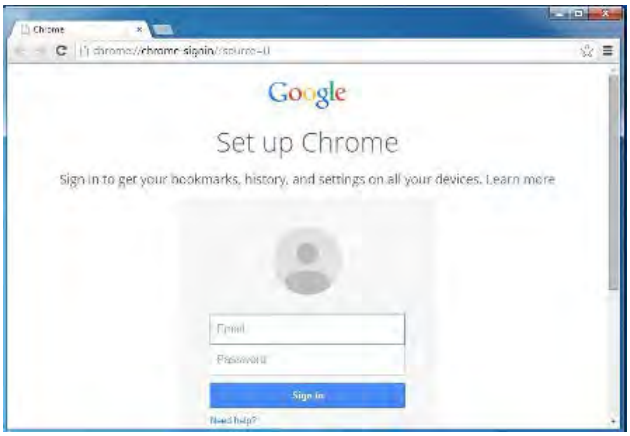
While trying to download Chrome, you may see the following screen. Please press Run to continue to installing the browser.



The Chrome installer should be displayed indicating that the installation progress.

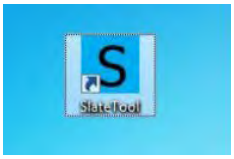


Once Chrome is installed the following screen will be displayed. You can close this window without entering any information if you prefer.



At this point you have successfully installed all of the software components required for the SLATE AX Tool.

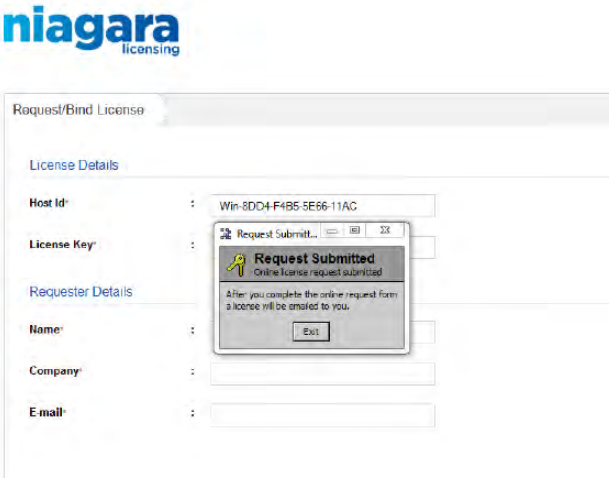
You will see the following icon on your desktop to start using the tool. Please always use this icon to start the SLATE tool in the future.



11. Please double click on the SLATE Tool icon to start the program. You should see the following screen.



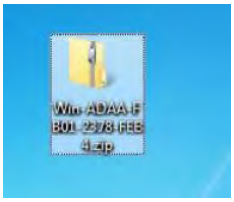
12. Click on Open SLATE AX Tool button. The following screen is displayed.



At this point, DO NOT FOLLOW THESE INSTRUCTIONS! Submit the host ID to Honeywell Customer Care for licensing.

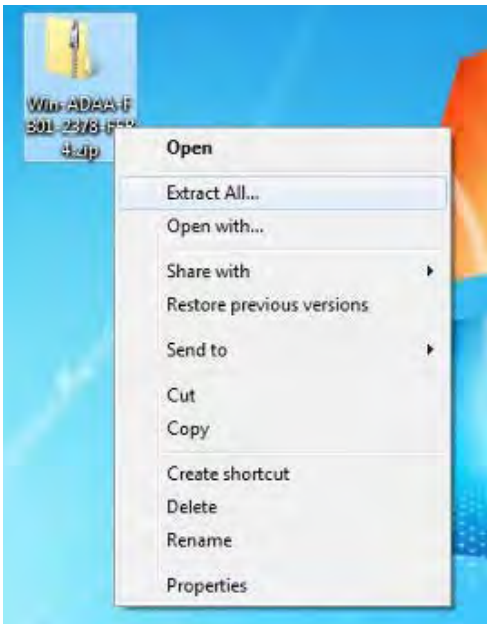
As mentioned the SLATE AX Tool requires a license to operate. Once you have received your license, you can only use it on this computer, since the license is tied to the computer hardware.

Once you have received your license in your e-mail copy the license file onto your desktop.

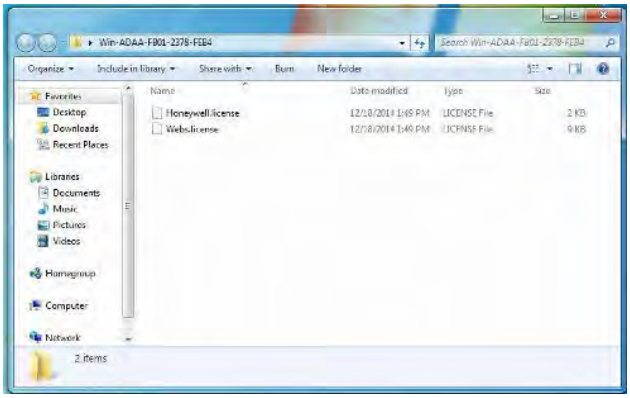


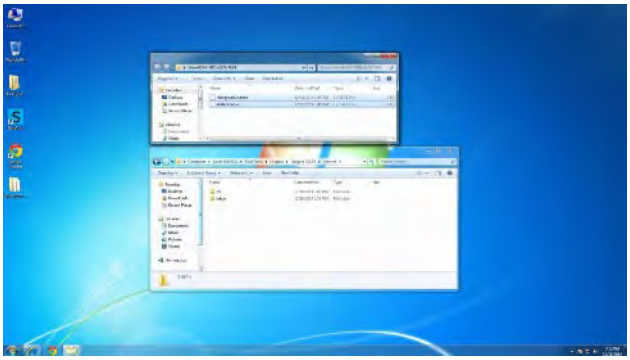
The file will be Win-XXXX-XXXX-XXXX-.zip

You will need to right click and extract the files inside to a folder on your desktop.



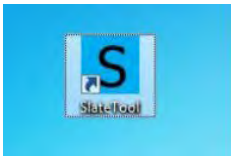
Inside the folder will be one or two license files. These files must be copied to the following location C:\Slate Tools\Niagara\ Niagara-3.8.38 \licenses. Note the license version may be different than highlighted based on updates.





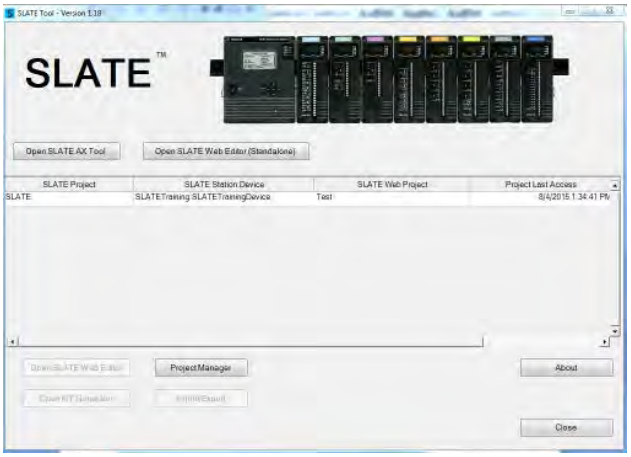
Once the licenses are copied in the correct location, the SLATE AX Tool software is ready to use.

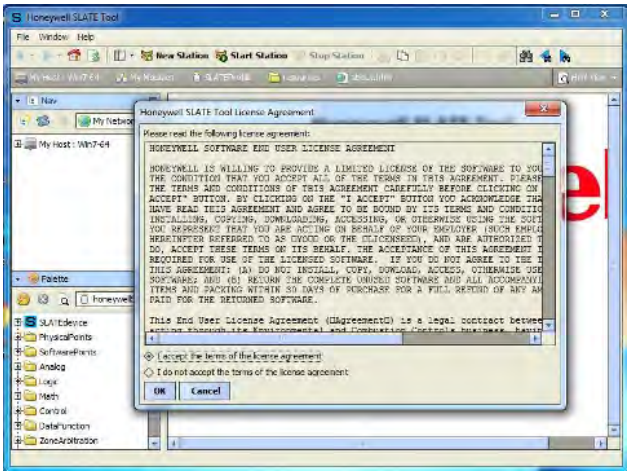
Locate the following icon and double click it to start the SLATE tools.



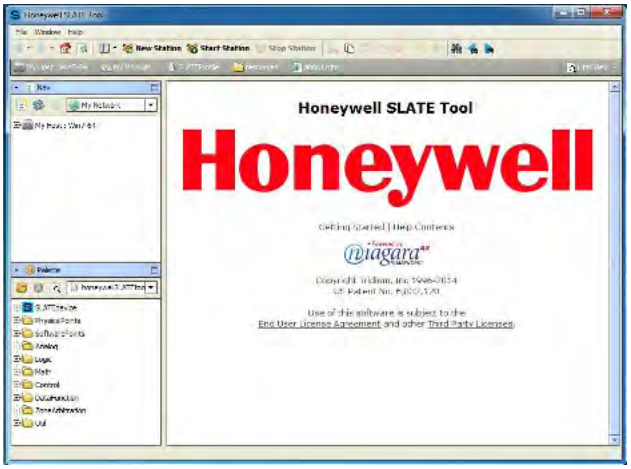
The SLATE Tool software will show the startup screen.

13. Press the Open SLATE AX Tool button.





The very first time that the SLATE AX Tool is started you will need to accept the End User Software Agreement. This agreement is always available for viewing by pressing the About in the SLATE Tool Program start page.



This screen is shown at the startup of the tool. If you see the above screen you have successfully installed all the components needed to use the SLATE Tool to create a design and web pages for your SLATE device.

14. Next you need to check if the SLATE Web Editor is properly installed. To do this return to the SLATE AX Tool Main page and select Open SLATE Web Editor Tool.



Confirm that the Chrome browser opens with the text below.



If you do not see any of these screens nor cannot launch the SLATE AX Tool please contact the Honeywell Technical Assistance Line at 1-888-516-9282.

15. Double click on the State Tool icon to start the SLATE tool program.



This screen will be displayed first when starting the SLATE tool program.

16. Click on the Open SLATE AX Tool button.

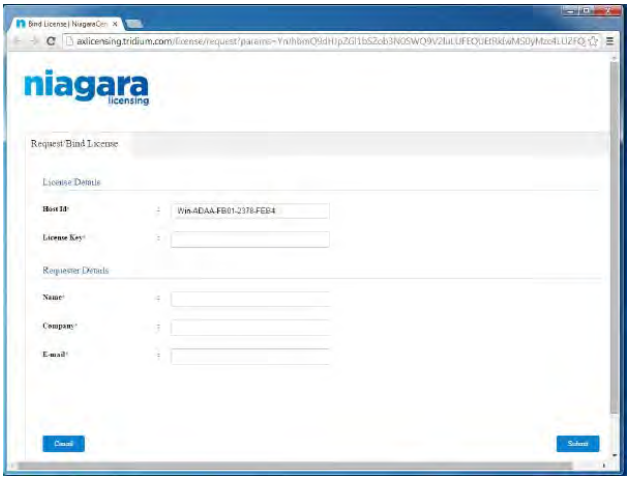


This screen is displayed to start the SLATE AX Tool.



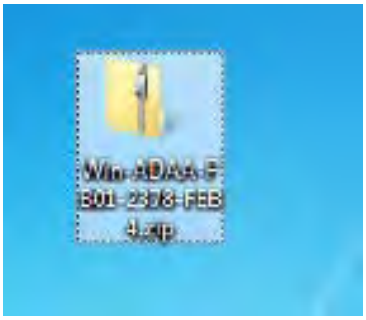
The SLATE AX Tool requires a licensed to operate. Once you receive a license, you can only use it on this computer, since the license it tied to the computer hardware.

If you do not have a license a screen will be displayed to prompt you to obtain a license.

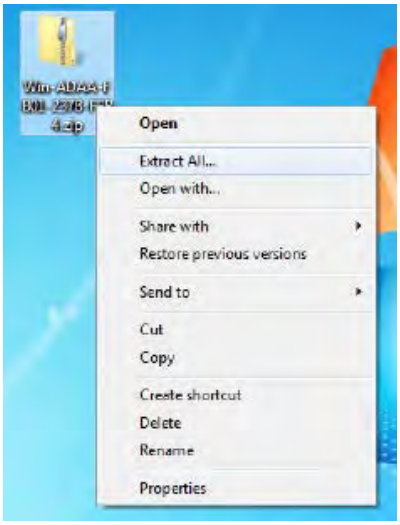


Note: Instead of requesting a license from Niagara, you must obtain the license from the Honeywell SLATE support team. E-mail the Host ID information Win-XXXX-XXXX-XXXX-XXXX to your Honeywell Customer Care representative and he/she will send you your official license.

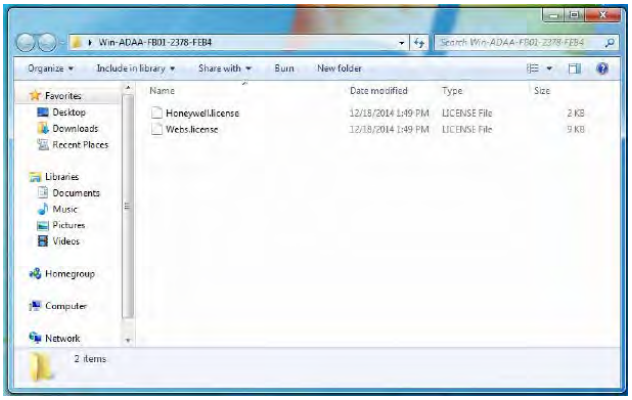
Once you receive your license in your e-mail. Copy the license file onto your desktop.



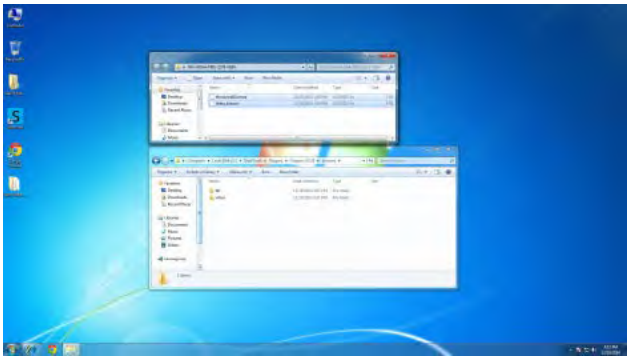
17. The file will be Win-XXXX-XXXX-XXXX-XXXX.zip. Right click and extract the files inside to a folder on your desktop.



Inside the folder will be one or two license files.

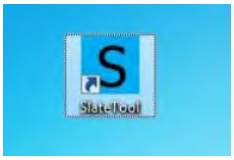


These files must be copied to the following location: C:\SlateTools\Niagara\Niagara-3.8.38\licenses



Once the licenses are copied in the correct location, the SLATE AX Tools software is ready to use.

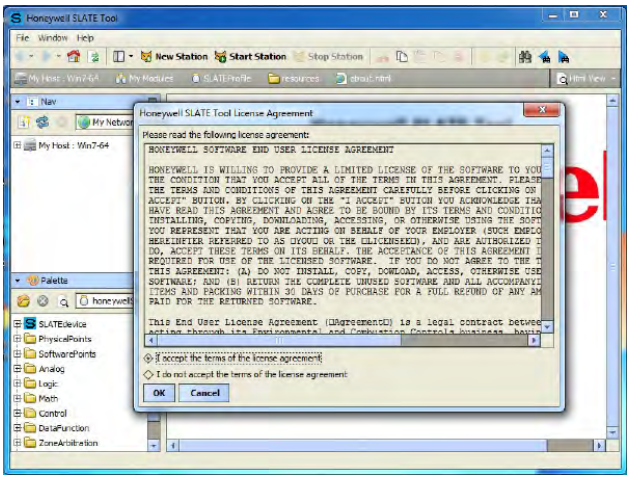
Locate the following Icon and double click it to start the SLATE tools.



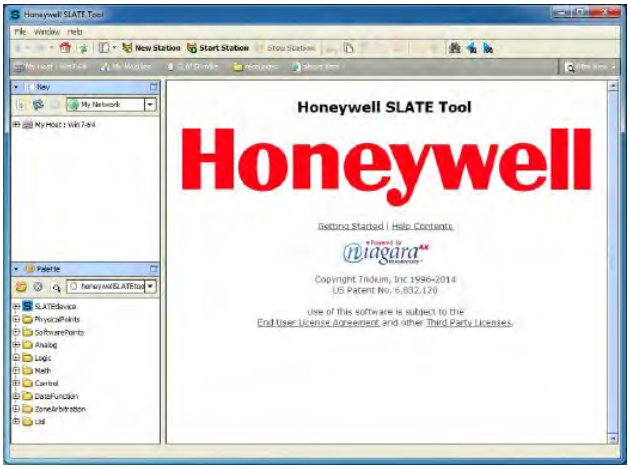
The SLATE tool software will show the startup screen.



Press the Open SLATE AX Tool button



The very first time that the SLATE AX Tool is started you will need to accept the End User Software Agreement. This agreement is always available for viewing from by pressing the “About “ in the Slate Tool Program Start Page.



This screen is shown at startup of the SLATE AX Tool.

If you see the above screen you have successfully installed all the components needed to use the SLATE Tools to create a design and web pages for your SLATE device.

At this point follow the instructions on how to use the SLATE AX Tool.

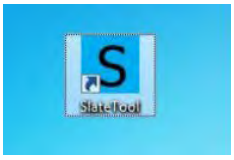
Getting to know the SLATE AX Tool

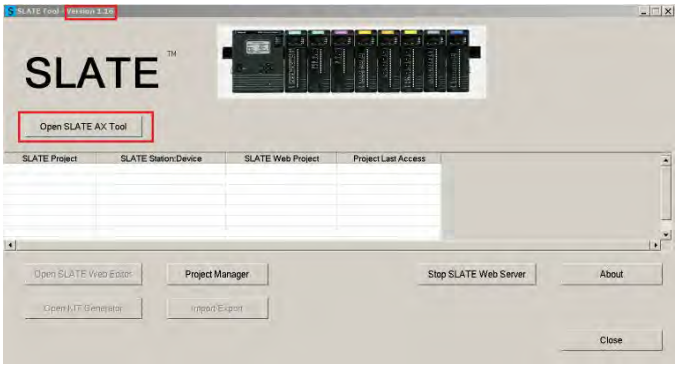
To understand how SLATE AX Tool works it’s important to understand a few terms.

- Platform- where you work, or your laptop or computer. Hosts the SLATE AX software
- Station- a method to group your work. You open a station and connect to it using credentials
- Device- is within a station, you can save your SLATE device: a design for a SLATE control
- Wire Sheet- The logic you create for you application using function blocks. A term that is interchanged with Logic.
- Function Block- Basic unit of programming SLATE logic where blocks represent behavior are placed on the wire sheet and connected with lines that indicate the flow of data.
- Block Configuration- Defining certain properties of a particular function block
- Binding- Assigning a wire sheet input or output to a SLATE register or physical terminal on a SLATE module
- Link- Connecting function blocks with lines that represent data flow
- Kit- Once the wire sheet is complete it must be compiled and loaded into the SLATE Base Module. The file loaded into the base is called the “kit”
- Web Page- A human interface to the SLATE control. The web page may contain controls, readings, graphics, etc. Created using the SLATE Web Editor tool
- Macro- Within a wire sheet the user can create a macro which is a sub-routine (more logic) that may be commonly used in many applications. The macro does not contain links to the “outside” world or bindings. Once created it can be stored in a library and drug into the wire sheet as if it were another function block
- Application- An application is like a macro, but may contain links to the outside world and will require bindings.
- Cloud- Referring to network; pc, internet, intranet, or displays

The SLATE AX Tool Software

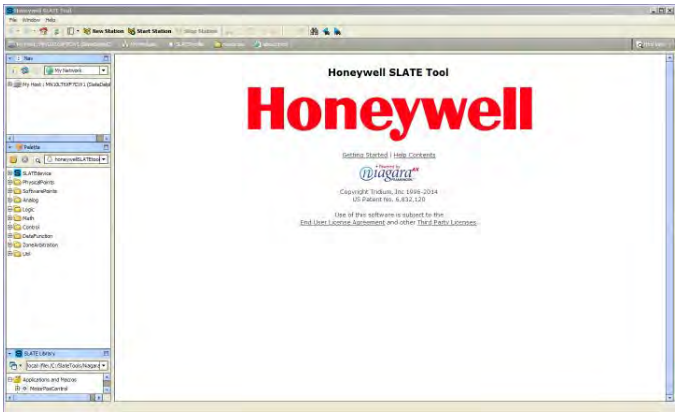
To begin using the SLATE AX Software find the SLATE icon on your desktop and double click it to launch the program.





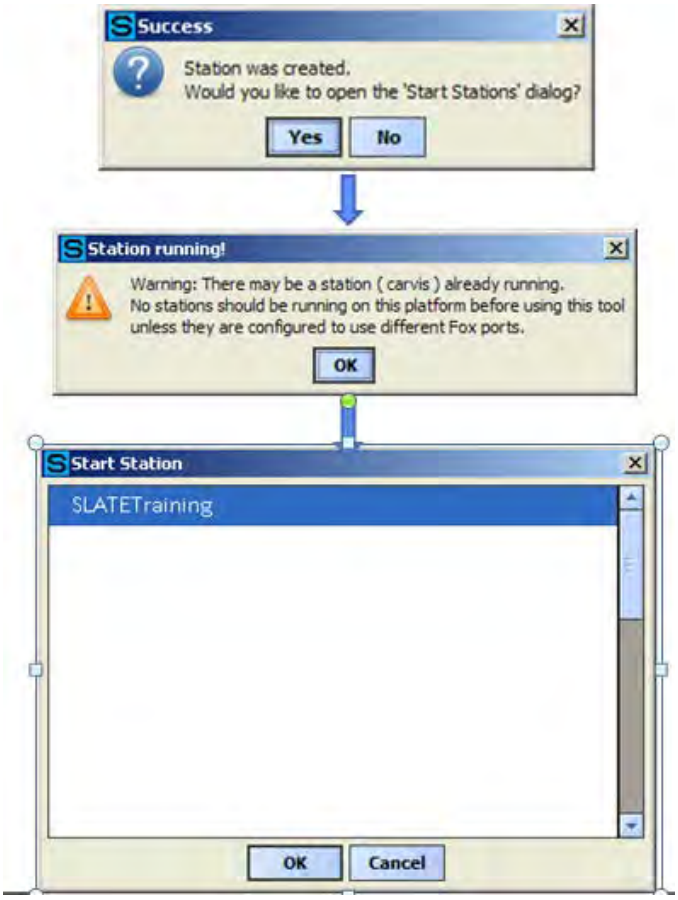
Honeywell will update the SLATE AX Tool periodically when new features are released. It is important to know what version you have installed and that information can be found in the upper left hand corner of the software.

1. To begin working on a project, click on Open SLATE AX Tool.

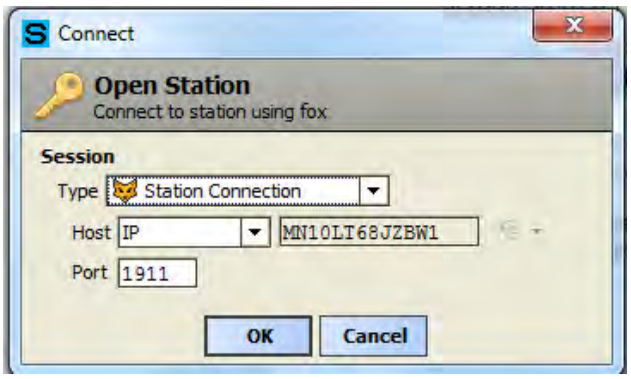


You need to create a Station. Click the New Station button to create the station. A dialog box appears that allows you to name the station. When naming a station do not use any special characters or spaces. Once the is created you will need to start the Station with the Start Station button that will start any existing changes and access any device within that station.





Creating a new station prompts you to name the station and then will ask if you would like to open the station you just created. If the station was already created and you would like to access it, simply click on the “Start Station” button and select the station you would like to open. When you have created or selected your station you will also be prompted to open it and the following dialog box appears with a drop down box. This drop down box includes two selections Station Connection and Station SSL Connection. Please select Station Connection.



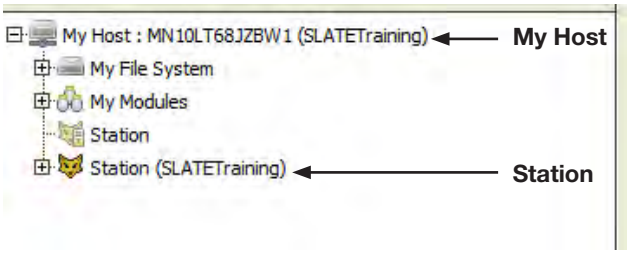
The Station will need authentication. The username is user and the password is SLATE. Please use these credentials. It is useful to select the “Remember these credentials”.



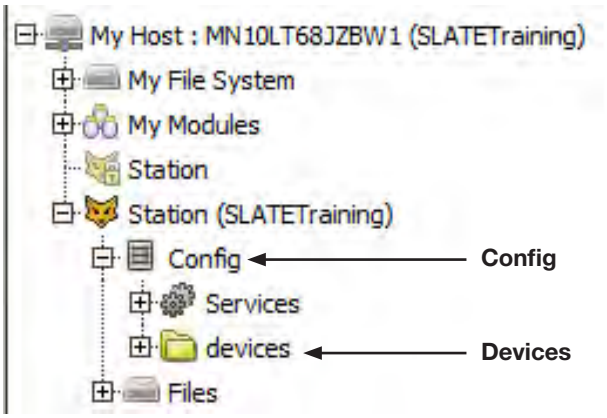
Username: user

Password: SLATE

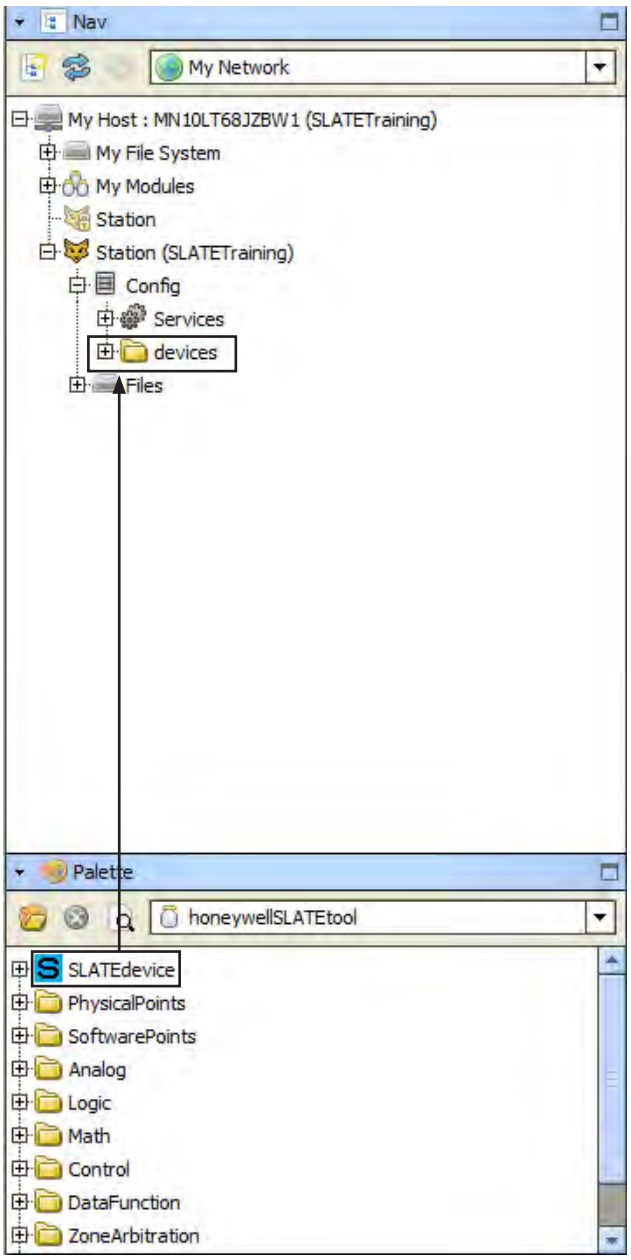
Once you have logged in, expand the My Host item by clicking the +SLATE AX Tool. Expand the Station by clicking it’s + symbol. See fig. below.



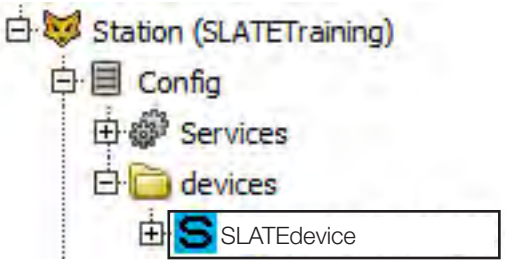
Expand the Config+ and expand devices+. This is where you will put SLATE devices. If this is your first device, the devices folder will be empty.



You will need to create a new device and put it in the devices folder. For the SLATE system you will see in the SLATE AX Tool Palette SLATEdevice. Click and drag the SLATEdevice from the Palette to the device folder in the Navigation pane until it is highlighted. Then drop it. See figure below.



This will be the look after you have moved the SLATEdevice folder into the devices folder.



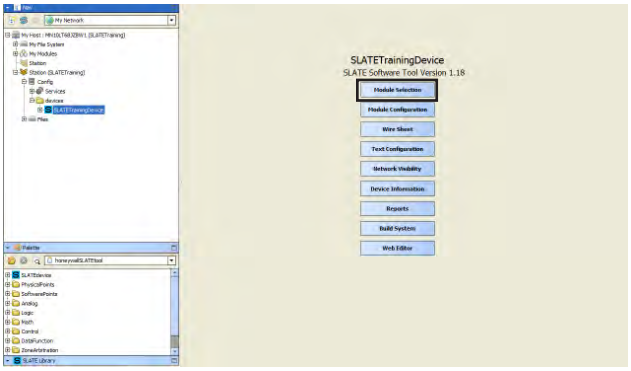
The SLATE AX Tool will require you to create a name for the new SLATE device within the devices folder. You can name the device

anything you would like. Avoid spaced in the device name because it will become the basis for your file name. See the example figure below.



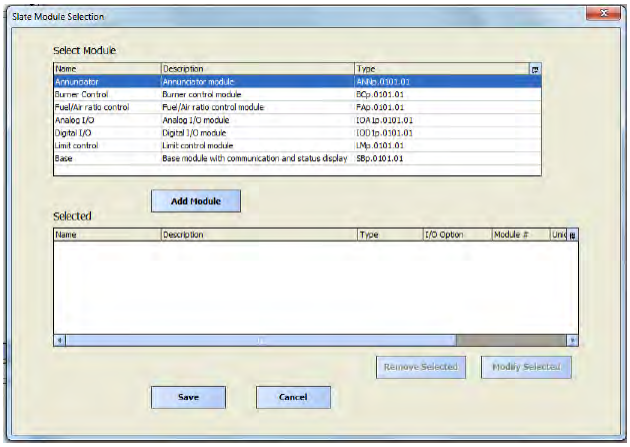
Module Selection

The next step to take is to define or select the modules you will be using in your project. By double clicking the SLATE device you just named, The SLATE AX Tool will display options for additional functionality through the following display. See figure below.



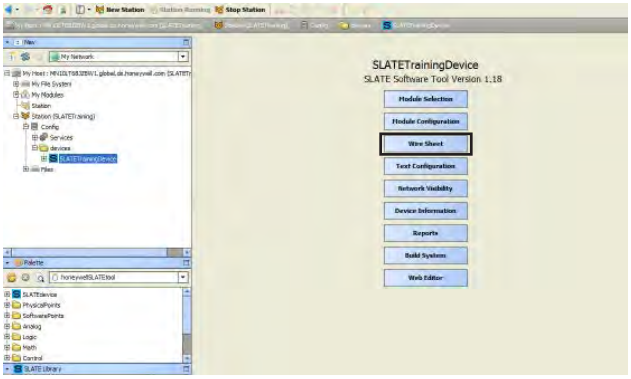
By clicking on the Module Selection tab you can begin adding the modules.

The Module Selection section of SLATE AX Tool let's you add SLATE modules. The top half lists all available modules. Clicking the Add Module button moves the highlighted module to the Selected List section below. The order in which the modules are selected does not have to match the order in which the modules are physically mounted to the DIN rail. However, the SLATE Base will always be module one on the left side of the DIN rail.

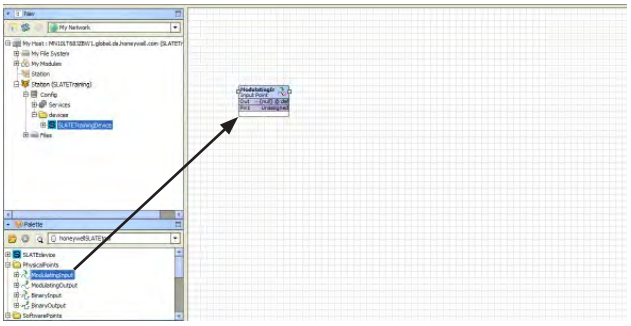


The tool will also allow you to remove or modify any selected modules.

When all modules are configured, you can continue by accessing the wire sheet where you will set up your SLATE devices and can begin programming your logic. Click the “Wire Sheet” button to begin.



Expand the content of the function block folders to expose the different function blocks available. To use them, simply select one and drag it onto the wire sheet. The flow of this editor moves from left to right. You will want to place input blocks on the left, logic in the middle and outputs toward the right to make the logic easier to follow.



Name the block with an appropriate name for the function of the block, for example “InterlockControl”. Note do not use spaces when naming blocks in SLATE AX Tool. Once the block is named you can reposition it anywhere on the work space and you have the ability to increase or reduce the block size by placing the cursor over the dots on the block and expanding and reducing as needed. For more information regarding SLATE AX Tool and the Wire Sheet functionality, particularly all function blocks please refer to the Function Block (Spyder) Library located on the SLATE website at combustion.honeywell.com.

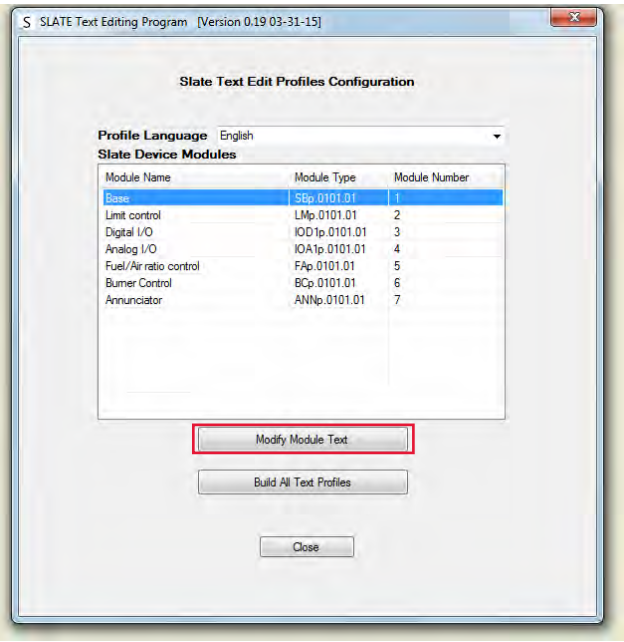
Chapter 3: SLATE Text Configuration and Network Visibility

SLATE Text Configuration

The SLATE Text Configuration feature allows you to edit text strings to provide better descriptions and translate text to other languages to suit your needs.

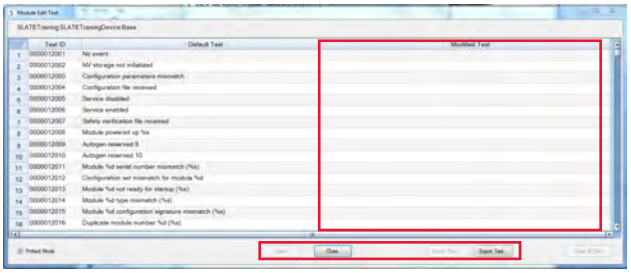
To access the Text Configuration tool launch SLATE AX Tool as shown below:



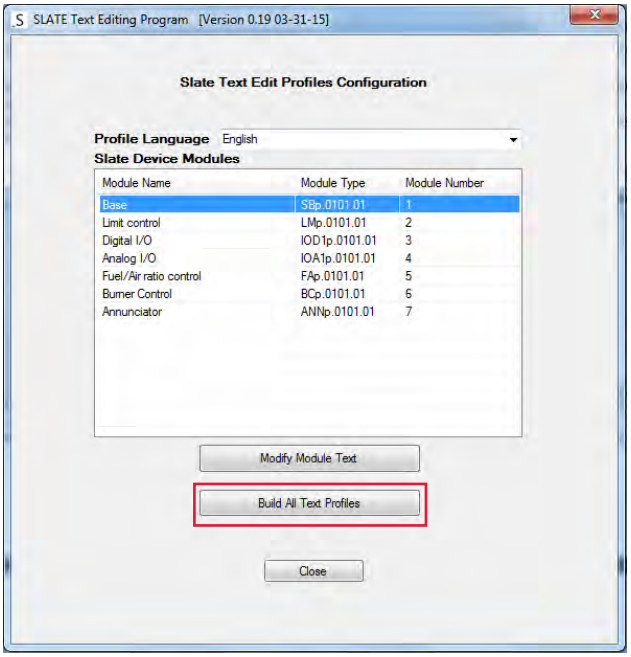


The Text Edit feature allows you to change any text based on the SLATE modules as highlighted above. Select a module, as in the example the Base, and select Modify Module Text. The drop down selection for the Profile Language is only compatible with English at print time. Other selections, French and Spanish will be completed in the next software release of SLATE.

Type the desired text in the Modified Text section to replace the Default Text. The Default Text is permanently stored in SLATE and will be used whenever no other text option is available. You can export and import text as needed by using the “Import Text” and “Export Text” buttons. When finished, click the “Save” and “Close” buttons.



Click the “Build All Text Profiles” to incorporate the changes into your SLATE Device.



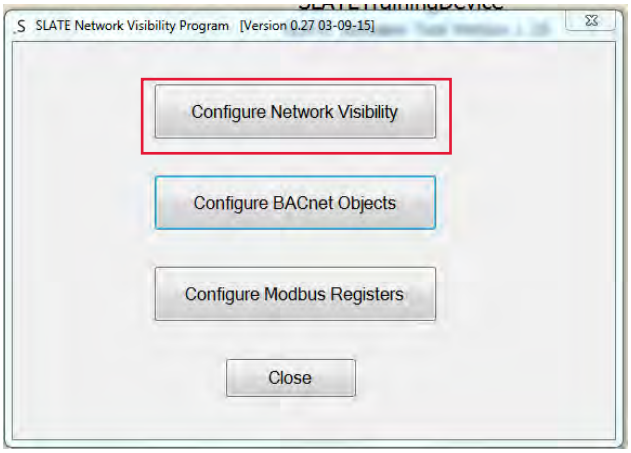
SLATE Network Visibility

The SLATE Network Visibility feature allows you to hide registers to make them inaccessible to the outside world, set register security

levels, and Configure BACnet objects and Modbus registers. Click on the “Network Visibility” button.



You can begin by setting Network Visibility. Click “Configure Network Visibility”. This is where we hide/unhide registers (external use-BACnet/Modbus) and select levels of security (read only, password protection). In order to see register information, a SLATE Wire Sheet device must have been previously created and built.

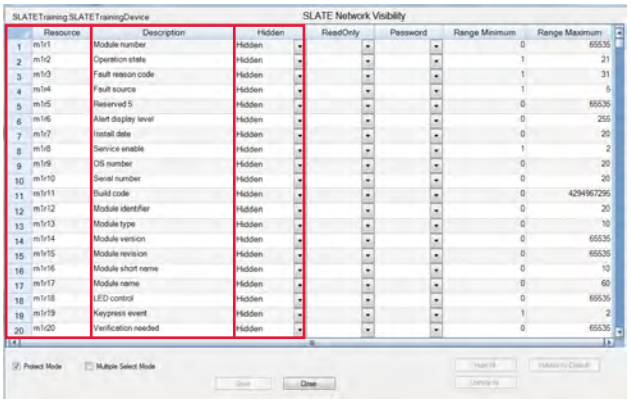


In order to edit values on this page, insure the “Protect Mode” box is unchecked.

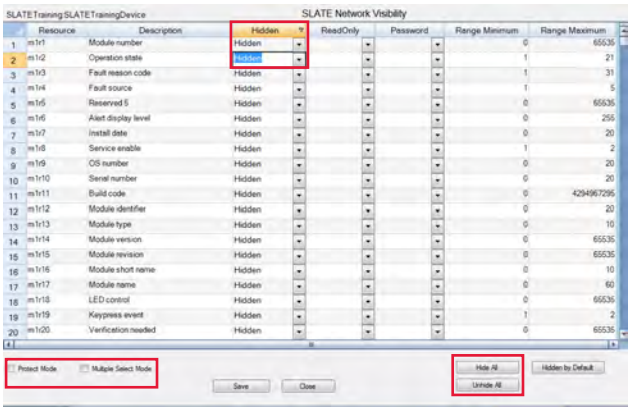
The Resource column identifies a SLATE module and register within that module. SLATE internal communication is based on module number and register number (“mr” value).

The Description column provides a short default description for the register.

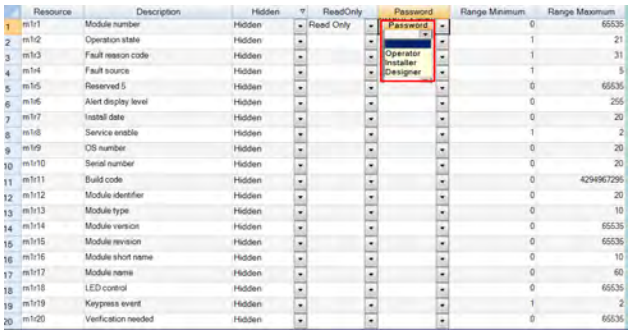
The Hidden column shows the register will be visible (available) for communication with external devices via BACnet and Modbus. Hidden registers can still be seen if used in a web page.



Expand each register drop down list individually to hide the register or leave blank to make the register information available. Click the “Multiple Select Mode” box to select multiple registers at once or use the “Hide All” or “Unhide All” buttons at the bottom of the window to set all registers. Insure the “Protect Mode” box is unchecked to edit. When finished, click the “Save” and “Close” buttons.



Another method to protect data in a register from being overwritten is by assigning it a security level. This is done in the “Password” column. Click the arrow in the register you want to protect and select the level of security you wish to assign to that register. Insure the “Protect Mode” box is unchecked! When finished, click the “Save” and “Close” buttons.



When setting the security levels, please note the following:

- Designer: Highest level of access: adjust safety parameters, build F/A curves, build kits, change set points, as well as software updates
- Installer: Next level of access: adjust safety parameters, build F/A curves, build kits, change set points, etc.
- Operator: Lowest level of access: change non-safety set points… allowed basic access (such as temp/pressure control and other basic items that keep the equipment running).

To access areas of SLATE including, fuel air commissioning, installing kits, and updating software the following are the passwords used with the different levels of users.

Default passwords:

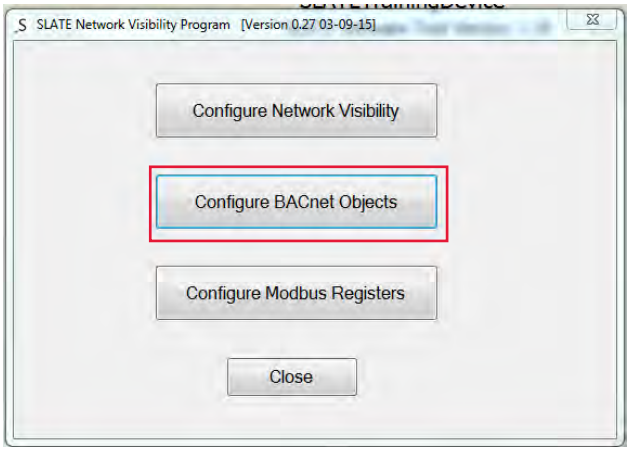
- Designer: SlateDesignerPassword
- Installer: SlateInstallerPassword
- Operator: SlateOperatorPassword

The register minimum and maximum values are shown for all registers in the “Range Minimum” and “Range Maximum” columns. The register minimum and maximum values can be edited as long as the new values are not less than the “Range Minimum” value or greater than the “Range Maximum” value (outside the existing range). When finished, click “Save” and “Close Buttons”

Range Minimum	Range Maximum
0	65535
1	21
1	31
1	5
0	65535
0	255
0	20
1	2
0	20
0	20
0	4294967295
0	20
0	10
0	65535
0	65535
0	10
0	60
0	65535
1	2
0	65535

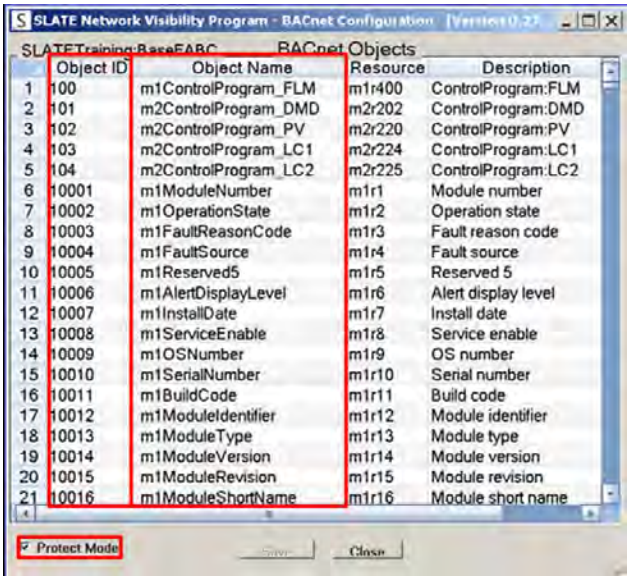
SLATE BACnet Configuration

To enable communication via BACnet, click on the “Configure BACnet Objects” to make modifications as necessary.



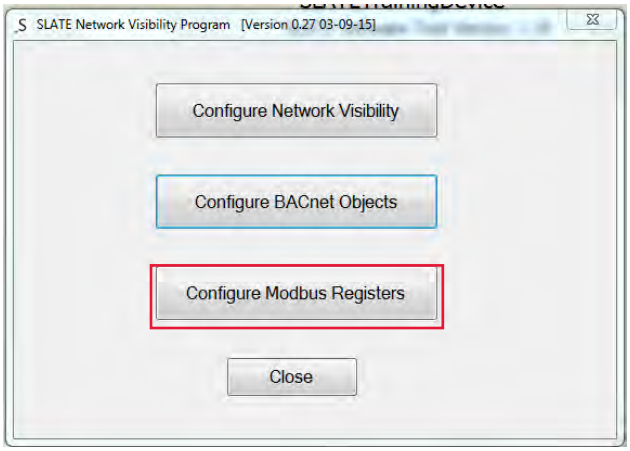
You can renumber the BACnet Object ID and Object Name. Uncheck to exit the Protect Mode and enter your changes in the appropriate rows.

Note: If you have not constructed a SLATE Wire Sheet with network inputs, network outputs and registers, your register page will be blank.

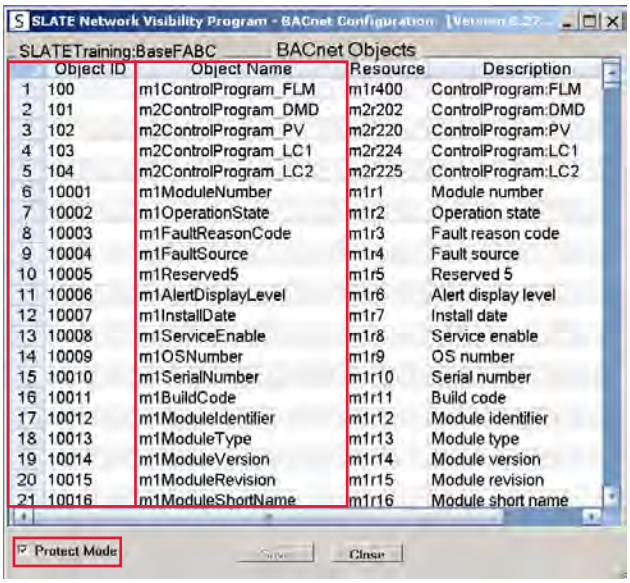


Modbus Configuration

To enable communications via Modbus, click the “Configure Modbus Registers” to make modifications as necessary.



The same rule applies to Modbus registers as BACnet registers, a SLATE Wire Sheet with network inputs, network outputs, and registers must exist to show the registers on the configuration page. This view allows you to renumber the Register value (external) and edit the Register Name. Uncheck to exit the Protect Mode and enter your changes in the appropriate rows.



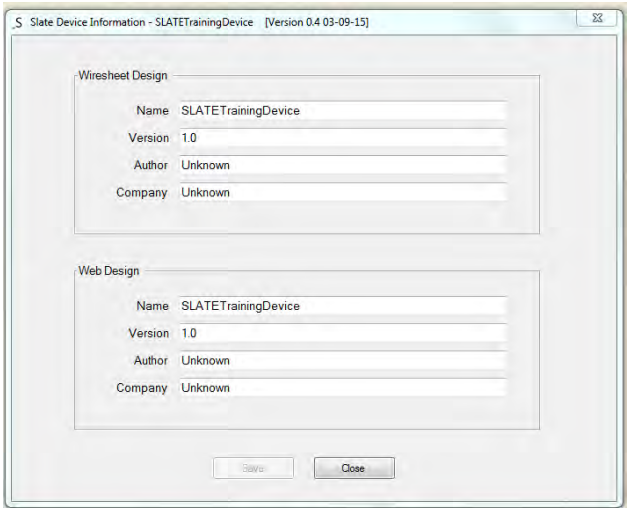
	Object ID	Object Name	Resource	Description
1	100	m1ControlProgram_FLM	m1r400	ControlProgram:FLM
2	101	m2ControlProgram_DMD	m2r202	ControlProgram:DMD
3	102	m2ControlProgram_PV	m2r220	ControlProgram:PV
4	103	m2ControlProgram_LC1	m2r224	ControlProgram:LC1
5	104	m2ControlProgram_LC2	m2r225	ControlProgram:LC2
6	10001	m1ModuleNumber	m1r1	Module number
7	10002	m1OperationState	m1r2	Operation state
8	10003	m1FaultReasonCode	m1r3	Fault reason code
9	10004	m1FaultSource	m1r4	Fault source
10	10005	m1Reserved5	m1r5	Reserved 5
11	10006	m1AlertDisplayLevel	m1r6	Alert display level
12	10007	m1InstallDate	m1r7	Install date
13	10008	m1ServiceEnable	m1r8	Service enable
14	10009	m1OSNumber	m1r9	OS number
15	10010	m1SerialNumber	m1r10	Serial number
16	10011	m1BuildCode	m1r11	Build code
17	10012	m1ModuleIdentifier	m1r12	Module identifier
18	10013	m1ModuleType	m1r13	Module type
19	10014	m1ModuleVersion	m1r14	Module version
20	10015	m1ModuleRevision	m1r15	Module revision
21	10016	m1ModuleShortName	m1r16	Module short name

SLATE Device Information, Reports and

Build System

The SLATE Device Information screen provides information about the SLATE Device, both the SLATE Wire Sheet and the Web pages. Edits can be made from this screen.





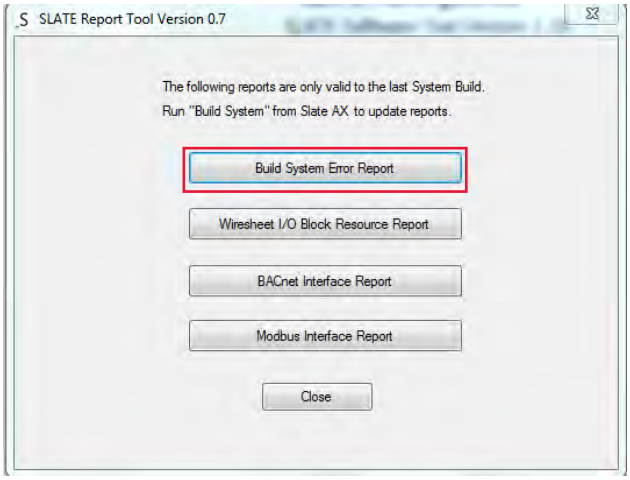
SLATE Reports

SLATE generates reports on all aspects of functionality including generated errors. Click on the “Reports” button for detailed information about your SLATE device.

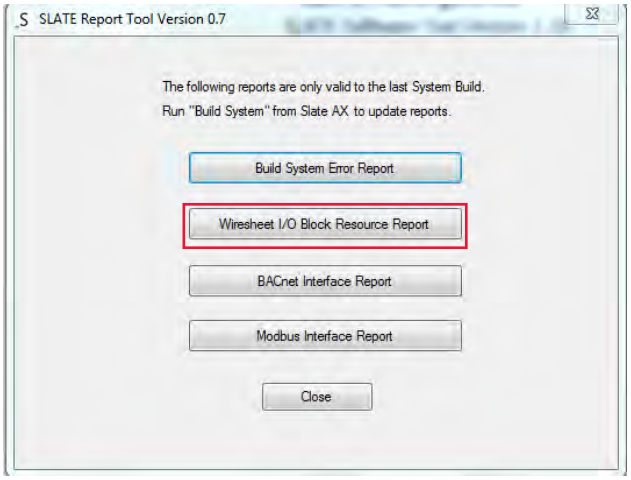


Reports can be generated identifying configurations an I/O usage, build errors, and communication interface for BACnet and Modbus.

Click the “Build System Error Report” when build failures occur. The report will indicate the build failure reason, giving you an opportunity to make corrections to the wire sheet and to build again.

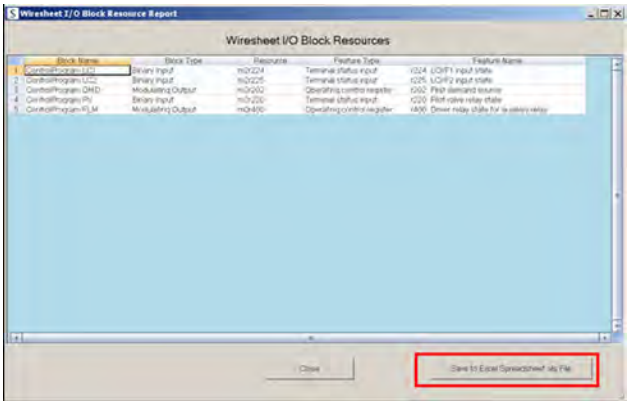


The “Wiresheet I/O Block Resource Report” gives general usage details. Click the “Wiresheet I/O Block Resource Report “button.

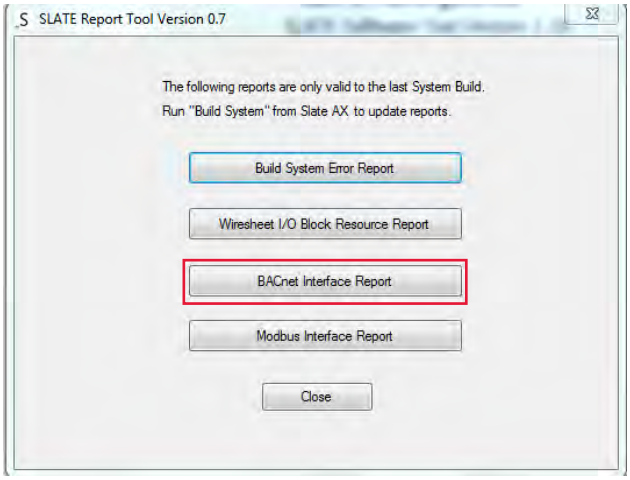


The Wiresheet I/O Block Report summarizes the I/O created in the wire sheet by way of block name, block type, resource or “mr” value, feature type, and feature name. This list can be saved for the project documentation by clicking on the “Save to Excel Spreadsheet” button. When you are finished click “Close” to return to the report selection window.

Note: You need a wiresheet for this report to work.

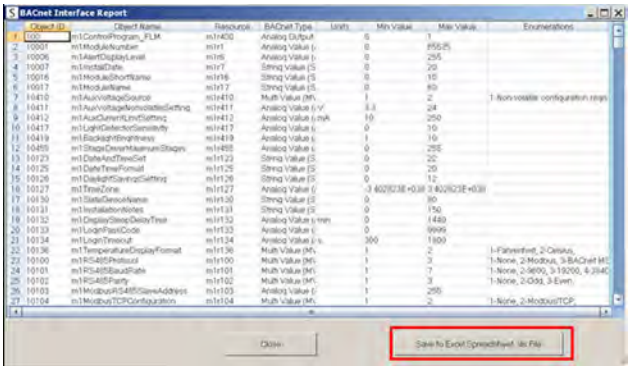


A BACnet object report can be generated for the project records or given to the end user for their records. Click the “BACnet Interface Report” button.



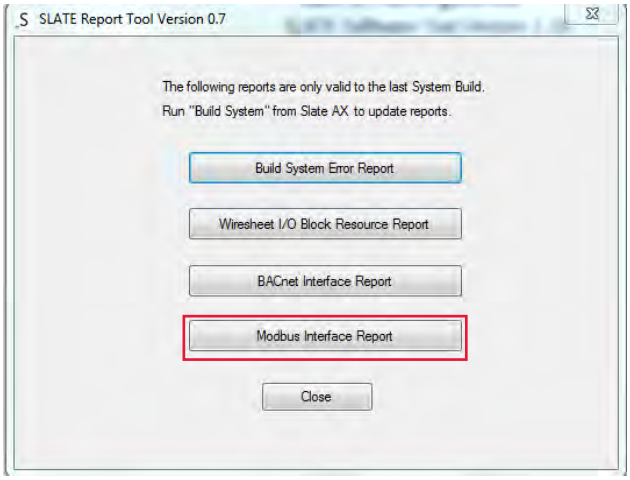
Either highlight the portion of the list that is of interest and copy or use the “Save to Excel Spreadsheet” button to copy the entire BACnet object list.

As noted before, you will need to have in your wiresheet network inputs, network outputs, and setpoints for BACnet registers.



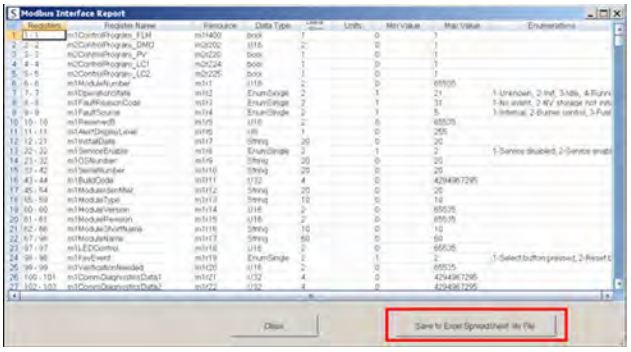
When you are finished click the “Close” button to return to the report selection window.

A Modbus register report can be generated for the project records or to be given to the end user for their records. Click the “Modbus Interface Report” button.



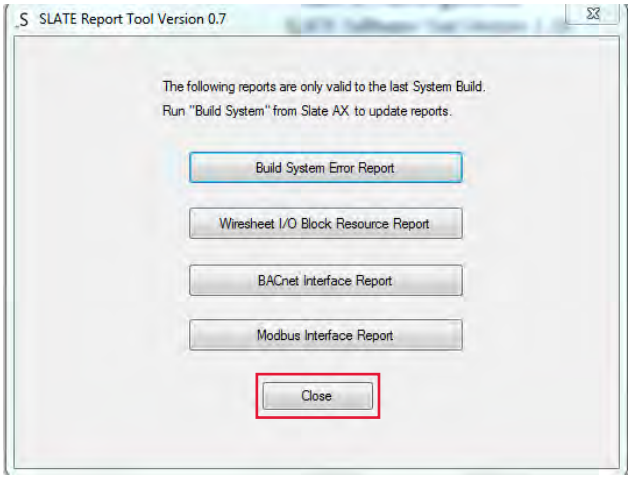
Same rule does apply to the Modbus Interface Report as the BACnet interface report. You will need a SLATE wire sheet with networking inputs, networking outputs and setpoints for this report to work.

Highlight the portion of the list that is of interest and copy or use the “Save to Excel Spreadsheet” button to copy the entire Modbus register list.



When finished click the Close button to return to the report selection window.

When you are finished click the Close button to return to the SLATE device.



The “Build System” button is used to compile the wire sheet. This process makes sure that there are no duplicate or erroneous configurations. Any errors will generate a “Build System Error Report” which can be found in the Reports section.



The SLATE Web Editor section is located in Chapter 14.

Chapter 4: SLATE Base Module Setup and Configuration



Overview

The R8001A1001 SLATE Base Module provides communications and power supply for the SLATE system, configurable safety for the Burner Control, Flame Amps, Fuel Air Ratio, and Limit modules. It also provides programmable logic for the Digital and Analog I/O, and Annunciation.

Within the SLATE system, the Base Module provides:

- Power to all modules with multiple voltage options
- External communication protocols: Modbus/TCP, BACNet MSTP or IP and web services
- Overall health of the system
- The ability to do remote troubleshooting
- Network identification of the system as a single device
- Web-based pages (both Honeywell provided and designer customized) for Web browser access to the system
- Module identification for the system
- Event log storage for user lockouts, fault history, and user requested events
- Trend logging for user specified data

Specifications

Electrical Ratings:

Input Voltage and Frequency:
24 VDC (± 15%)
24 VAC (± 15%)
85-264 VAC, 50/60 Hz

Output Voltage and Frequency:
18 VDC (± 1 VDC)

Power Dissipation:
38W max @ 24V (approx. 12 modules)
45W max @ 85-264V (approx. 14 modules)

Fusing Total Connected Modules: 5A, slow type, non-replaceable

Terminal Ratings are below:

Terminal	Description	Rating
E100-1	L1 - line voltage hot	---
E100-2	L2 - line voltage common	---
E100-3	PE - Earth Ground	---
E200-1	Alarm (dry contacts)	120 / 240 VAC, 1A pilot duty
E200-2	Alarm (dry contacts)	120 / 240 VAC, 1A pilot duty
E200-3	Unused	---
E200-4	A (BACnet MS/TP)	---
E200-5	B (BACnet MS/TP)	---
E200-6	GND (BACnet MS/TP)	---
E200-7	VAUX +	3.3-24 VDC output, 250mA max
E200-8	VAUX - [a]	3.3-24 VDC output, 250mA max

[a] Do not connect to earth ground.

Environmental Ratings

Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
LCD Operating: 32°F to +150°F (0°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C)

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Approvals:

Underwriters Laboratories Inc. Listed, File: MP268.
IRI acceptable.
Federal Communications Commission: Part 15, Class A Emissions.
Must be mounted inside a grounded metal enclosure.

LED Array

There are three LEDs on the front of the base module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s).

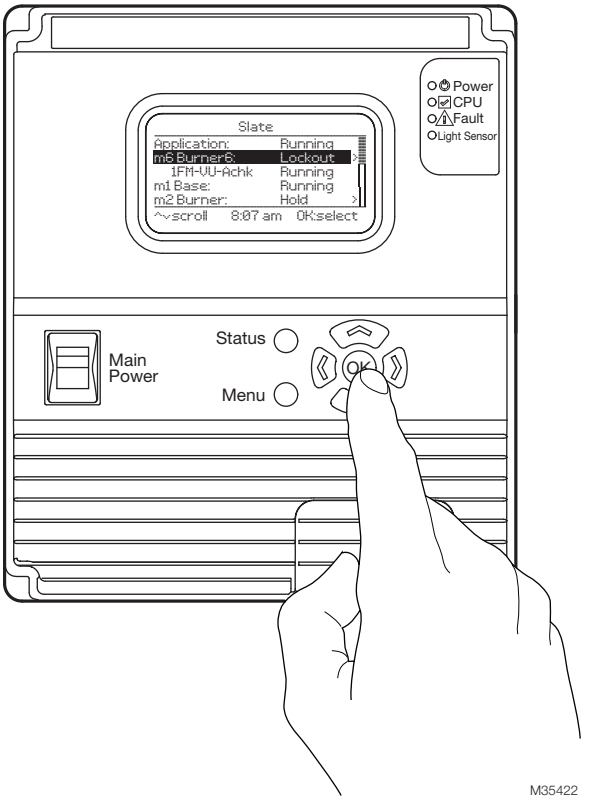
LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	Running

There are three LEDs on the front of the Base Module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s).

LCD Screen

The Base Module LCD screen will show information about various modules and other parts of the combustion system. By using the arrow keys to navigate the items on the LCD screen, then press OK to select one.

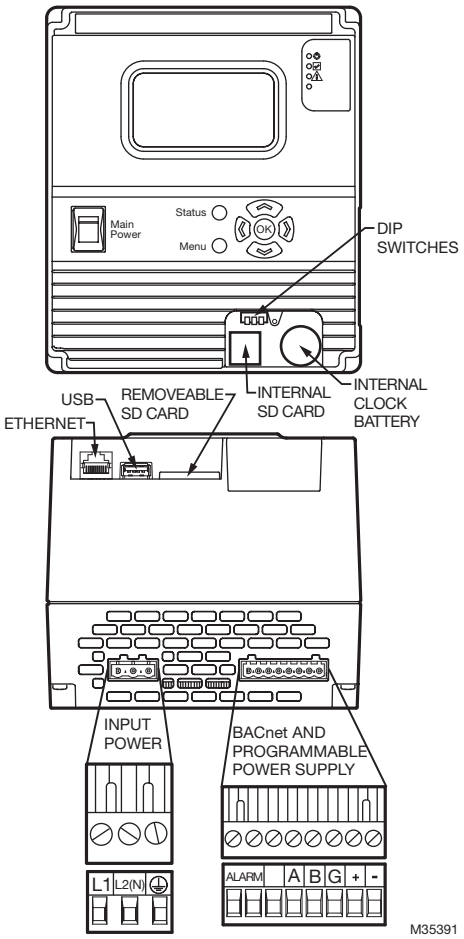
The figure below shows Burner6 is in lockout. For additional information, navigate to that menu item and press OK.



Wiring

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved
2. Wiring must comply with all applicable codes, ordinances and regulations.

Note: MS/TP must be wired in a straight line without spurs—no star wiring.



3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.
4. The Base Module should not interfere with proper safety operation of the controls, limits, and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS, AND INTERLOCKS.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16, or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C

Application	Recommended Wire Size	Recommended Part Numbers
Communication lines[a]	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

BACnet MS/TP connections must be wired in daisy chain configuration, 1 (a)-1(a), 2(b)-2(b), 3(c)-3(c). The order of interconnection of all the devices is not important. Be aware that the termination DIP switch (number 3) must be used if the SLATE system is at the end of connections over 100 feet.

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth ground

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

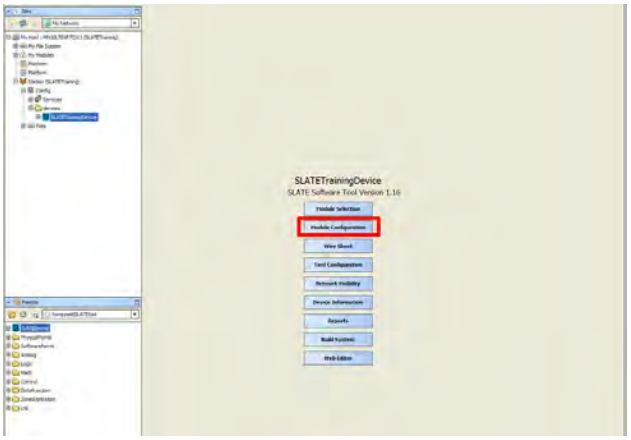
Recommended wire routing of leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.
- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

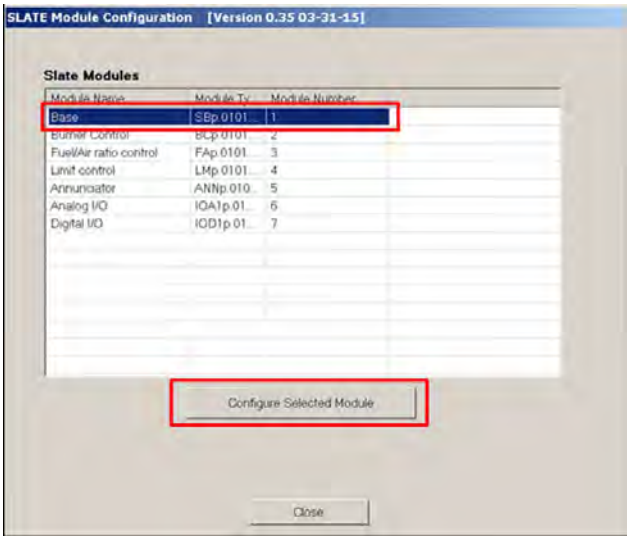
Be sure loads do not exceed the terminal ratings.

Base Configuration with SLATE AX Tool

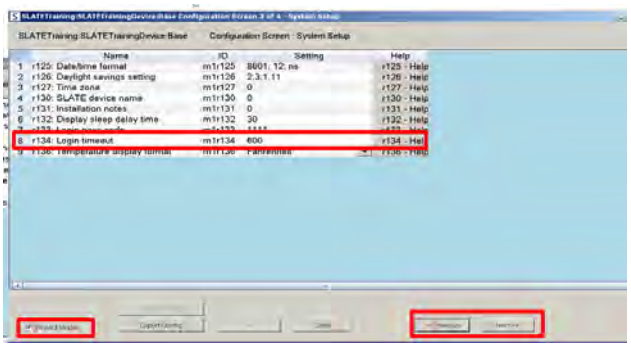
The SLATE AX Tool is used to configure all modules within the SLATE family. To configure the Base Module you will use the SLATE AX Tool Module Configuration selection.



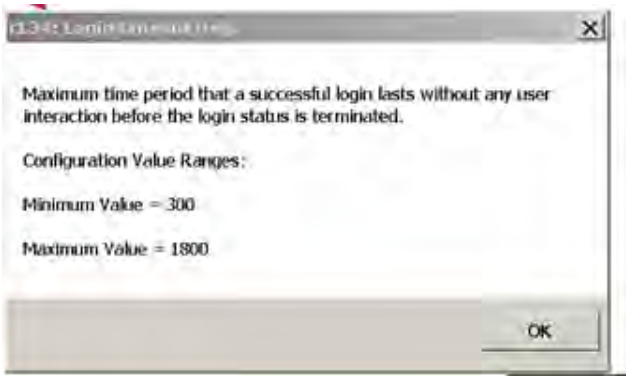
1. After selecting Module Configuration you will be presented with the SLATE Module Configuration screen. Select Base.



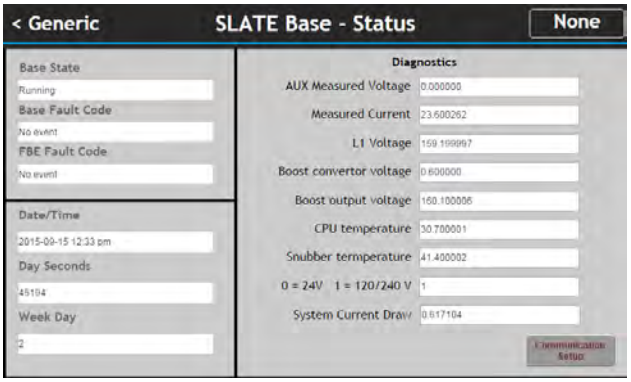
2. Select Configure Selected Module.
3. All registers containing information related to the Base are made available for editing. Use the Previous or Next buttons to maneuver through the Base registers. Editing these registers is possible only when the “Protect Mode” check box is unchecked.



4. Help files are available to describe the register details. Clicking in the Help column and register will reveal information about the register.



5. After you have completed setting the registers, you will need to click the Save button. You will be asked to confirm that you want to save the changes. Simply click Yes.



SLATE Base HMI Screen

Chapter 5: Burner Control Module and Configuration



Overview

The R8001B2001/U Burner Control Module is a configurable flame safeguard control that can sequence a commercial or industrial burner. Applications include automated fired gas, oil or combination fuel single burners. It may be configured as a primary or programmer, automatic or semi-automatic with many selectable options.

As well, the SLATE Burner Control Module may be configured to emulate various Honeywell 7800 SERIES flame safeguard controls such as RM7800L, RM7800G, RM7800M, RM7800E, RM7838A, RM7838 and EC7850 and many other models. Emulation of the 7800 SERIES controls via canned configurations is completed at the Base Module level, where the entire configuration kit is stored.

The SLATE AX Tool is used to configure the Burner Control Module parameters.

For enhanced diagnostics, the SLATE Annunciator Module can be used. The Annunciator Module monitors the status of individual components in a series wiring of limits, control and/or interlock contacts wired to the Burner Control Module. Refer to Chapter 13 for further information on the Annunciator Module.

Status LEDs

There are 4 LEDs on the front of the Burner Control Module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s). See the table below for descriptions of the four status LEDs.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No valid configuration
	Green	Running
Fault	Red	Fault
	No light	No fault
Flame	Yellow	Flame is detected
	No light	No flame is detected

There are also 17 separate LEDs for each of the Burner Control Module terminals. See the table below for module terminal LED descriptions.

Color	Description
Green	Terminal is ON or is Normal
Red	Fault
No light	Terminal is OFF or Not in use

LED Display

All SLATE system modules have a seven-segment, three-position LED display for indicating the assigned module number of the SLATE system.

Select and Reset Buttons

All SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

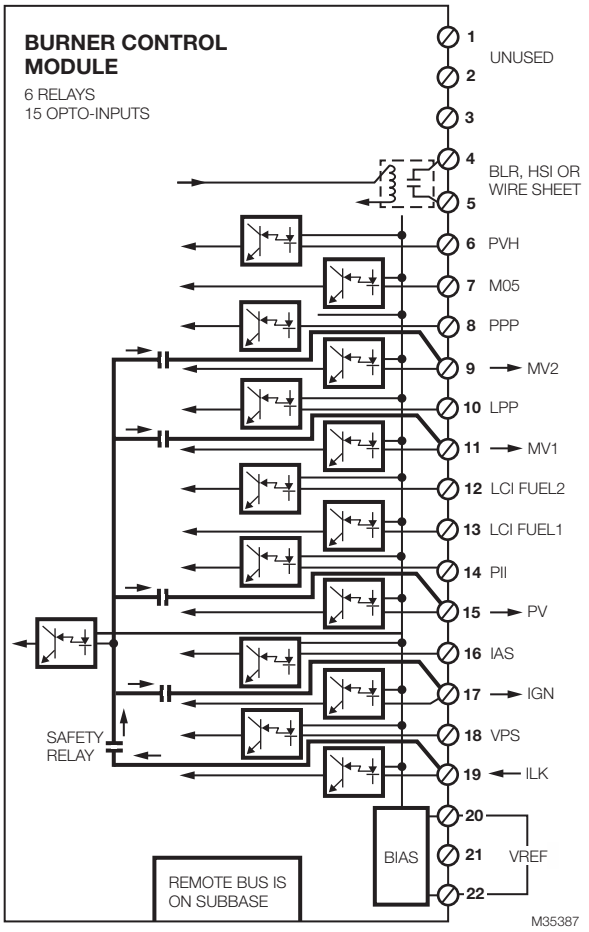


Understanding the Terminals

The SLATE Burner Control Module contains 22 wired terminals. All terminals are 24VDC or 24-240VAC and automatically adapt to the applied system voltage.

The LCI (limit and control input) terminals 12 and 13 for fuel 2 and 1 provide connection to limits and operating controls. They must be closed before burner startup is allowed. If they are open during Run mode, it causes the burner to shut down. The LCI terminals can optionally generate a call-for-heat when they are closed. When the dual fuel option is enabled, the LCI/F2 or LCI/F1 LED indicates the selected fuel. The Burner Control Module wiring terminal descriptions can be found in the table below.

Note: Only one voltage can be applied per module (same at all terminals).



Label	Terminal	Description	Rating	Information
mA/V ↓	1	Not used	-	-
	2	Not used	-	-
-	3	Not used	-	-
K1	4	BLR, HSI or Wire Sheet, K1 relay dry contacts	9.8 FLA, 58.8 LRA @120VAC, 20A inrush @240VAC	Dry contacts for burner, fan, blower or HSI (hot surface ignition) or used by SLATE wire sheet
	5			
PVH	6	Pilot valve hold	24VDC (0.5 mA), 24-240VAC (0.2 mA)	Manually operated during Run to relight the pilot and then turn off the main burner, until PVH is turned off again, which relights the main burner.
MOS	7	Manual open switch		Used when a main valve must be opened normally before lighting the burner. The switch closes when the manual valve is fully open.
PPP	8	Purge position proven)		A PPP switch (or High Fire Switch) is used for mechanical throttle systems. It closes when airflow is sufficient to purging.
MV2 ►	9	Main valve 2	4A (0.5 PF) @120VAC, 2.0A inrush @240VAC, 2A continuous, 10A inrush @ 24VDC	Second main fuel valve in a double block system. May be used for delayed main (2nd stage) valve or VPS (valve proving sequence).
LPP	10	Lightoff position proven	24VDC (0.5 mA), 24-240VAC (0.2 mA)	An LPP switch (or Low Fire Switch) is used for mechanical throttle systems. It closes when the throttle position is correct for lightoff.

Label	Terminal	Description	Rating	Information
MV1 ▶	11	Main valve 1	4A (0.5 PF) @120VAC, 2.0A inrush @240VAC, 2A continuous, 10A inrush @ 24VDC	First main fuel valve in a double block system. May be used to power both main valves or for VPS (valve proving sequence).
LCI/F2	12	Limit and control input, Fuel 2	24VDC (0.5 mA), 24-240VAC (0.2 mA)	Provide connection to limits and operating controls. It must be closed before burner startup is allowed. If it is open during Run, it causes burner shutdown. It can optionally generate a call-for-heat when it closes. When the dual fuel option is enabled, the LCI/F2 or LCI/F1 LED indicates the selected fuel.
LCI/F1	13	Limit and control input, Fuel 1		
PII	14	Pre-ignition interlocks		Interlock connection required to be closed before ignition sequence begins. Typically POC (proof of closure switch).
PV ▶	15	Pilot Valve	4A (0.5 PF) @120VAC, 20A inrush @240VAC, 1A continuous, 5A inrush @ 24VDC	Pilot valve connection point.
IAS	16	Interrupted Airflow Switch/ Lockout input	24VDC (0.5 mA), 24-240VAC (0.2 mA)	Airflow proving switch input or lockout input for EU.
IGN ▶	17	Ignition	4A (0.5 PF) @120VAC, 20A inrush @240VAC, 1A continuous, 5A inrush @ 24VDC	Ignition transformer connection point.
VPS	18	Valve Proving Switch (VPS)	24VDC (0.5 mA), 24-240VAC (0.2 mA)	Valve proving sequence (VPS) switch input. Provided from a pressure switch which is mounted between the two main gas shutoff valves (MV1 and MV2). It is used to perform the systematic gross leakage test.
ILK ◀	19	Lockout Interlocks		Lockout interlock input string connection point.
Vref+	20	Reference voltage +	24VDC (0.1 mA), 24VAC (0.1 mA) 85-264VAC (0.2 mA)	Voltage reference circuit.
-	21	Not used	-	-
Vref-	22	Reference voltage -	24VDC (0.1 mA), 24VAC (0.1 mA) 85-264VAC (0.2 mA)	Voltage reference circuit

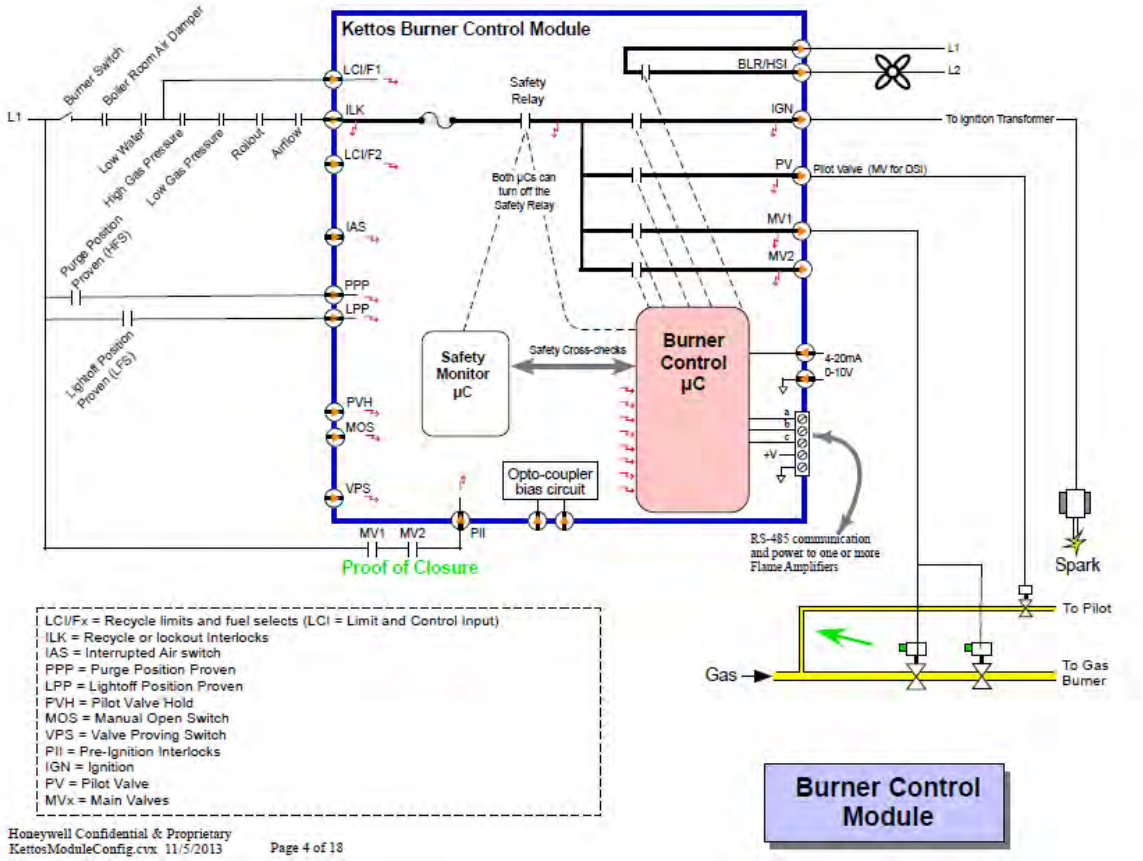
Wiring

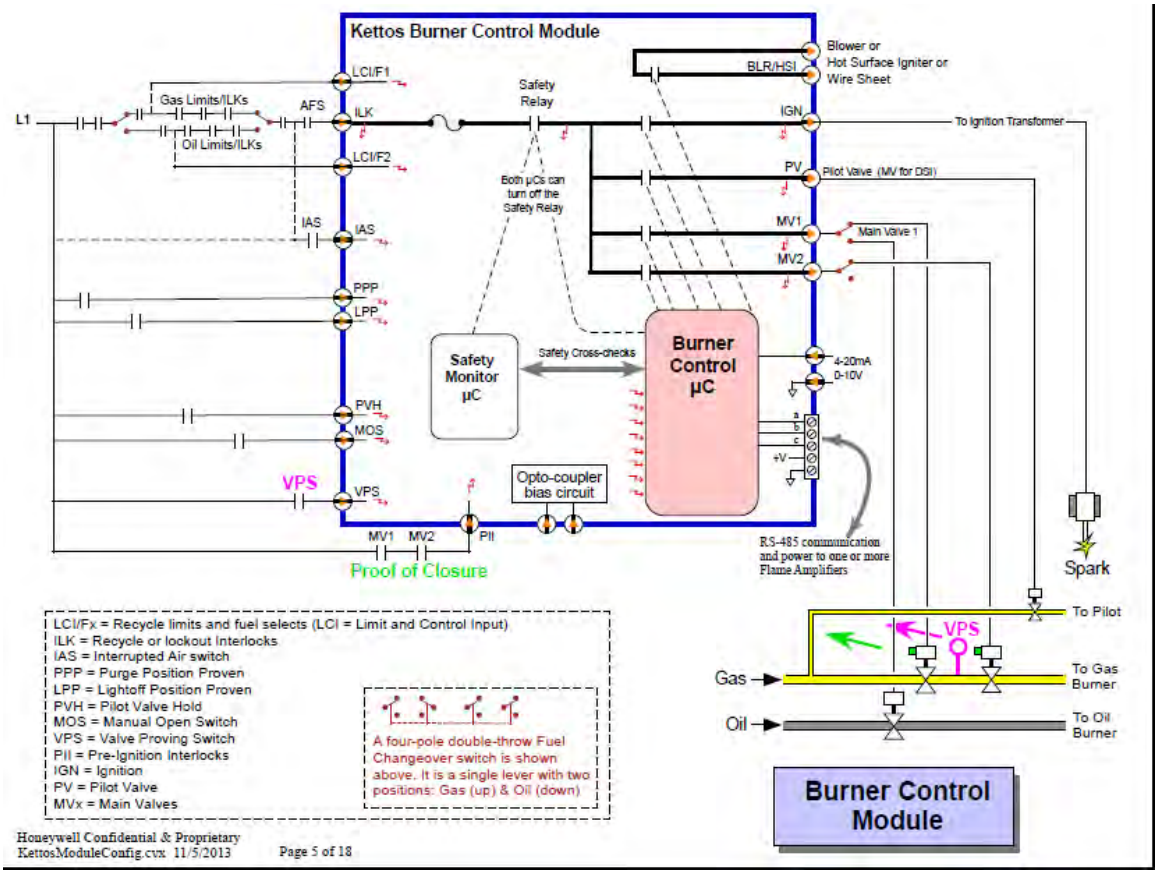
For installation and wiring information, refer to document 32-00010, the SLATE Burner Control Module Installation Instructions.

The SLATE AX Tool is used to configure the 128 available Burner Control Module parameters which are relative to the type of burner and terminals used.

It is important to lie out and understand the wiring to and from the Burner Control Module as well as the full system wiring before proceeding with configuration.

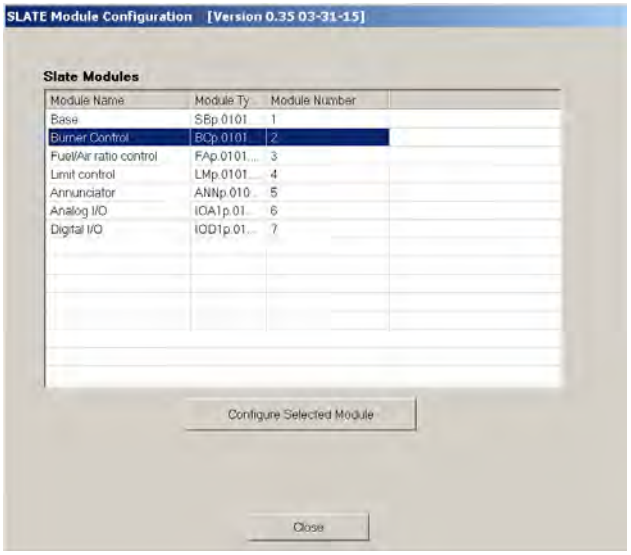
Examples of single and dual fuel wiring with the SLATE Burner Control Module are shown below.


Kettos Burner Control Module
L1
Burner Switch
Boiler Room Air Damper
Low Water
High Gas Pressure
Low Gas Pressure
Relout
Airflow
LCI/F1
ILK
LCI/F2
IAS
Purge Position Proven (HFS)
PPP
LPP
Lightoff Position Proven (LFS)
PVH
MOS
VPS
MV1
MV2
PII
Proof of Closure
Safety Relay
Both µCs can turn off the Safety Relay
Safety Monitor µC
Safety Cross-checks
Burner Control µC
Opto-coupler bias circuit
BLR/HSI
IGN
PV
MV1
MV2
L1
L2
To Ignition Transformer
Pilot Valve (MV for DSI)
4-20mA
0-10V
a
b
c
+V
RS-485 communication and power to one or more Flame Amplifiers
Spark
To Pilot
Gas
To Gas Burner
LCI/Fx = Recycle limits and fuel selects (LCI = Limit and Control Input)
ILK = Recycle or lockout Interlocks
IAS = Interrupted Air switch
PPP = Purge Position Proven
LPP = Lightoff Position Proven
PVH = Pilot Valve Hold
MOS = Manual Open Switch
VPS = Valve Proving Switch
PII = Pre-Ignition Interlocks
IGN = Ignition
PV = Pilot Valve
MVx = Main Valves
Honeywell Confidential & Proprietary
KettosModuleConfig.cvx 11/5/2013
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Burner Control Module



Getting Started

1. To access the configuration tool you will need to launch the SLATE AX Tool
2. If you have not created a Station please refer to Chapter 2 of this manual to learn how to create a new station.
3. If you have created a Station open up the Navigation pane until to reach your SLATE Device. Double-click on the SLATE device to launch the Module Configuration Tool.
4. Select “Burner Control” from the module list as shown below, then click on “Configure Selected Module.”

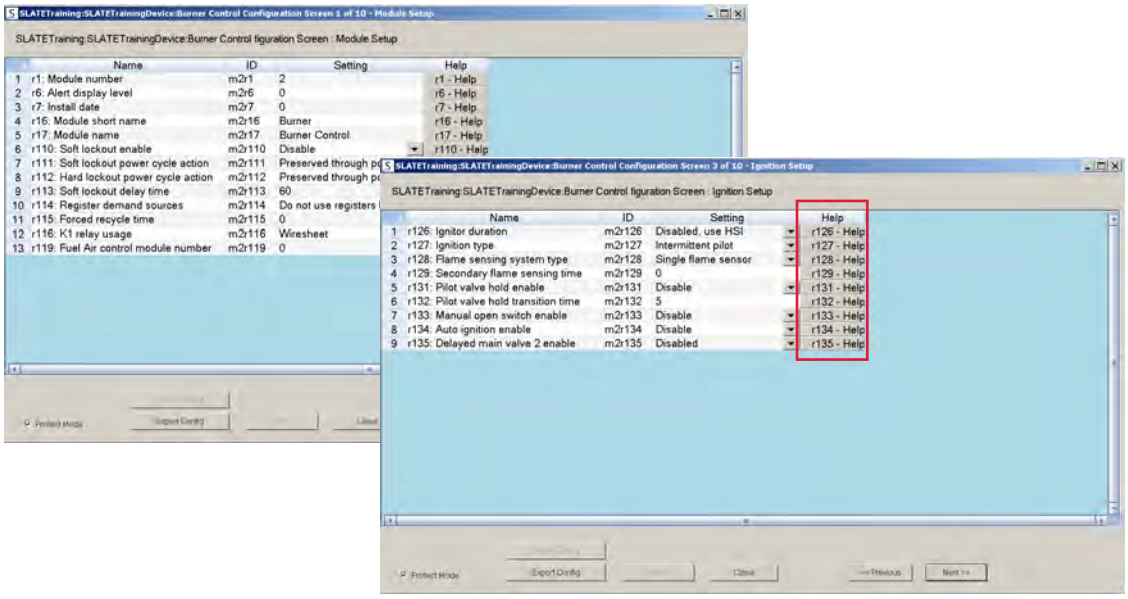


5. You should be taken to a set of screens that allow you to setup the burner control parameters. This is how the SLATE Burner Control Module is configured for use. The settings are selected by utilizing the pull-down menus. There are 128 parameters that will need to be configured.

Note: Help files are available to describe the parameter / register details. For further information on a specific parameter/register, select the Help button on the far right of the screen.

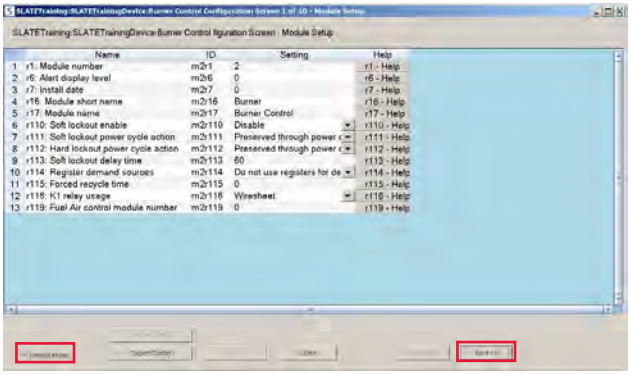
After you have configured all of the parameters you will need to click the Save button.

Once you are done with all of the SLATE programming and configuration it will be stored as a kit file as explained in “Load the SLATE Device” on page 8.



6. Before proceeding, you must uncheck the “Protect Mode” box to allow editing of the configuration.

   Use the “Next” and “Previous” buttons to move through the Burner Control Module configuration pages.



7. There are 128 configurable registers/parameters in the SLATE Burner Control Module. Not all available parameters must be used since fuel air and limit module interactions are included. There are 10 categories of setup parameters; module, rate, ignition, flame module, timings, interlocks, failure response, recycle, valve proving and limit socket. These are shown in the table below.

Category	Register #	Name	Description	Default Value	Range
Module Setup	r1	Module number	Assigned module number in SLATE rack	-	2-99
	r6	Alert display level	Enable/disable alert output	0	0 Disable >0 Alert context level
	r7	Install date	Date when this module was installed in the system	-	-
	r16	Module short name	For Base Module use	Burner	-
	r17	Module name	For Base Module use	Burner Control	-
	r110	Soft lockout enable	Master enable for soft lockouts. If this parameter value is Disable, then all soft lockouts become hard lockouts.	1	1 Disable 2 Enable
	r111	Soft lockout power cycle action	Action to follow when the control power cycles and it is in a soft lockout condition.	1	1 Preserved through power cycle 2 Cleared by power cycle
	r112	Hard lockout power cycle action	Action to follow when the control power cycles and it is in a hard lockout condition.	1	1 Preserved through power cycle 2 Cleared by power cycle
	r113	Soft lockout delay time	Length of time to delay after a lockout occurs before automatically clearing the lockout and resuming	60	0-60 seconds
	r114	Register demand sources	Identifies the registers used to request burner demand.	1	1 Do not use registers for demand 2 Demand 1 Register 3 Demand 2 Register 4 Demand 1 OR Demand 2 Register
	r115	Forced recycle time	Maximum time length that the burner can continuously run before it is automatically recycled.	0	0-24 hours 0=Disabled
	r116	K1 relay usage	Specifies how the K1 relay will be used. 1 If wire sheet is chosen, the relay is not used by the burner control and may be controlled by wire sheet logic. 2 If Hot surface igniter (HSI) is chosen, the relay is closed during the pre-ignition state and throughout the Direct Burner Ignition (DBI) state or Pilot Flame Establishing Period (PFEP), whichever is enabled. Turning on the HSI option disables the IGN output; it remains off. 3 If Blower is chosen, the relay is closed at the start of prepurge and it remains closed up through the end of postpurge.	1	1 Wire sheet 2 Hot surface igniter 3 Blower
	r119	Fuel air control module number	Assigned Fuel/Air Module number in SLATE rack	0	0, 2-99 0=Disabled

Category	Register #	Name	Description	Default Value	Range
Rate Setup	r120	Prepurge rate (RPM)	The rate used for prepurge when this rate is a direct RPM value provided by the Burner Control. Wire sheet logic may read this value to operate the rate output control. When rate proving is via RPM feedback, the value provided here is the value that is tested vs. the feedback	0	-
	r121	Prepurge rate proving	Determines whether and how the modulation rate is proven during prepurge. 1 Disabled 2 If PPP switch is chosen, the purge position proven switch is used. 3 If Fuel air control is chosen, the modulation rate is proven by data sent from the fuel air ratio control. 4 If Fan RPM is chosen, the modulation rate is proven by the RPM feedback via the tachometer input. For options 2, 3 and 4, failure to prove lightoff rate follows the configured response (r154). Related registers: r124 Rate proving delay r152 Early purge proving delay r154 Purge rate proving failure response	1	1 Disable 2 PPP switch 3 Fuel air control 4 Fan RPM
	r122	Lightoff rate (RPM)	The rate used for lightoff when this rate is a direct RPM value provided by the burner control. Wire sheet logic may read this value to operate the rate output control. When lightoff rate proving is via RPM feedback, the value provided here is the value that is tested vs. the feedback. Related register: r123 Lightoff rate proving	0	-
	r123	Lightoff rate proving	Determines whether and how the modulation is proven during lightoff. 1 Disabled 2 If LPP switch is chosen, the lightoff position proven switch is used. 3 If Fuel air control is chosen, the modulation rate is proven by data sent from the fuel air ratio control. 4 If Fan RPM is chosen, the modulation rate is proven by the RPM feedback via the tachometer input. For options 2, 3 and 4, failure to prove lightoff rate follows the configured response (r155). Related registers: r124 Rate proving delay r153 Early lightoff proving delay r155 Lightoff rate proving failure response	1	1 Disable 2 LPP switch 3 Fuel air control 4 Fan RPM
	r124	Rate proving delay	Identifies how long to wait for the modulation rate to be proven before giving up and taking the configured response (r154, r155). Includes Prepurge and Lightoff. Related registers: r121 Prepurge rate proving r123 Lightoff rate proving r154 Purge rate proving failure response r155 Lightoff rate proving failure response	0	0-300 seconds (0-5 minutes) 0=Must be proven immediately
	r125	Fan speed tolerance	When prepurge and/or lightoff proving is configured to occur depending on measured fan RPM and when the measured speed differs from the specified speed by less than the value of this parameter and it has been in this range for 3 seconds, then fan speed is considered to be proven. It then remains proven as long as the speed remains within the tolerance band of this parameter.	0	0-100%

Category	Register #	Name	Description	Default Value	Range
Ignition Setup	r126	Igniter duration	Specifies how long a spark igniter (IGM output, T17) should be turned on during ignition. 1 If a Hot Surface Igniter (HSI) is enabled (r116), this parameter must be disabled. 2 Normal duration provides IGN power throughout the Pilot Flame Establishing Period (PFEP) or Direct Burner Ignition (DBI) time, whichever is enabled. 3 Early spark termination turns the IGN output off halfway through the PFEP period or one second prior to the end of DBI time.	1	1 Disabled, use HSI 2 Normal duration 3 Early spark termination
	r127	Ignition type	Type of ignition system used.	1	1 Intermittent pilot 2 Interrupted pilot 3 Direct burner ignition
	r128	Flame sensing system type	Describes the number of flame sensors and how they are compared to determine whether successful flame is present. 2 Two flame sensors with OR logic: flame detection is true if either sensor detects flame 3 Two flame sensors with AND logic: flame detection is true only if both sensors detect flame 4 Two flame sensors DELAYED: the first sensor must detect flame within the normal tim, then a second sensor must also detect flame after a delay time expires. 5 Four flame sensors-DELAYED OR logic: same as previous case, except each sensor is now paired with another sensor and within those pairs OR logic is used; a pair detects that flame is present if either sensor detects flame. 6 Four flame sensors-DELAYED AND logic: same as previous case, except each sensor in the pair uses AND logic with its partner; each pair detects flame only if both sensors in the pair are sensing flame. For DELAYED options, the delay time (see Secondary Flame Sensing Time, r129) may be set to 0 to mean “no delay” which causes the evaluation to be done immediately. Doing this makes some of the options above equivalent.	1	1 Single flame sensor 2 Two flame sensors -OR 3 Two flame sensors -AND 4 Two flame sensors-DELAYED 5 Four flame sensors-DELAYED OR 6 Four flame sensors-DELAYED AND
	r129	Secondary flame sensing time	Time until the second flame sensor must report a flame when a DELAYED flame detection option is used. The delay time starts at the same time that the non-delayed sensor’s time starts, and it is subject to the same pilot test hold.	0	0-30 seconds
Flame Module Setup	r130	Flame failure response time	Maximum time length between a loss of the sensed flame and the turn-off of power to the main fuel valve(s).	1	1 Unknown 2 0.8 seconds 3 1 second 4 2 seconds 5 3 seconds

Category	Register #	Name	Description	Default Value	Range
Ignition Setup	r131	Pilot valve hold enable	Identifies whether Pilot Valve Hold (PVH) behavior is enable or not	1	1 Disable 2 Enable
	r132	Pilot valve hold transition time	Timing used to establish the Pilot Valve Hold condition.	5	5-60 seconds
	r133	Manual open switch enable	Specifies if a manual open switch is to be used. Note: It is a configuration fault if this input and also Direct Burner Ignition (DBI) is enabled (r127); this feature must be used with a pilot system. 2 When enabled with MFEP hold for MOS closure: a hold occurs at the MFEP start if this input is off. There is no limit to the hold time. During the hold the pilot remains on as normal, and all normal flame monitoring and input monitoring performed during MFEP still occur. However, the MFEP timer is held and during this hold the Main Valve outputs are commanded off and monitored to ensure they are off. As soon as the MOS input is detected as on, then a normal MFEP state occurs: normal MFEP timing begins and proceeds without monitoring of the MOS input. 3 When enabled with immediate MFEP: no hold occurs and MFEP proceeds normally as if MOS were not used at all. In both cases 2 and 3, when MOS is enabled: at the end of MFEP and throughout subsequent states while the main valve is commanded on (e.g. Run Stabilization, Run), a MOS fault configured response occurs if the MOS input is detected as off (r173). Related register: r173 Manual open switch off response	1	1 Disable 2 Enable with MFEP hold for MOS closure 3 Enable with immediate MFEP
	r134	Auto ignition enable	Allows a Limit Module to provide indication that the combustion chamber is at or above an auto ignition temperature (typically 1400°F/760°C minimum) and in this case the flame signal from the flame amplifier can be ignored. For this feature to become active one of the limit sockets (r600-r645) in the Burner Control must be configured to accept auto ignition status, and this status must actually be received. Related registers: r600-648 Socket limit 1-8	1	1 Disable 2 Enable
	r135	Delayed main valve 2 enable	If enabled, the MV2 is turned on after flame has been established via MV1 (upon entry to Run). Note: It is a configuration fault to enable this feature for a fuel that is also enabled for valve proving (see r186).	1	1 Disable 2 Enable always 3 Enable for fuel F1 4 Enable for fuel F2

Category	Register #	Name	Description	Default Value	Range
Timings Setup	r136	Prepurge time	Time length to prepurge the burner to clear out any possible leftover fuel or products of combustion.	0	0-65535 0=Disable
	r137	Preignition time	During the preignition state the igniter is on but neither main valve(s) nor pilot are powered. Time period typically used either to prove that flame is not simulated by spark, since no flame signal is allowed during preignition, or it is used as pre-heat time for a Hot Surface Igniter (HIS)	0	0-120 seconds 0=Disable
	r138	Pilot fame establishing time	Time length allowed before requiring a flame to be present during ignition, when a pilot is used. Ignored if Direct Burner Ignition (DBI) is enabled (r127).	0	0-30
	r139	Fuel 1 main flame establishing time	Time length that an interrupted pilot is on along with the main valve(s) for Fuel 1. At the end of this time an interrupted pilot is turned off and only the main flame provides proof of combustion. Notes: - This parameter is ignored for an Intermittent pilot because there is no MFEP, and for Direct Burner Ignition (DBI) because DBI time is a separate parameter (r127, r140). - Fuel 2 main flame establishing time is register r190	0	0-30
	r140	Direct burner ignition time	Time length main valve may be on before flame must be proven when Direct Burner Ignition (DBI) is used. Note: This parameter is ignored for other ignition types (r127).	0	0-4 seconds
	r141	Postpurge time	Time length to wait for the burner to clear excess fuel and products of combustion after it has been running or attempted to ignite.	0	0-65535 seconds 0=No postpurge

Category	Register #	Name	Description	Default Value	Range
Interlocks Setup	r142	Fuel selection setup	1 When NA-No fuel air module is selected, the Burner Control does not use fuel air communication. Note: If the Fuel air control module number (r119) is non-zero, a configuration fault exists and a lockout occurs. A configuration fault lockout also occurs if this parameter has any other value but the Fuel air control module (r119) is zero 2/3 If a single fuel is selected via Always use Fuel 1/2 the reported fuel selection sent to a Fuel Air Ratio Control Module will be according to that selection, no matter how the LCI/F1 and LCI/F2 input are used (or not used) 4 If Use Limits LCI/F1 (T13) and LCI/F2 (T12) to select the fuel is chosen, it is a dual fuel application and both LCI/F1 and LCI/F2 must be configured for Limit functions (r143, r145). This condition both may be off or one may be on, but a configured response (r167) occurs if both are on at the same time (except for a brief transition tolerance of 1 second). Note: It is a configuration fault lockout if LCI/F1 and LCI/F2 are not configured for Limit functions (r143, r145).	1	1 N/A-No fuel air module 2 Always use Fuel 1 3 Always use Fuel 2 4 Use Limit LCI/F1 and LCI/F2 to select the fuel
	r143	LCI/F1 enable	1 Disabled = the input is disabled and ignored. 2 When used as demand, the input acts as a demand input and call for heat is true when it is on. A call for heat is present when the input is energized and when it is off (and also there is no other source for a call for heat) , then the system returns to an idle condition in Standby with no call for heat and no hold condition. This return to Standby may include going through postpurge if the burner was igniting or firing, but eventually it becomes idle 3 When used as a limit, the input acts as a run-permissive input. The call for heat comes from some other source and this input must turn on before startup will proceed. During the time demand is present but LCI is open, a hold is annunciated, describing the reason. An LCI input configured as a limit must remain on throughout the prepurge, ignition and run states; if it opens during these states the startup or run condition is aborted abnormally and a configured response occurs (r160). Note: This selection is required for dual fuel applications.	1	1 Disable 2 Use as demand 3 Use as limit (dual fuels)
	r144	LCI/F2 enable			
	r145	Demand hold limit time	Maximum time to wait in a Standby hold condition when demand is present. If it fails to resolve for this amount of time, a configured response occurs (r161).	0	0-65535 0=no limit, wait forever

Category	Register #	Name	Description	Default Value	Range
Interlocks Setup	r146	Preignition interlock enable	1 Disabled = the PII input (T14) is disabled and ignored. 2 When enabled with no dynamic check is selected, the PII input is not monitored for any condition. The PII input is tested to ensure that it's energized whenever the main valve(s) should be off. Whenever the main valve status changes from one or both valves on, to both valves off, 5 seconds is allowed before checking if the energized state has resumed to allow time to fully close their proof of closure switches. Normal PII open response followed via configured response (r162). 3 When enabled with dynamic check, the PII input is monitored for both On and Off conditions during specific burner sequences. During the Run state, the PII input must be de-energized and during the Standby state, the PII must be energized. If any test reveals that the PII is not in its mandated position, a configured response occurs (r166).	1	1 Disable 2 Enable with no dynamic check 3 Enable with dynamic check
	r147	ILK start check enable	Selects whether the interlock input (ILK, T19) must be off at startup as a check that proves it is possible for it to signal the off condition. 1 Disable=start check not performed. Normal ILK open response followed via a configured response (r163). 2 If ILK is on during the start check, the control waits for it to turn off before startup is allowed. If it fails to turn off for 4 minutes, then a configured response occurs (r165).	1	1 Disable 2 Enable
	r148	IAS start check enable	Selects whether the interrupted airflow switch (IAS, T16) must be off at startup as a check that proves it is possible for it to signal the off condition. 1 Disable=start check not performed. Normal IAS open response followed via a configured response (r164). 2 If IAS is on during the start check, the control waits for it to turn off before startup is allowed. If it fails to turn off for 4 minutes, then a configured response occurs (r165).	1	1 Disable 2 Enable
	r149	IAS/LOI monitoring	The T16 input can be configured as either an Interrupted Airflow Switch (IAS) or a Lockout Input (LOI). The LOI is primarily used in EU applications. 1 Disable=no airflow switch in system. 2/3 When monitored as an IAS input during prepurge, it is not a fault for this input to be off until the IAS proving maximum wait time has elapsed (r151). The measured purge timing does not begin until the IAS is energized 4 If configured as a LOI input, it must be energized at all times, with the only exception being during initialization when it is given time to turn on. If the T16 input is in an incorrect state, a configured response occurs (r164).	1	1 Disable 2 IAS: Prepurge only 3 IAS: Prepurge/ Ignition 4 LOI: At all times including Standby
	r150	ILK monitoring	Selects when the Interlock string (ILK, T19) is monitored by the Burner Control. 1 Use this input as a lockout input (LOI). It must be energized at all times, with the only exception being during initialization when it is given time to turn on. Typically used in EU applications. 2 Use the input as a normal interlock input. During prepurge, it is not a fault for this input to be off until the IAS proving maximum wait time has elapsed (r151). The measured purge timing does not begin until the ILK is energized. If the T19 input is in an incorrect state, a configured response occurs (r163).	1	1 LOI: At all times including standby 2 During Prepurge, Ignition and Run

Category	Register #	Name	Description	Default Value	Range
Timings Setup	r151	ILK/IAS proving maximum wait time	Time that a de-energized ILK or IAS (whichever is configured) is tolerated from the start of the prepurge state. If this time is exceeded without establishing the input as energized, a configured response occurs (r163 or r164??) Note: In previous Honeywell controls this time was fixed. In this system it is programmable to accommodate VFDs which take a longer time to provide optimum airflow.	0	0-60 seconds
	r152	Early purge proving delay	If purge proving is enabled (r121) and it is proven immediately upon entry to the prepurge state, an extra delay occurs that lasts for the duration defined by this parameter. Related register: r121 Prepurge rate proving	30	0-65535 0=accept the proven condition with no delay
	r153	Early lightoff proving delay	If lightoff proving is enabled (r123) and it is proven immediately upon entry to the drive to lightoff state, an extra delay occurs that lasts for the duration defined by this parameter. Related register: r123 Lightoff rate proving	30	0-65535 0=accept the proven condition with no delay
Failure Response Setup	r154	Purge rate proving failure response	The action taken upon a failure to achieve the target firing rate during purge within the time provided by the Rate proving delay parameter (r124). Related register: r124 Rate proving delay	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r155	Lightoff rate proving failure response	The action taken upon a failure to achieve the target firing rate during lightoff within the time provided by the Rate proving delay parameter (r124). Related register: r124 Rate proving delay	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r156	Valve proving failure response	The action taken upon a failure to prove the valve is functioning properly during the valve proving test.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r157	Pilot ignition failure response	The action taken when the pilot fails to light.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r158	Main ignition failure response	The action taken when a satisfactory main flame is not established during ignition. This response is used for flame failure during DBI (direct burner ignition), MFEP (main flame establishing period) and during the first 10 seconds of the Run state.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r159	Run flame failure response	The action taken upon loss of satisfactory flame after the burner has been in the Run state over 10 seconds. Prior to this, during DBI, MFEP or the first 10 seconds of Run, the Ignition flame failure response (r158) is used.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout

Category	Register #	Name	Description	Default Value	Range
Failure Response Setup	r160	LCI open response	Action taken when the LCI (T12, T13) opens abnormally while it should be closed during the burner sequence. Note: Only applies when LCI/F1 or LCI/F2 is defined as a Limit input (r143, r144). It does not apply if LCI/F1 or LCI/F2 is defined as a Demand input because its opening during a sequence is a normal indication of the end of demand. Related registers: r143 LCI/F1 enable r144 LCI/F2 enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r161	Demand hold limit response	Action taken when the Demand hold limit time is exceeded (r145). Related register: r145 Demand hold limit time	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r162	PII open response	Action taken if the PII is open when it should be closed during the burner sequence. Related register: r146 Preignition interlock enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r163	ILK open response	Action taken if the ILK is open when it should be closed during the burner sequence. Related registers: r147 Preignition interlock enable r151 ILK/IAS proving maximum wait time	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r164	IAS/LOI open response	Action taken if the Interrupted Airflow Switch (IAS) is open when it should be closed during the burner sequence. Related registers: r148 IAS start check enable r150 ILK monitoring r151 ILK/IAS proving maximum wait time	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r165	ILK/IAS start check failure response	Action taken if a start check failure occurs of the ILK and/or IAS inputs. Related registers: r147 ILK start check enable r148 IAS start check enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r166	PII dynamic check failure response	Action taken if a dynamic check failure occurs of the PII input. Related register: r146 Preignition interlock enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r167	Dual fuel fault response	Action taken if both the LCI/F1(T13) and LCI/F2 (T12) are energized when dual fuel is enabled (this is an invalid condition). Related register: r142 Fuel selection setup	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r168	Flam amplifier fault response	Action taken for a failure in the flame detector system.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout

Category	Register #	Name	Description	Default Value	Range
Failure Response Setup	r169	MV PV IGN on should be off response	Action taken if the MV, PV or IGN outputs are on when they should be off (T9, T11, T15, T17). An example might be shorted power.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r170	MV PV IGN should be on response	Action taken if the MV, PV or IGN outputs are off when they should be on (T9, T11, T15, T17).	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r171	Safety relay fault response	Action taken if the Burner Control safety relay is in the wrong state (internal fault).	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r172	Flame on should be off response	Action taken if flame is detected when it should not be.	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r173	Manual open switch off response	Action to take if the Manual Open Switch (MOS) is off when it should be on (during MFEP and Run). Related register: r133 Manual open switch enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r174	Fuel air communication fault response	Action to take if the Fuel Air Ratio Control does not have reliable communication with the Burner Control. Related register: r119 Fuel air control module number	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r175	Limit communication fault response	Action to take if a Limit Module does not have reliable communication with the Burner Control. Related registers: r600 Socket 1 limit module number r606 Socket 2 limit module number r612 Socket 3 limit module number r618 Socket 4 limit module number r624 Socket 5 limit module number r630 Socket 6 limit module number r636 Socket 7 limit module number r642 Socket 8 limit module number	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout
	r176	Stuck reset switch response	Action taken if the reset push button is stuck	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout

Category	Register #	Name	Description	Default Value	Range
Recycle Setup	r177	Recycle 1 delay time	Delay time that must take place while in Standby before retrying the burner sequence for the 1st recycle handler. The 5 second minimum ensures the recycle reason has time to be displayed. Related registers: r154-r176 Failure Response Setup	5	5-65535 seconds
	r178	Recycle 1 retry limit count	Maximum number of recycle tries before giving up for the 1st recycle handler. Retry counting is cleared when the burner reaches the Run state or when the call for heat disappears Related registers: r154-r176 Failure Response Setup r 179 Recycle 1 retry limit response	3	0-65535 seconds
	r179	Recycle 1 retry limit response	Action taken if the number of recycles hits the retry limit count for the 1st recycle handler. When the response is None, the recycles continue indefinitely until successful or the call for heat is lost. Related registers: r154-r176 Failure Response Setup r 178 Recycle 1 retry limit count	1	1 None 2 Soft lockout 3 Hard lockout
	r180	Recycle 2 delay time	Delay time that must take place while in Standby before retrying the burner sequence for the 2nd recycle handler. The 5 second minimum ensures the recycle reason has time to be displayed. Related registers: r154-r176 Failure Response Setup	5	5-65535 seconds
	r181	Recycle 2 retry limit count	Maximum number of recycle tries before giving up for the 2nd recycle handler. Retry counting is cleared when the burner reaches the Run state or when the call for heat disappears Related registers: r154-r176 Failure Response Setup r 182 Recycle 2 retry limit response	3	0-65535 seconds
	r182	Recycle 2 retry limit response	Action taken if the number of recycles hits the retry limit count for the 2nd recycle handler. When the response is None, the recycles continue indefinitely until successful or the call for heat is lost. Related registers: r154-r176 Failure Response Setup r 181 Recycle 2 retry limit count	1	1 None 2 Soft lockout 3 Hard lockout
	r183	Recycle 3 delay time	Delay time that must take place while in Standby before retrying the burner sequence for the 3rd recycle handler. The 5 second minimum ensures the recycle reason has time to be displayed. Related registers: r154-r176 Failure Response Setup	5	5-65535 seconds
	r184	Recycle 3 retry limit count	Maximum number of recycle tries before giving up for the 3rd recycle handler. Retry counting is cleared when the burner reaches the Run state or when the call for heat disappears Related registers: r154-r176 Failure Response Setup r 185 Recycle 3 retry limit response	3	0-65535 seconds
	r185	Recycle 3 retry limit response	Action taken if the number of recycles hits the retry limit count for the 1st recycle handler. When the response is None, the recycles continue indefinitely until successful or the call for heat is lost. Related registers: r154-r176 Failure Response Setup r 184 Recycle 3 retry limit count	1	1 None 2 Soft lockout 3 Hard lockout

Category	Register #	Name	Description	Default Value	Range
Valve Proving Setup	r186	Valve proving enable	If enabled, valve proving is performed when the configured fuel is selected. Note: It is a configuration fault to enable this feature for a fuel that is also enabled to use a delayed main valve (see r135). 2 Enable always causes valve proving to be performed always, either for a single fuel or for both fuels in a dual fuel system. 3/4 Enable for dual fuel selected by LCI/F1 and Enable for dual fuel selected by LCI/F2 are allowed only if the Fuel selection setup parameter (r142) enables dual fuels; otherwise a configuration fault occurs. Related registers: r142 Fuel selection setup	1	1 Disable 2 Enable always 3 Enable for dual fuel selected by LCI/F1 4 Enable for dual fuel selected by LCI/F2
	r187	Valve proving occurrence	Determines when valve proving occurs if enabled. VPS includes two tests; one where the short pipe between the two shutoff valves is pressurized (high pressure test) and one where it is depressurized (low pressure test). VPS Before Run occurs simultaneously with prepurge and will delay lightoff if it lasts longer. VPS After Run occurs simultaneously with postpurge (if any) and will delay re-entry into Standby until completed. 1 Both pressure tests BEFORE entering the Run state 2 Both pressure tests AFTER in the Run state 3 Both pressure tests BEFORE and AFTER entering the Run state 4 High pressure test BEFORE Run and low pressure test AFTER Run.	1	1 Before Run 2 After Run 3 Both before and after Run 4 Split
	r188	Valve proving open time	How long one valve is commanded open to pressurize or depressurize the pipe between the two shutoff valves. A typical value is t seconds for a slow valve. Shorter times may be used for faster valves.	5	0-60 seconds
	r189	Valve proving time	Test time used for valve proving leakage test.	0	0-65535 seconds
Timings Setup	r190	Fuel 2 main flame establishing time	Time length that an interrupted pilot is on along with the main valve(s) for Fuel 2. At the end of this time an interrupted pilot is turned off and only the main flame provides proof of combustion. Notes: - This parameter is ignored for an Intermittent pilot because there is no MFEP, and for Direct Burner Ignition (DBI) because DBI time is a separate parameter (r127, r140). - Fuel 1 main flame establishing time is register r139	0	0-30

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r600	Socket 1 limit module number	Assigned Limit 1 Module number in SLATE rack	0	0-99 0=Disabled
	r601	Socket 1 limit name	Name for Socket 1 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum
	r602	Socket 1 limit response	Response to valid limit status as defined by Socket 1 limit response trigger register (r603). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 1 limit response trigger parameter (r603) is ignored. Related registers: r603 Socket 1 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r603	Socket 1 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r602 Socket 1 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r606	Socket 2 limit module number	Assigned Limit 2 Module number in SLATE rack	0	0-99 0=Disabled
	r607	Socket 2 limit name	Name for Socket 2 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r608	Socket 2 limit response	Response to valid limit status as defined by Socket 2 limit response trigger register (r609). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 2 limit response trigger parameter (r603) is ignored. Related registers: r609 Socket 2 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r609	Socket 2 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r608 Socket 2 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r612	Socket 3 limit module number	Assigned Limit 3 Module number in SLATE rack	0	0-99 0=Disabled
	r613	Socket 3 limit name	Name for Socket 3 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r614	Socket 3 limit response	Response to valid limit status as defined by Socket 3 limit response trigger register (r615). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 3 limit response trigger parameter (r615) is ignored. Related registers: r615 Socket 3 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r615	Socket 3 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r614 Socket 3 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r618	Socket 4 limit module number	Assigned Limit 4 Module number in SLATE rack	0	0-99 0=Disabled
	r619	Socket 4 limit name	Name for Socket 4 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r620	Socket 4 limit response	Response to valid limit status as defined by Socket 4 limit response trigger register (r621). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 4 limit response trigger parameter (r621) is ignored. Related registers: r621 Socket 4 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r621	Socket 4 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r620 Socket 4 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r624	Socket 5 limit module number	Assigned Limit 5 Module number in SLATE rack	0	0-99 0=Disabled
	r625	Socket 5 limit name	Name for Socket 5 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r626	Socket 5 limit response	Response to valid limit status as defined by Socket 5 limit response trigger register (r627). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 5 limit response trigger parameter (r627) is ignored. Related registers: r627 Socket 5 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r627	Socket 5 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r626 Socket 5 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r630	Socket 6 limit module number	Assigned Limit 6 Module number in SLATE rack	0	0-99 0=Disabled
	r631	Socket 6 limit name	Name for Socket 6 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r632	Socket 6 limit response	Response to valid limit status as defined by Socket 6 limit response trigger register (r633). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 6 limit response trigger parameter (r633) is ignored. Related registers: r633 Socket 6 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r633	Socket 6 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r632 Socket 6 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r636	Socket 7 limit module number	Assigned Limit 7 Module number in SLATE rack	0	0-99 0=Disabled
	r637	Socket 7 limit name	Name for Socket 7 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

Category	Register #	Name	Description	Default Value	Range
Limit Socket	r638	Socket 7 limit response	Response to valid limit status as defined by Socket 7 limit response trigger register (r639). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 7 limit response trigger parameter (r639) is ignored. Related registers: r639 Socket 7 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r639	Socket 7 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r638 Socket 7 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
	r642	Socket 8 limit module number	Assigned Limit 8 Module number in SLATE rack	0	0-99 0=Disabled
	r643	Socket 8 limit name	Name for Socket 8 limit. String up to 12 characters. Note: All sockets in the Burner Control must have unique names. Data packets exchanged between modules must have the correct number and name otherwise data is ignored.	-	12 character string maximum

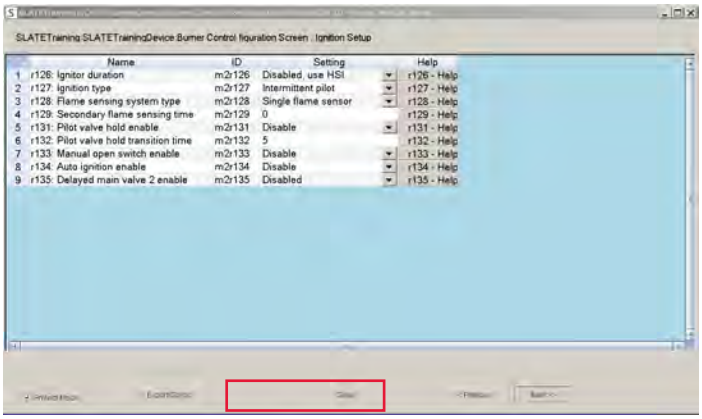
Category	Register #	Name	Description	Default Value	Range
Limit Socket	r644	Socket 8 limit response	Response to valid limit status as defined by Socket 8 limit response trigger register (r645). 2/3/4 If Recycle 1, Recycle 2 or Recycle 3 are chosen, whenever the limit status is not “Limit OK”, a recycle and hold occurs until the status reverts to “Limit OK”. 5/6 If Soft lockout or Hard lockout is chosen, whenever the limit status is not “Limit OK”, the appropriate type of lockout occurs. 7 If Auto-ignition active is chosen, whenever the limit status is “Auto ignition threshold exceeded”, the Burner Control will act as defined by the Auto ignition enable parameter (r134). For the Auto ignition active response, the Socket 8 limit response trigger parameter (r645) is ignored. Related registers: r645 Socket 8 limit response trigger r177-179 Recycle 1 delay time / retry limit count / retry limit response r180-182 Recycle 2 delay time / retry limit count / retry limit response r183-185 Recycle 3 delay time / retry limit count / retry limit response r134 Auto ignition enable	1	1 Unknown 2 Recycle 1 3 Recycle 2 4 Recycle 3 5 Soft lockout 6 Hard lockout 7 Auto-ignition active
	r645	Socket 8 limit response trigger	Determines when the Burner Control responds to the Limit Module. It also provides a master disable for the limit socket. 1 Disabled-Ignore limit: This limit socket is inactive 2 Always: This limit socket is active without regard to the Burner Control state 3 Prepurge, Ignition and Run: This limit socket is active during the named states and their sub-states. 4 Ignition and Run: This limit socket is active during the named states and their sub-states. 5 Flame is on: This limit socket is active whenever flame is required to be on. 6 Run: This limit socket is active during the Burner Control Run state only. Related register: r644 Socket 8 limit response	1	1 Disabled-Ignore limit 2 Always 3 Prepurge, Ignition and Run 4 Ignition and Run 5 Flame is on 6 Run
Flame Module Setup	r648	Flame amplifier 1 required type	1 None: Unused for setup is needed. 2 UV Ampli-Check: Ultraviolet Minipeeper detector used (C7027/C7035) 3 UV Shutter-Check: Ultraviolet Purple Peeper detector used (C7061) 4 IR Ampli-Check: Infrared (lead sulfide) detector used (C7915) 5 UV/Visible Ampli-Check: Ultraviolet solid state (C7927) or visible light detector used (C7962) 6 Rectification Ampli-Check: Flame rod (C7000x) or UV dag tube Purple Peeper (C7012A/C) detector with shutter is used.	1	1 None 2 UV Ampli-Check 3 UV Shutter-Check 4 IR Ampli-Check 5 UV/Visible Ampli-Check 6 Rectification Ampli-Check
	r649	Flame amplifier 1 flame threshold	Minimum acceptable flame signal that must be present otherwise a lockout occurs.	0.8	??-??
	r650	Flame amplifier 1 weak flame threshold	Flame signal to trigger a weak flame warning condition.	1.2	??-??

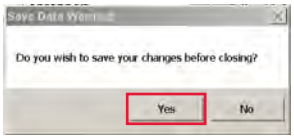
Category	Register #	Name	Description	Default Value	Range
Flame Module Setup	r655	Flame amplifier 2 required type	1 None: Unused for setup is needed. 2 UV Ampli-Check: Ultraviolet Minipeeper detector used (C7027/C7035) 3 UV Shutter-Check: Ultraviolet Purple Peeper detector used (C7061) 4 IR Ampli-Check: Infrared (lead sulfide) detector used (C7915) 5 UV/Visible Ampli-Check: Ultraviolet solid state (C7927) or visible light detector used (C7962) 6 Rectification Ampli-Check: Flame rod (C7000x) or UV dag tube Purple Peeper (C7012A/C) detector with shutter is used.	1	1 None 2 UV Ampli-Check 3 UV Shutter-Check 4 IR Ampli-Check 5 UV/Visible Ampli-Check 6 Rectification Ampli-Check
	r656	Flame amplifier 2 flame threshold	Minimum acceptable flame signal that must be present otherwise a lockout occurs.	0.8	??-??
	r657	Flame amplifier 2 weak flame threshold	Flame signal to trigger a weak flame warning condition.	1.2	??-??
	r662	Flame amplifier 3 required type	1 None: Unused for setup is needed. 2 UV Ampli-Check: Ultraviolet Minipeeper detector used (C7027/C7035) 3 UV Shutter-Check: Ultraviolet Purple Peeper detector used (C7061) 4 IR Ampli-Check: Infrared (lead sulfide) detector used (C7915) 5 UV/Visible Ampli-Check: Ultraviolet solid state (C7927) or visible light detector used (C7962) 6 Rectification Ampli-Check: Flame rod (C7000x) or UV dag tube Purple Peeper (C7012A/C) detector with shutter is used.	1	1 None 2 UV Ampli-Check 3 UV Shutter-Check 4 IR Ampli-Check 5 UV/Visible Ampli-Check 6 Rectification Ampli-Check
	r663	Flame amplifier 3 flame threshold	Minimum acceptable flame signal that must be present otherwise a lockout occurs.	0.8	??-??
	r664	Flame amplifier 3 weak flame threshold	Flame signal to trigger a weak flame warning condition.	1.2	??-??
	r669	Flame amplifier 4 required type	1 None: Unused for setup is needed. 2 UV Ampli-Check: Ultraviolet Minipeeper detector used (C7027/C7035) 3 UV Shutter-Check: Ultraviolet Purple Peeper detector used (C7061) 4 IR Ampli-Check: Infrared (lead sulfide) detector used (C7915) 5 UV/Visible Ampli-Check: Ultraviolet solid state (C7927) or visible light detector used (C7962) 6 Rectification Ampli-Check: Flame rod (C7000x) or UV dag tube Purple Peeper (C7012A/C) detector with shutter is used.	1	1 None 2 UV Ampli-Check 3 UV Shutter-Check 4 IR Ampli-Check 5 UV/Visible Ampli-Check 6 Rectification Ampli-Check
	r670	Flame amplifier 4 flame threshold	Minimum acceptable flame signal that must be present otherwise a lockout occurs.	0.8	??-??
	r671	Flame amplifier 4 weak flame threshold	Flame signal to trigger a weak flame warning condition.	1.2	??-??

8. When finished with the final Burner Control Module configuration, click the “Save” button.

   Click “Yes” when prompted to save the changes.

Click the “Close” button to go back to the SLATE Module Configuration page.





9. The Burner Control Module is now part of your kit file. You may proceed to configuration of the next module. If you are finished with all of the SLATE modules programming and configuration, you may load the kit file. Refer to “Load the SLATE Device” on page 8.

Chapter 6: SLATE Flame Amp Modules

Installing Flame Detectors with the SLATE System

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire length is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the SLATE Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the SLATE Burner Control Module, then it must be externally wired to it via the remote bus communications.

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminals screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

Note: R7842C, Series 2 or greater, pulse shutter when signal of 1.5VDC is sensed. Display readings of 0.7 to 2.4 Vdc are common.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8 V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector for the defects including:
   - **a.** Incorrect connections
   - **b.** Wrong type of wire
   - **c.** Deteriorated sire
   - **d.** Open circuits
   - **e.** Short circuits
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
7. For all optical detectors, clean the detector viewing window, lens, and inside of the sight pipe as applicable.
8. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature
   - **a.** Add a heat block to stop conducted heat traveling up the sight pipe.
   - **b.** Add a shield or screen to reflect radiated heat.
   - **c.** Add cooling (refer to sight pipe ventilation in the detector Instructions).
4. Make sure that the flame adjustment is not too lean
5. Make sure the optical detector is properly sighting the flame
6. If necessary, resight or reposition the detector
7. If you cannot obtain proper operation, replace the plug-in amplifier
8. If you cannot yet obtain proper operations, replace the flame detector

LED Array

There are four LEDs on the front of the UV/Visible Ampli-Check Flame Amp modules that provide quick identification of the system status and any other problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

LED Display

The SLATE system modules have a seven-segment, three position LED display used for indicating flame strength. It is also used to identify the module of the SLATE system.

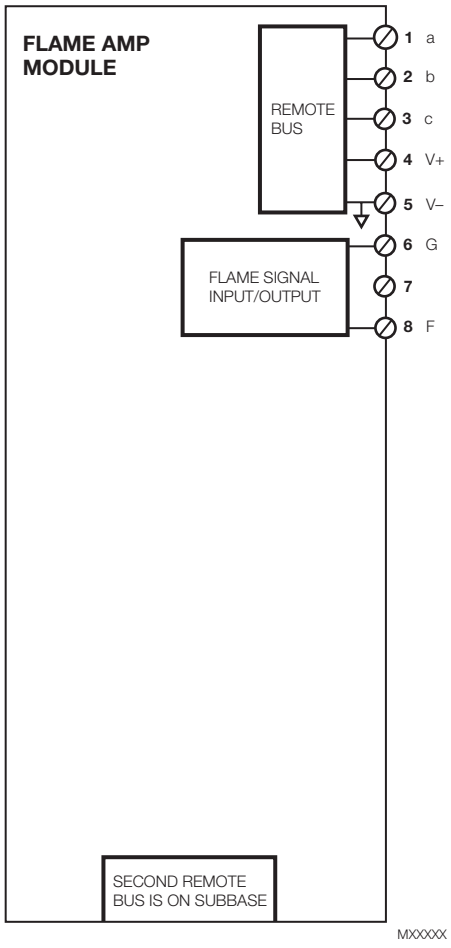
Color	Description
Terminal T2	

Color	Description
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Understanding the Terminals



Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Approvals
cULus (UL) Listed, File: MP268
IRI Acceptable
FM Approved
Federal Communications Commission: Part 15, Class A
SIL-3 pending
CE pending

Overview of the SLATE Flame Amplifier Modules

The R8001F1091 UV Visible Ampli-Check Flame Amplifier module responds to an ultraviolet/visible light signal from an UV/visible light type flame detector to indicate the presence of flame. The flame amplifier is used with the C7927 (UV), C7962 (Visible) detector series.

The R8001V1031 Rectification Ampli-Check Flame Amplifier module responds to a rectified signal from a rectification type flame detector to indicate the presence of flame. This flame amp is used with the C7000X detector series.

The R8001F1041 IR Ampli-Check Flame Amplifier module responds to an infrared signal from an infrared type flame detector to indicate the presence of flame. This flame amplifier is used with the C7915 detector series.

The R8001S1051 UV Shutter-Check module responds to an ultraviolet signal from an ultraviolet type flame detector to indicate the presence of flame. This flame amplifier is used with the C7061 detector series.

The R8001S1071 UV Ampli-Check module responds to an ultraviolet signal from an ultraviolet type flame detector to indicate the presence of flame. This flame amplifier is used with the C7027 and C7035 detector series.

Chapter 7: SLATE Fuel Air Control Module and Commissioning



Overview

The R8001C6001 SLATE Fuel Air Ratio module uses the latest technology to control up to 4 SLATE actuators and or 2 Variable Frequency Drives. The Fuel Air Control module controls the relationship between fuel, airflow and flue gas recirculation on a power burner.

Within the SLATE system, the fuel air ratio module provides:

- Air fuel ratio control for up to 4 actuators
- Drive 2 Variable Frequency Drives (VFDs)
- RS-485 Modbus communications to communicate to the actuators and receive feedback
- SLATE actuator torque sizes:
  - R8001M1050 50 in/lb in NEMA 1
  - R8001M1150 150 in/lb NEMA 1
  - R8001M4050 50 in/lb NEMA 4
  - R8001M4150 150 in/lb NEMA 4
- Up to 24 points on the curve
- Field configurable
- Automated actuator endpoint seeking process
- UL Listed, FM and NFPA acceptable
- Password protected
- Fault information
- Status of four actuator channels
- Unused VFD terminals can be used as analog cells for general purpose I/O configuration
- Flue gas recirculation (FGR)
- Trim
- Dual Fuel
- Seasonality or recipe curves

Safety Features

- Class C operating software system
- Fail-safe feedback
- Curve verification algorithms
- Password protected
- Built in self test
- No slope constraints that would limit the steepness of the curve
- Component anti-swap protection
- Off curve checking algorithm

LED Array

There are three LEDs on the front of the Fuel Air Ratio module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power

LED	Color	Description
☑ CPU	Red	No valid configuration
	Green	Running
⚠ Fault	Red	Fault
	No light	No fault

LED Display

The Fuel Air Ratio module has three-character LED display used for indicating the number it is in the SLATE system. It also has a three-position LED colors to indicate the states as shown below.

Color	Description
Green	Terminal is ON or is Normal
Red	Fault
No light	Terminal is OFF or Not in use

Select and Resent Buttons

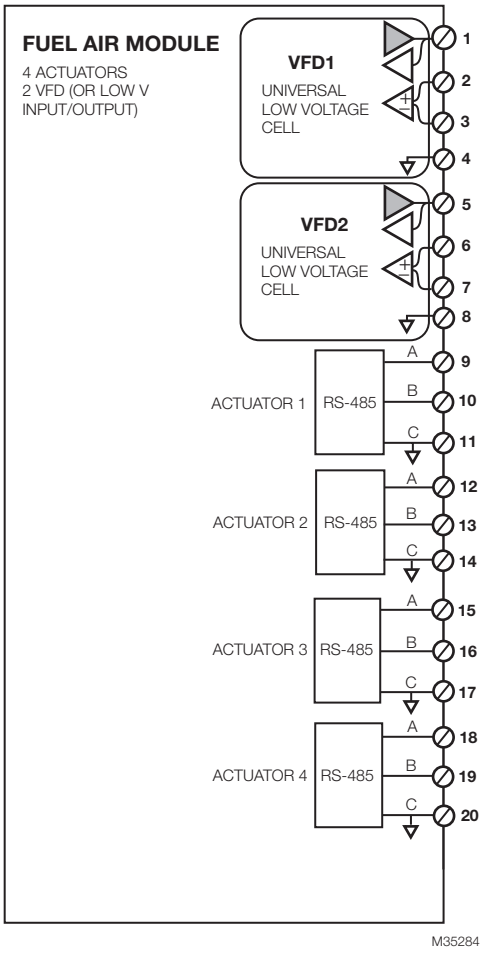
The Fuel Air Ratio module have Select and Reset buttons located on the front module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.



Fig. 1. Fuel Air Ratio Control LED Display

Understanding the Terminals

The SLATE Fuel Air Ratio Control Modules contains 20 wired terminals.



Terminal Functions and Configurations

Terminal Functions				Min	Typical	Max	Units	
T1	Voltage	In	Range	0.0	-	15.0	VDC	Rin=1MOhm
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out[c]	Range	0.0	-	15.0	VDC	10KOhm load
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b,c]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50	-	50	uA DC	4 to 20 mA

Terminal Functions				Min	Typical	Max	Units	
T2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
T3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA

[a] T1 input terminal is held at constant 2.5VDC over allowable current range.
[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.
[c] Imax=25mA for Vout<10V
Imax=20mA for 10V<Vout<15V

Specifications based on worst case over ambient temperatures.

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
T2 & T3	Type J	Range	-200.0		1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
T2 & T3 & T4	Type PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
T1-T3, T1-T4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C
T1-T3, T1-T4	Type 12K	Range	-20.0	-	125.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-20 °C to 30 °C
			-1.0	-	1.0	°C	30 °C to 120 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	120 °C to 125 °C

	Complex Functions		Min	Typical	Max	Units	
T1-T3, T1-T4	Type 20K	Range	-25.0	-	150.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-25 °C to 50 °C
			-1.0	-	1.0	°C	50 °C to 135 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	135 °C to 150 °C

[a] Shielded cable required for reliable operation in noisy environment.
[b] NTC on terminal T4 is rated down to 0 °C.
[c] Temperatures refer to sense range.

	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
T1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	0-100% output allowed
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
T2-T4	Amplitude		5.0	10.0	15.0	VDC	
	Range		2.0	-	1000.0	Hz	
	Min. "on" pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. "off" pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1.0	-	Hz	
	Accuracy		-5.0	-	0.0	%	Whichever is greater
			-1.0	-	0.0	Hz	
	PWM In						
T2-T4	Amplitude[a]		5.0	10.0	15.0	VDC	
	Frequency		125.0	-	500.0	Hz	
	Min. "on" pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. "off" pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution			-	1.0	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

[a] Trip points = 3.0V +/- 0.25V
Hysteresis Voltage = 0.5V

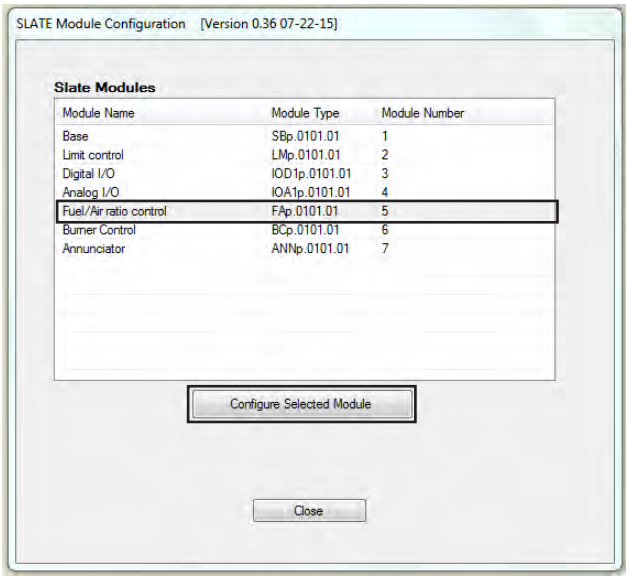
Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Application	Recommended Wire Size	Recommended Part Numbers
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Fuel Air Ratio Configuration

Getting Started

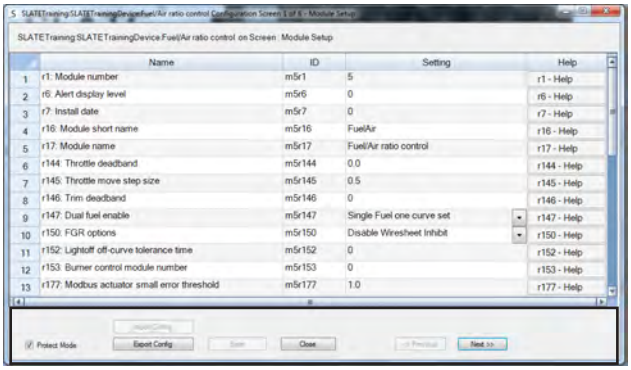
1. To access the configuration tool you will need to launch the SLATE AX Tool.
2. If you have not created a Station please refer to Chapter 2 of this manual to learn how to create a new station.
3. If you have created a Station open up the Navigation pane until to reach your SLATE Device. Double-click on the SLATE device to launch the Module Configuration Tool.
4. Select the Fuel/Air ratio control, then click Configure Selected Module.



When configuring, you will need to uncheck the “Protect Mode” box. As you move through the registers you will use the Next and Previous buttons to move to the next page or back to the previous page.

Curve configuration and preset setup (positions for purge, ignition, etc) are configured using the Honeywell built in web pages as part of the installation.

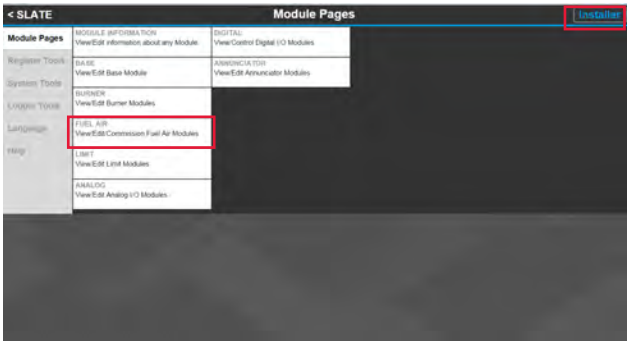
When all registers have been configured, click the Save button. Click the Close button to go back to the SLATE Module Configuration page.



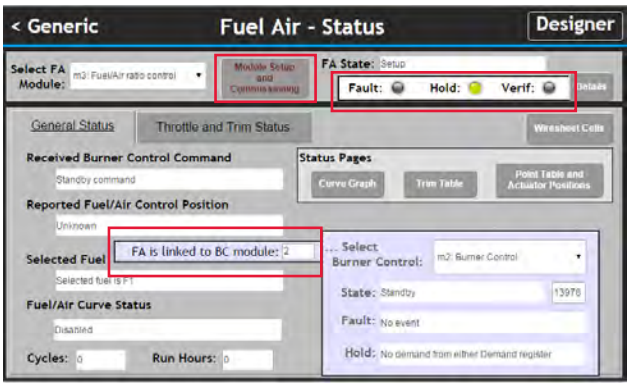
SLATE Fuel Air Commissioning

Fuel Air Commissioning begins at the SLATE Generic Web Pages provided. For better commissioning you can connect your laptop to the SLATE Base and connect via Ethernet. You will need to setup you IP address as previously noted in this User Guide under Network Setup section.

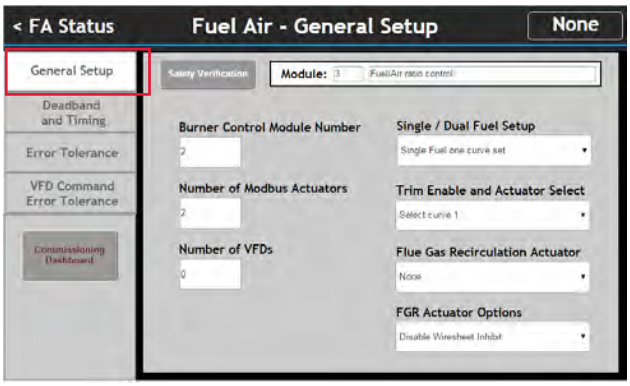
When you are connected to begin you will need to make sure you are logged in as an Installer or Designer. See figure below. The log in is located in the upper right hand corner. Select the Log In. You will then see the log in screen. To log in as an Installer the password is SlateInstallerPassword. When you log in as a designer the password will be SlateDesignerPassword. After entering the password you will need to select Request RIN. This is an indication to SLATE to provide you with a 6 digit number. The SLATE Base Display will provide a 6 digit number. You will need to enter those numbers in along with the dash. Then you will be connected to the system for commissioning.



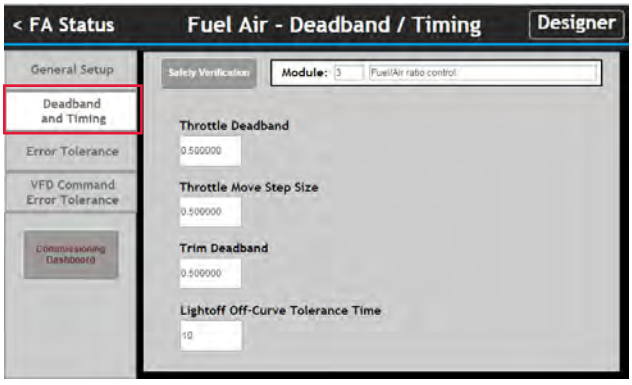
Clicking on the Fuel Air Commissioning screen takes you to the Fuel Air Status screen. Here you will see any faults that may occur since the SLATE Burner Control is linked to the Fuel Air Ratio Module and any other important information. To move to commissioning you will select Module Setup and Commissioning.



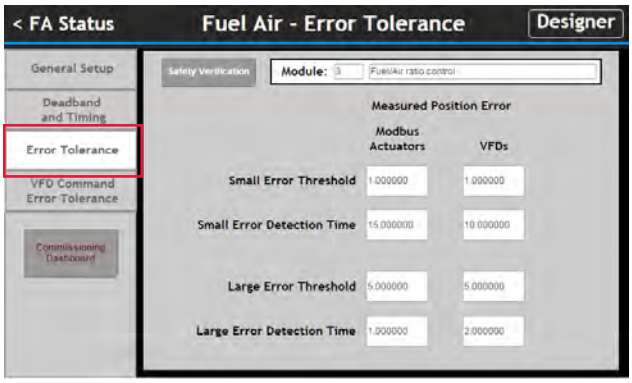
General setup allows you to set up information about the SLATE Burner Control and Fuel Air Ratio device environment. If you have configured the SLATE Fuel Air Ratio using the SLATE AX Tool that information will be displayed on this page.



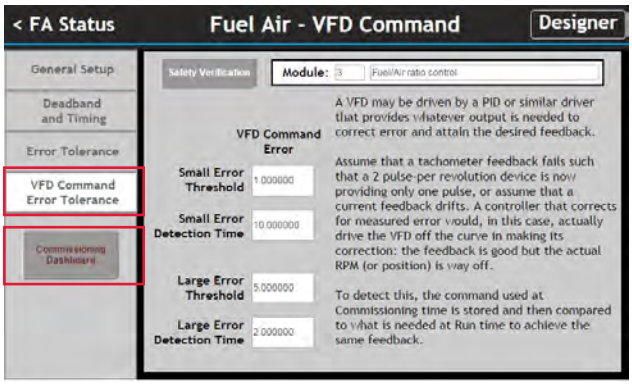
Deadband and Timing is used to set the throttle deadband, move step size and light off-curve tolerance time. The light off curve tolerance time is important because it's the time allotted for the actuators to reach the curve after light off, when the light off is not on the curve.



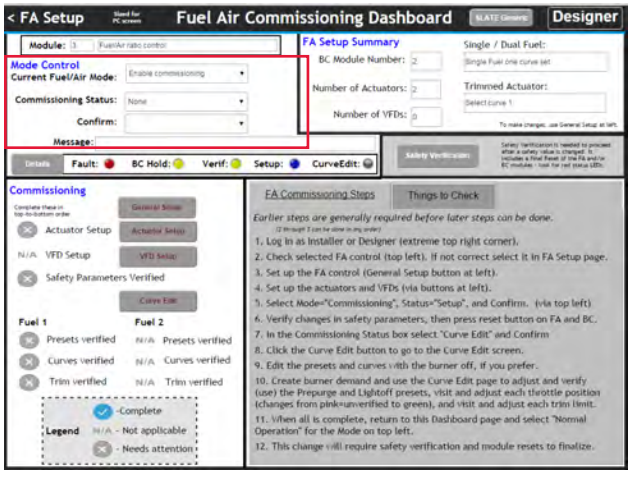
The Error Tolerance defines the large and small errors, position wise. It also defines how much time you will be in the large error or small error zone before an error occurs.



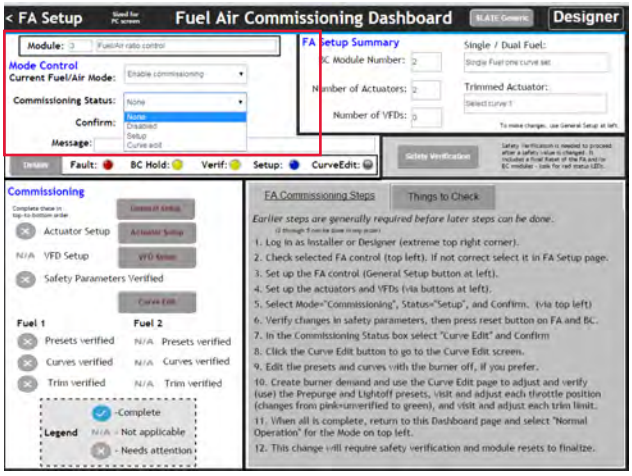
The VFD Command and Error Tolerance selection allows users to set small and large error tolerances with the VFD. To begin the Fuel Air Commissioning process Click the Commissioning Dashboard.



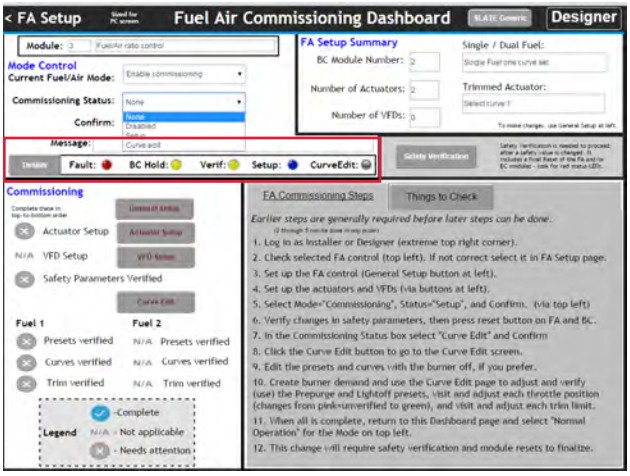
The Fuel Air Commissioning provides an area that shows the current state of the Fuel Air Ratio system. This is for placing the fuel air commissioning into a desired mode via a drop down list. The current view shown is Enable Commissioning.



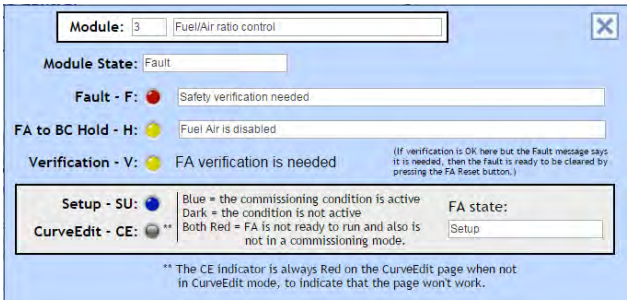
Within Commissioning, the Commissioning Status, as highlighted below allows you to select either Setup or Curve Edit. Once you make your selection, you will need to confirm your decision with the next selection box.



The Details section shows you the current state of your system. It is a good tool to use to understand what item is holding up the commissioning.

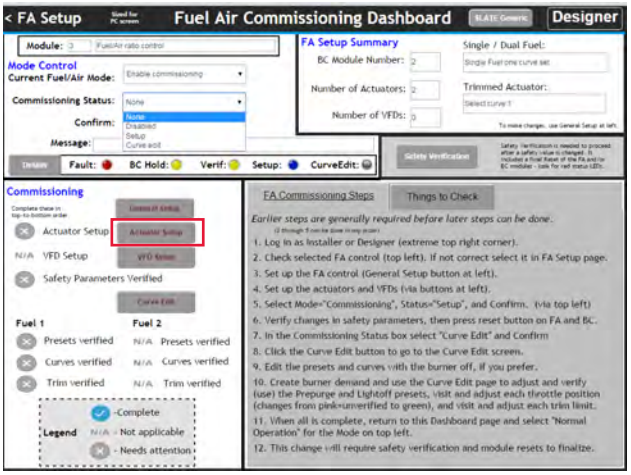


Clicking Details will provide more detailed information as shown below.

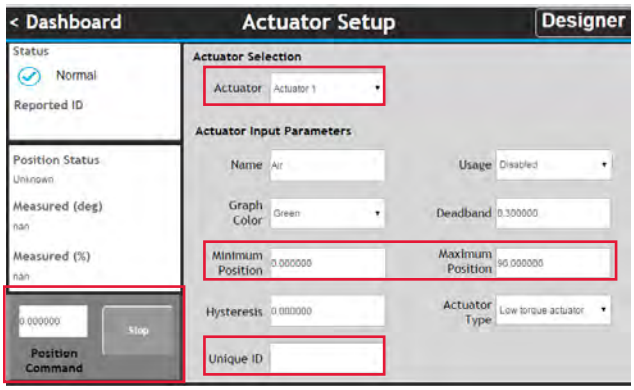


The Commissioning Section will be used to setup the actuators, the VFD, and do the curve edit. The gray area to the right of this section will provides help information that will walk through the process.

The General Setup has been completed using the SLATE AX Tool so you can begin (if you configured it) with the Actuator Setup. Click Actuator Setup.



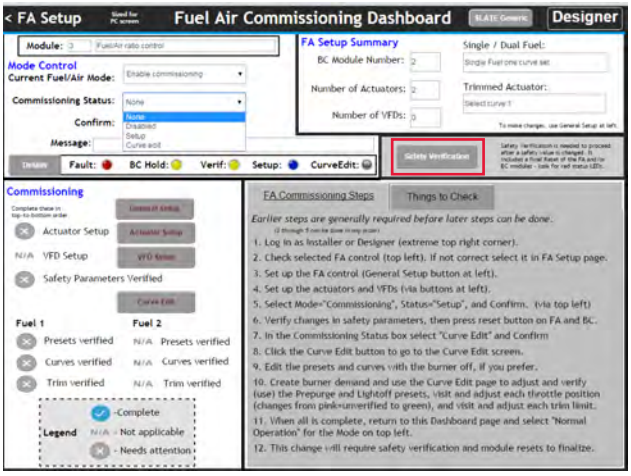
Begin with the Actuator Selection as highlighted below. Notice the Position Command Section. This section will allow you to enter a value to drive the motor to that position. You can use this to determine the minimum and maximum positions located in the middle of this screen.



The SLATE Fuel Air Ratio system will also automatically provided the unique ID for those actuators and will we be found in the highlighted area above. This is the information found on the label of the actuator. If this is unavailable at the time of designing, SLATE will automatically get it from the motor at commissioning time.

After the actuators are setup, you will need to run a safety verification test. Safety verification is required each time a safety parameter is changed. You will need to perform this multiple timed during the start up/configuration process, especially in the Fuel/Air Control Module.

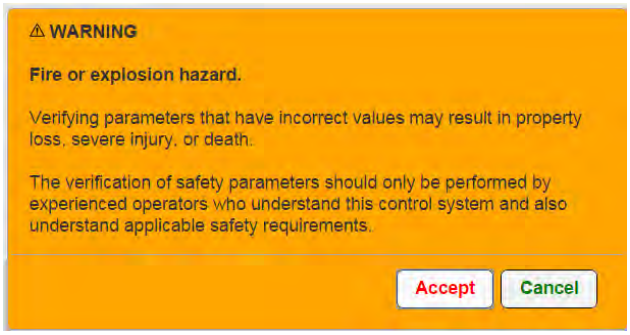
To begin the safety verification process, click the Safety Verification button.



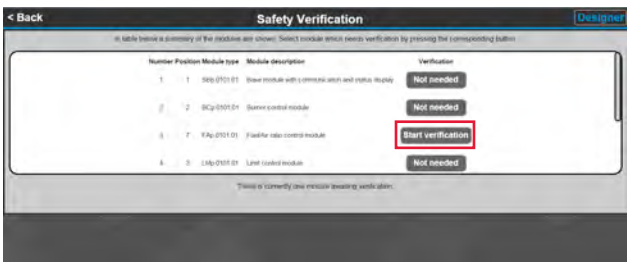
The Safety Verification screen will allow users to start the verification process. Click Start Verification button.



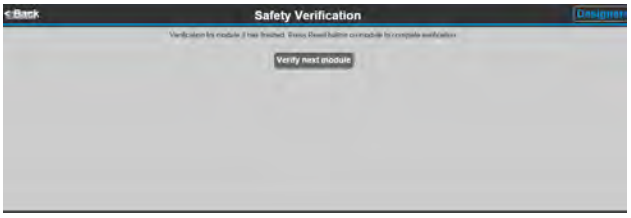
You will be alerted to a warning that you will need to accept. Press Accept.



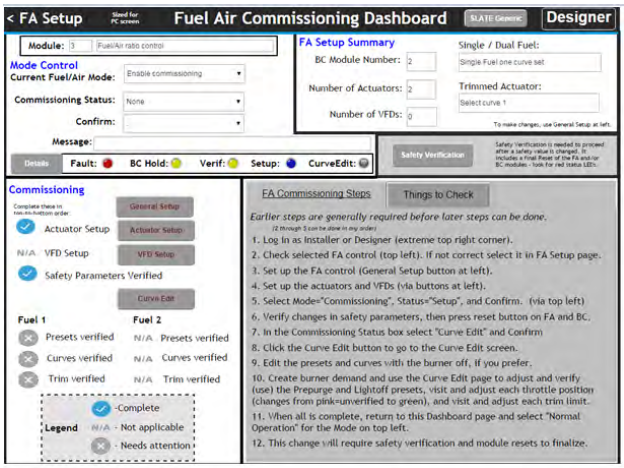
Now start the Verification.



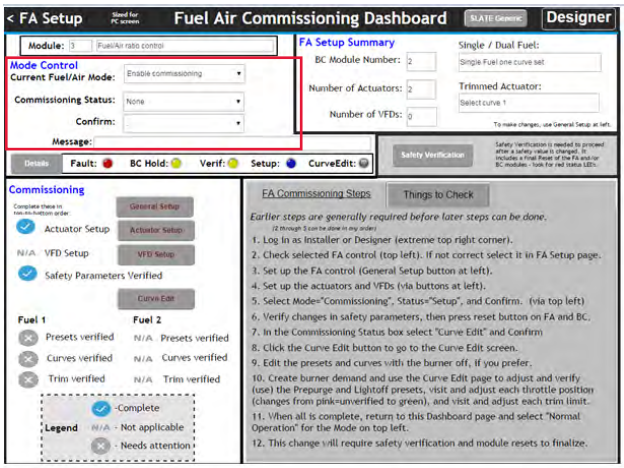
After the Safety Verification steps you will need to push the Reset button located on the Fuel Air Ratio module to complete the verification process. At this point you can go back to the Dashboard.



You can see two blue circles with checks to indicate that this step has been completed and verified. Now you can move to the next step, enabling the edit curve.

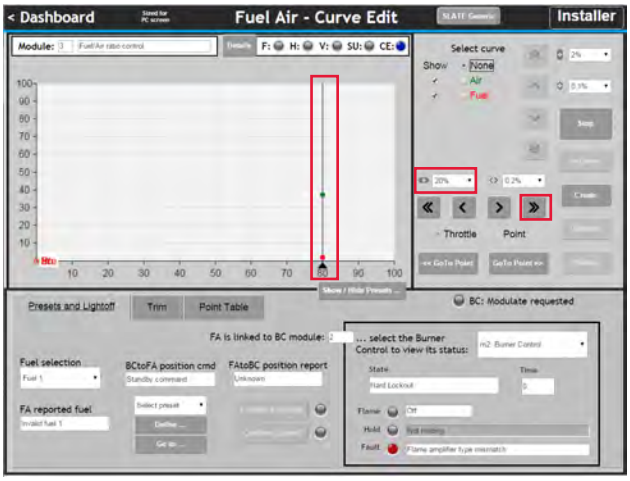


Next select and confirm “Curve Edit” mode as highlighted below.

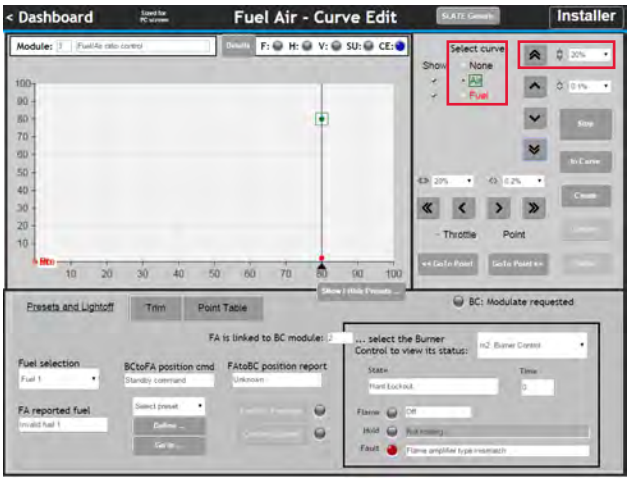


The Curve Edit feature allows you to begin building your curve for Fuel Air Ratio.

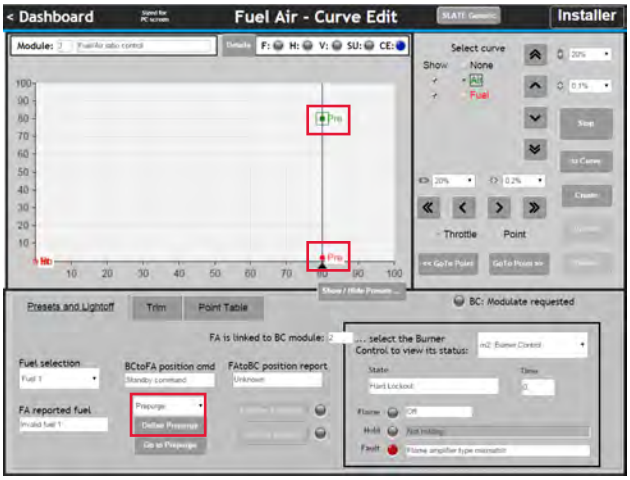
You will begin to set a Pre-Purge Preset. Use the drop-down to set a larger left-right motion of 20%, then click the >> button several times to move the throttle cursor over to the 80% position.



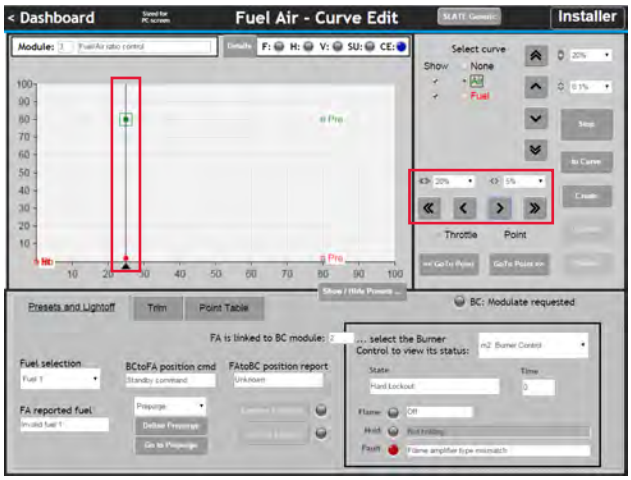
Select the Air actuators using the radio button, set the large up/down motion to 20%, and use the double-up-arrow button to move it up to around 80% (on the Y axis).



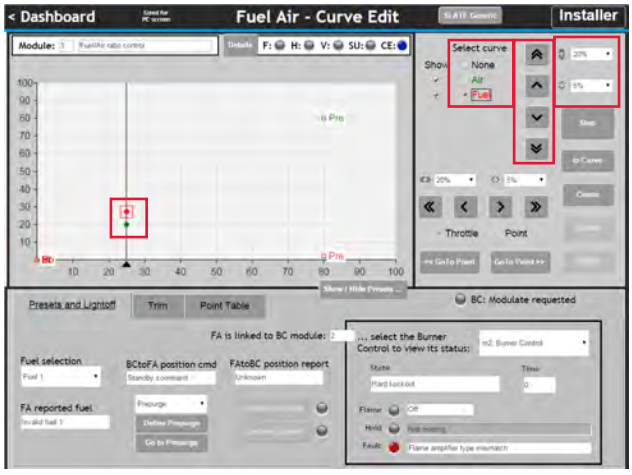
Select the Pre-purge Preset from the drop down list then click the Define Prepurge button. Note that the label “Pre” now shows next to the air and fuel positions.



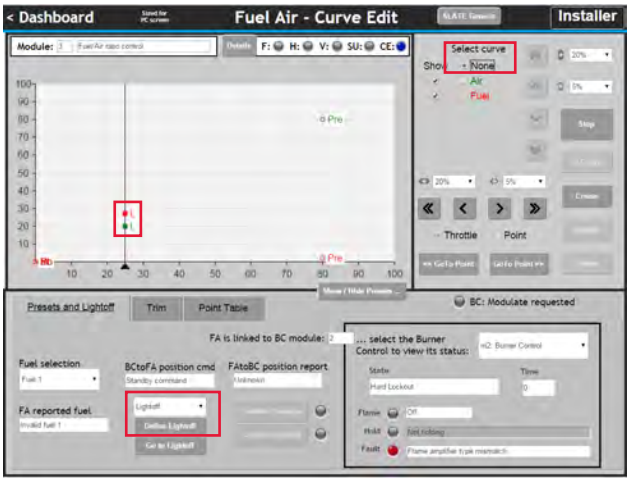
In a similar way, you will now need to set the estimated Lightoff position. First move the throttle cursor over to about 25% (use the small and large movement selectors and buttons)



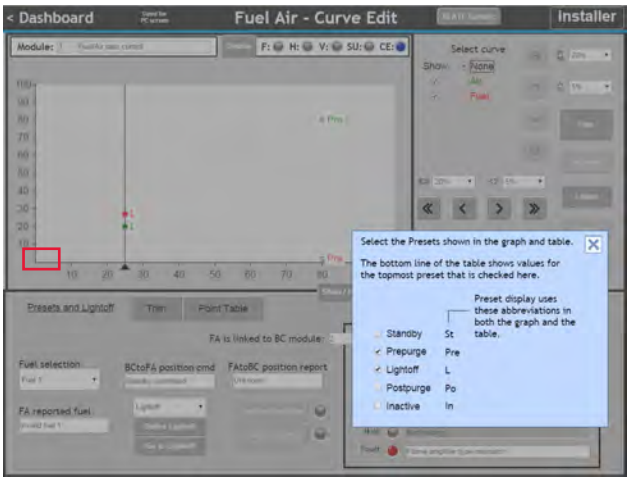
Next use the curve select and the up/down movement selectors and buttons to move the air actuator to about 20%, and the fuel actuator to about 25% (on the Y axis).



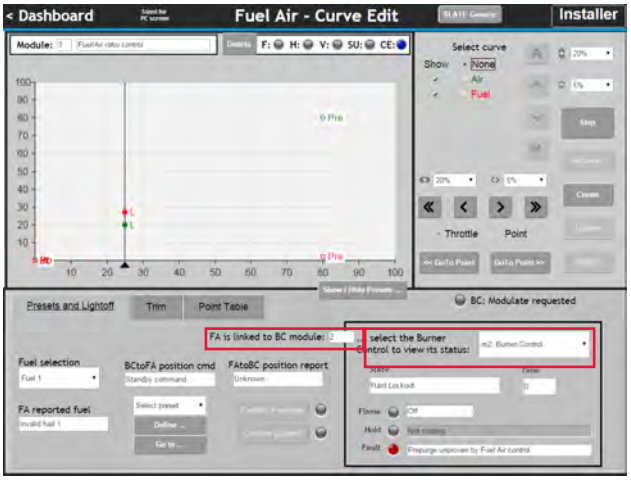
You will now need to define the Lightoff Preset by selecting “Lightoff” and clicking “Define Lightoff”. Note that L appears next to these positions (below “None” has been chosen for the curve select to hide the selector box and show this more clearly).



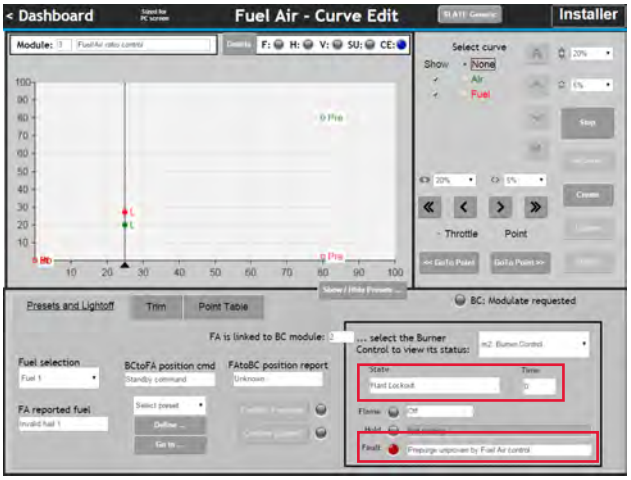
The Presets that are shown determine by the Show/Hide Presets dialog box. Click the button (at arrow). Turning off those off not currently in use will help clean up your screen. Also note the abbreviations.



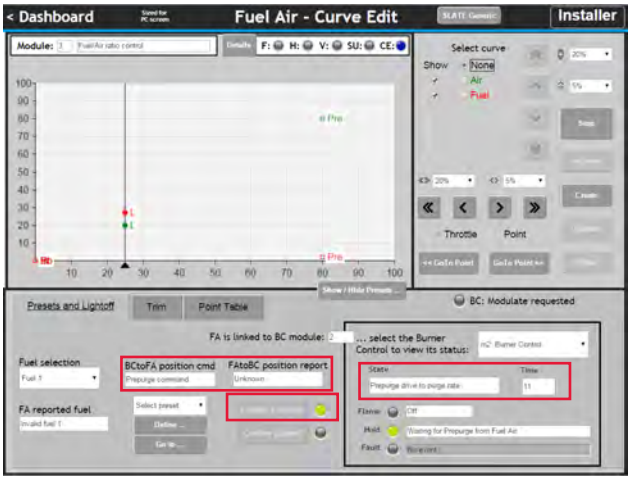
You are now ready to start the Burner. The SLATE Fuel Air reports to the SLATE Burner Control that is linked to it, but you must select it to show its status (if there is only one SLATE Burner Control it will be connected automatically).



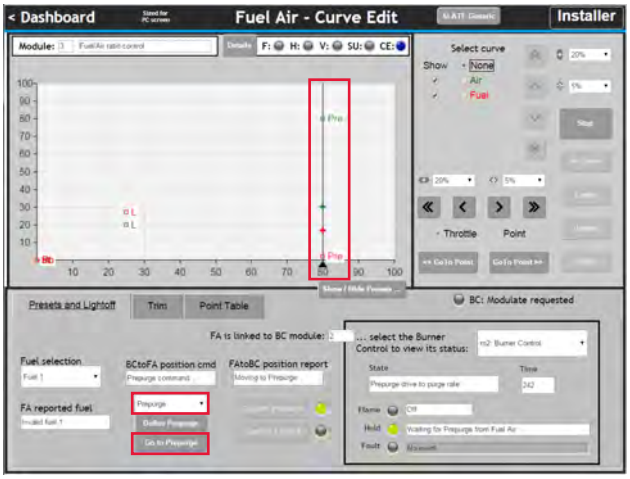
You will need to fix any problems and clear (press Reset) any lockouts in the SLATE Burner Control, and then give it a demand signal in a way that it is configured to accept a call for heat.



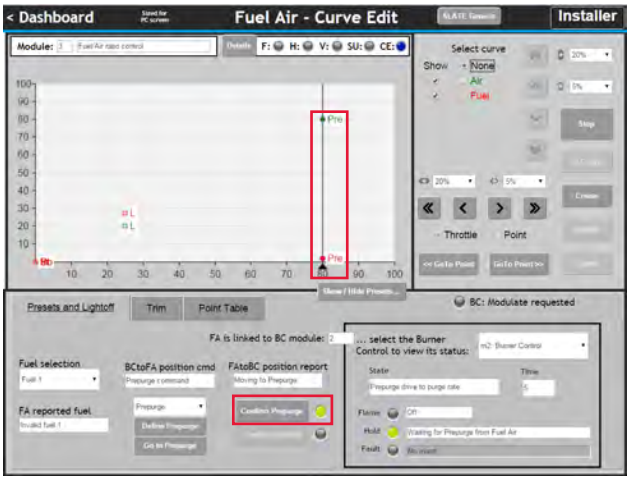
When the demand is on, the SLATE Burner Control will go through Initiate (10 sec.), Standby and Safe Start Check (briefly) and then request the SLATE Fuel Air to go to Prepurge. The amber LED is next to “Confirm Prepurge” button indicating that it is required, but the button is grayed out because the SLATE Fuel Air is not at that position.



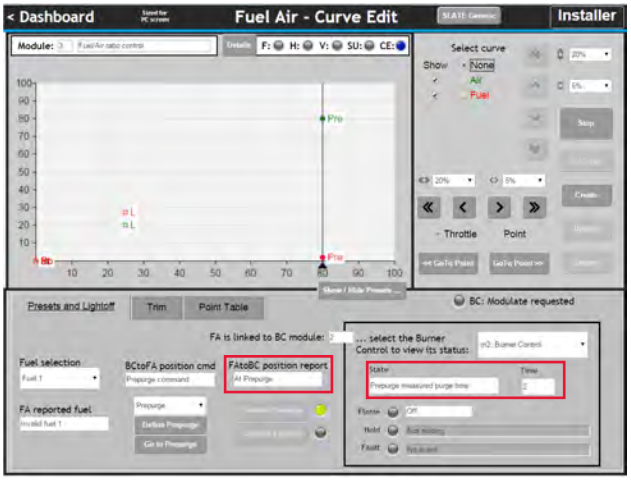
To send the SLATE Burner Control to the Prepurge position, select Prepurge in the drop down list and then click the “Go to Prepurge” button. The commanded position will move, and the actuators will move to the Prepurge position.



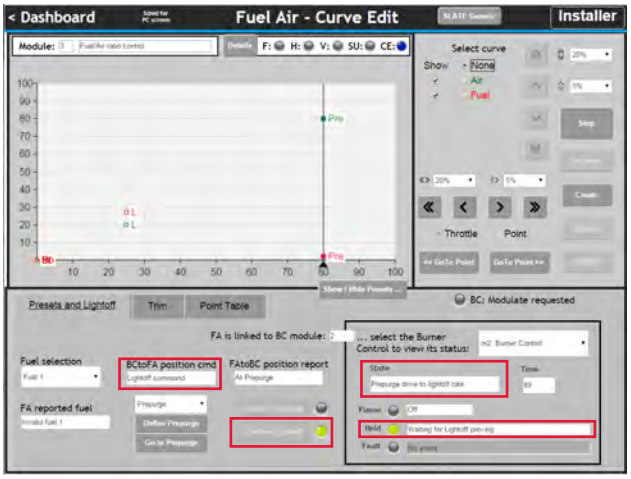
When the actuators have stopped the “Confirm Prepurge” button will become enabled. During commissioning, none of the steps occur automatically, the installer is always in control. Click the Confirm Prepurge button.



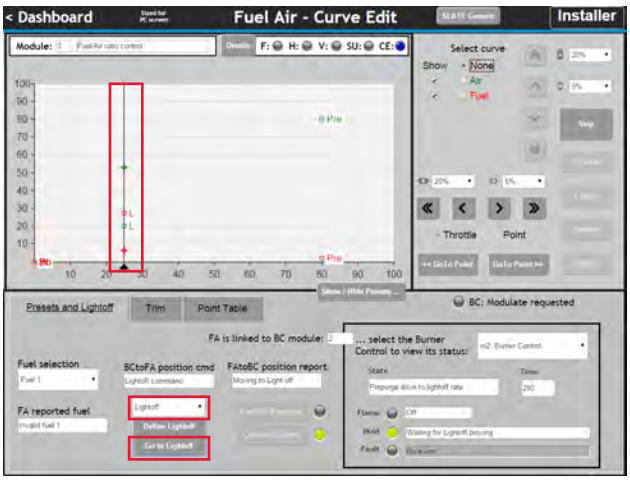
When Prepurge is confirmed, the SLATE Fuel Air Ratio reports that it is “At Prepurge” and this causes the SLATE Burner to measure the prepurge time.



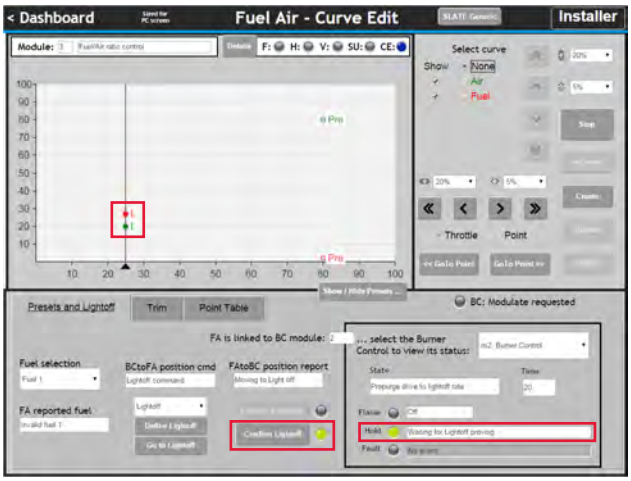
When Prepurge is done the SLATE Burner Control will then request the Lightoff position. The yellow light is on next to the Confirm Lightoff button, but again it is gray because the actuators are not in position.



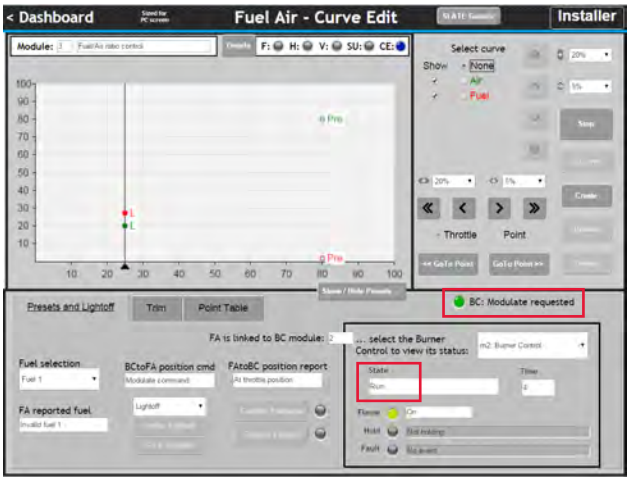
Select “Lightoff” from the drop-down list and click the Go to Lightoff button to move the actuators to the lightoff position.



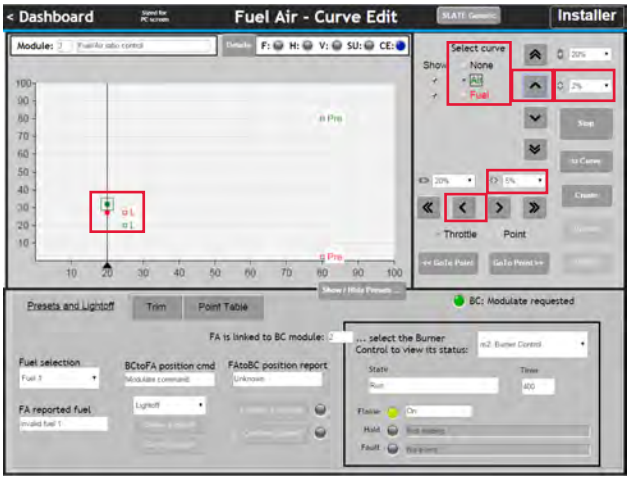
Once the Lightoff position has been reached, the Confirm Lightoff button will become enabled. Click it to confirm that you want the SLATE Burner Control to light the burner. NOTE: You may have just a few seconds to get the flame turned on at just the right time, after clicking this button.



After Pilot and Main flame establishing periods have been completed, the SLATE Burner Control will be in the Run condition and will request modulation from the SLATE Fuel Air Ratio Control. It is now time to start building the Fuel/Air Curve.



As an example, start by moving the throttled down to about 20%, select and move the air up to above the Fuel a bit to just make it different. (Normally this is done while watching a combustion analyzer.)



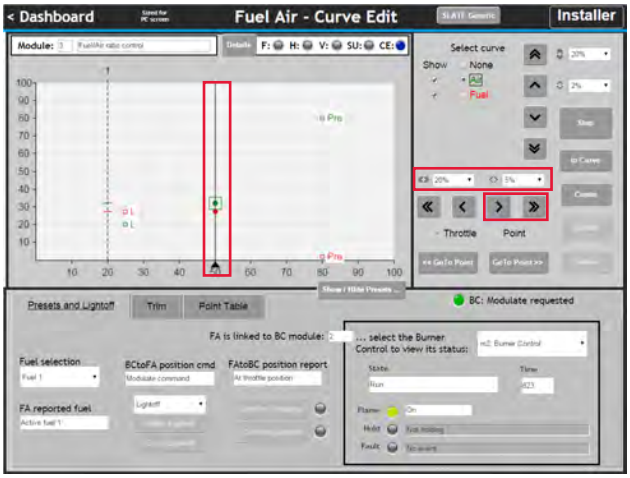
When done, click the Create button to create a point.



Point 1 now exits. (It is also selected because the throttle is close to the point, as shown by the box around the number.



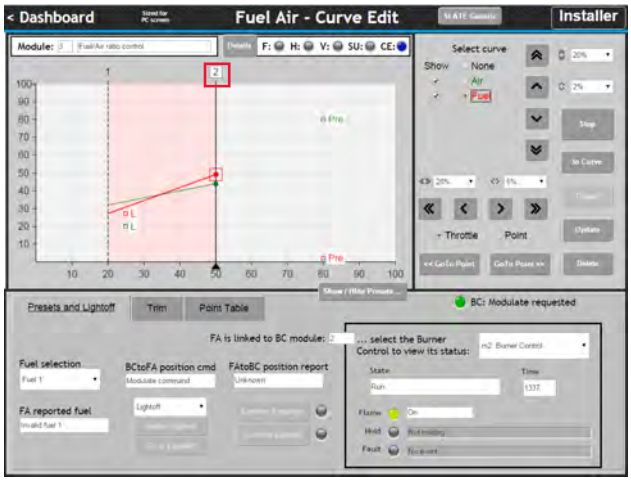
Move the commanded throttle over to around 50% (x axis). Note that the actuators do not change the position (y axis) because there is no curve to follow yet.



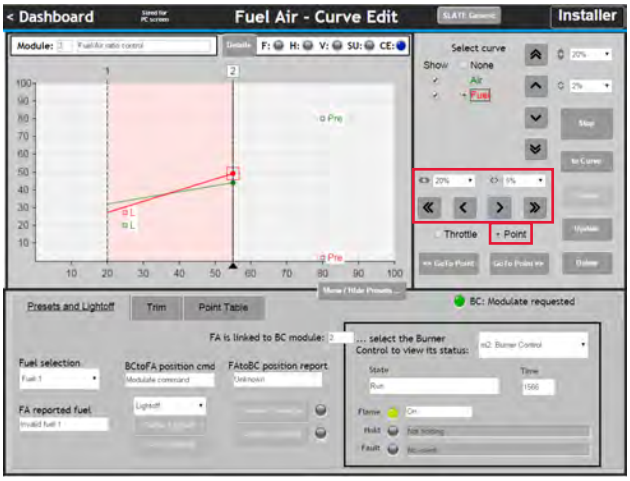
Select the Air and move it up to about 45% (y axis). Select the fuel and move it up to about 50%, above the air. Not that the throttle is locked (padlock icon) and the stopped actuator icons are circles instead of dots, indicating an off-curve condition. When done, click Create to create a second point.



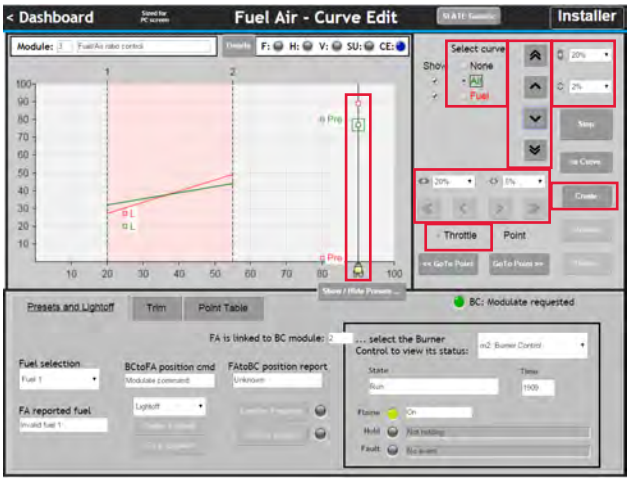
Point 2 now exists (and is selected). The curve segment between the points is pink colored because it has not been verified yet: there are ratios of fuel and air within the region that have not been visited and confirmed as OK. The throttle is unlocked because the actuators are now on-curve.



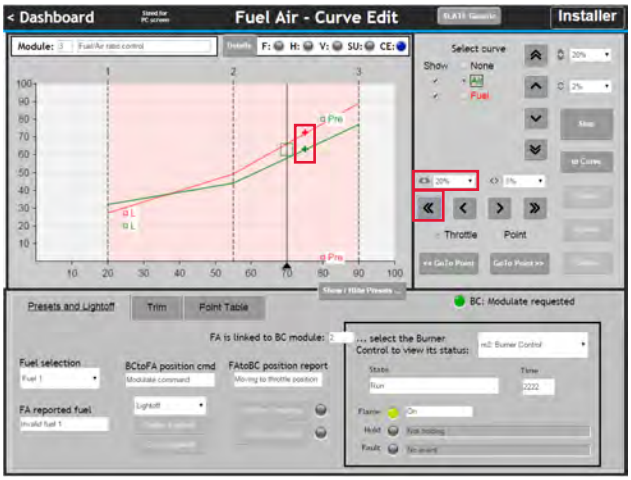
It is possible to move a selected point. Choose the “Point” radio button and move point 2 around to the left and right. Leave it at the 55% position.



Create a third point. Select “Throttle” for the left-right button function and move the throttle over to around 90% (x axis). Select and move the Fuel up to about 90% (y axis) and the air up to about 75%. Then click “Create” to create a point.



Now that a curve exists, actuators will follow it. Move the commanded throttle to the left by 20% and watch the actuators follow the curve to the new position. They are shown as “+” symbols while in motion.



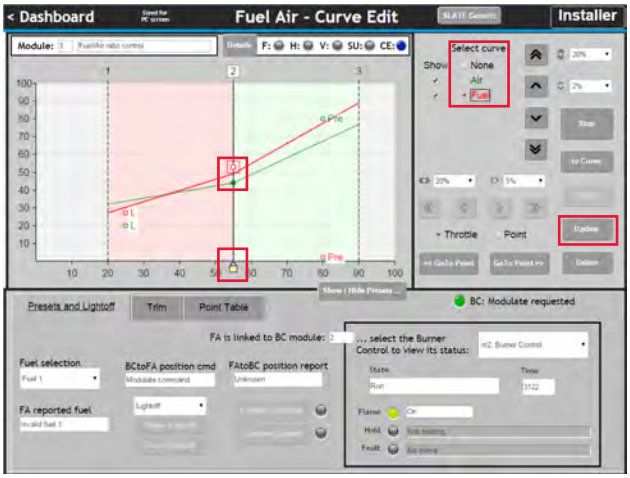
Jump up the throttle left by another 20% and note that as the actuators cross point 2, the segment turns green. It has been verified because all of it has been “visited”. Normally this is done slowly while watching a gas analyzer, making any necessary adjustments, and creating new points as needed.



Adjust point 2. Select the second point, which means the actuators must stop very close to the point. There is a Go to Point button that allows the actuator to move to the point.

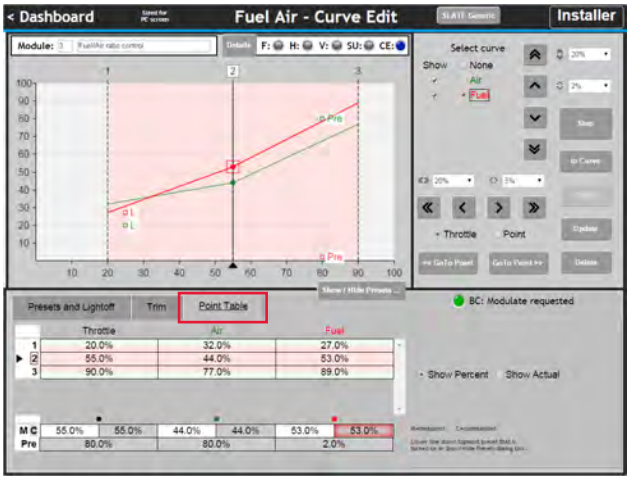


Select the fuel and move it up 5%. Not that the throttle gets locked and the fuel position is shown as an open circle when it stops. Both of these indicate it is off curve. Also not that Update is enabled. Click it to update point 2.



When the point changed, the adjacent segments become invalid and turn pink again, the ratios have changed.

SLATE Fuel Air Ratio commissioning also provides a Point Table. This table is another source of information and is more precise. To access the Point Table Click the tab.



The Point Table shows the same information as the chart; including

- The value of each point
- The Throttle position (triangular arrow) and a lock icon if it is locked.
- The Point that is selected indicated by a box around the number.
- Pink and green shading for verification status

It also shows the exact Measured and the Commanded positions of the throttle and each actuator, and if the actuator is selected, it is shaded (example of the red shaded area at 53% above)

The bottom line shows whichever Preset is the top most selected item in the Show/Hide Presets dialog, so you can see one at a time. Right now the Prepurge (“Pre”) values are shown.

You can also switch the table between showing percent values and actual values. For angular actuators this reads in degrees. Example: an actuator configured to be closed at (0%) at 10 degrees and open (100%) and 70 degrees would show 40 degrees at its 50% position. For a VFD it would typically show RPM (or whatever units are configured), which 0% corresponding to minimum RPM and 100% to maximum RPM. Throttle is always a percentage value.

	Throttle	Air	Fuel
1	20.0%	32.0%	27.0%
2	55.0%	44.0%	53.0%
3	90.0%	77.0%	89.0%

	LOCKED					
M C	55.0%	55.0%	44.0%	44.0%	55.0%	55.0%
Pre	80.0%		80.0%		2.0%	

In the case above, the actuator is above the curve. Note that at point 2 the Fuel position is 53% but the actuator has been commanded to go to and has achieved the position of 55%.

It is above the curve and stopped (open circle) and the throttle is locked.

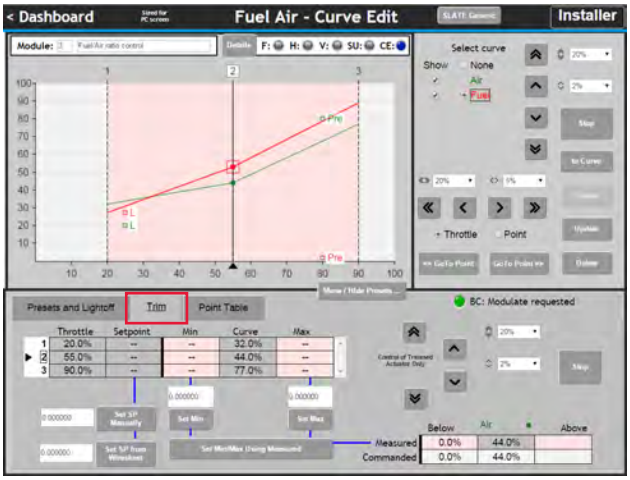
Trim Function

Because Tim is enabled, every point also has:

- Trim Limits - Contains the maximum movement of the actuator

- Trim Setpoint - The desired operating condition (e.g. a percent of O2)

Click the Trim tab to show the Trim Control Panel

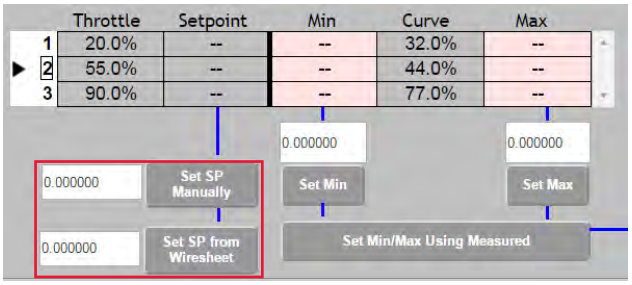


Points are again shown on the left, with a selected point shown by a box around the number. Trim settings must be performed when a point is selected: the buttons are gray and disabled otherwise.

Below, nothing has been entered yet.

At each point, there must be a Setpoint value. There are two ways to provide them.

1. Enter a number into the top box and click the “Set SP Manually” button
2. If SLATE AX Tool Wire Sheet logic exists to read one or more sensors and provide a measurement then it will be shown in the bottom box and can be entered using the “Set SP from Wiresheet” button.



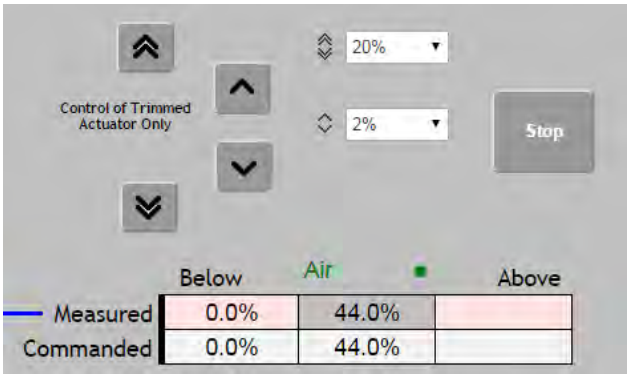
At each point, there must be a Min and a Max actuator deviation. These provide safety limits as a percent of actuator travel (e.g. the maximum amount it is allowed to deviate such as 5% or 2%. Both Min and Max are positive numbers. They are the magnitude of offset that is allowed)

The Min limit is mapped to a -100.0 (negative 100%) trim request coming from the SLATE AX Tool Wire Sheet and the Max is mapped to +100.0 (positive 100%). For example, assume that Min for point 2 is set to 3% and as-shown, the curve says 44.0% is the on-curve value for the trimmed actuator at point 2.

If the Wire Sheet then asked for maximum negative (-100.0) the actuator would move to its 41% position, which is 44% minus the full 3% deviation that is allowed. If it asked for -50.0 (-50%) the actuator would move to its 42.5% position (44% minus half of 3%, or 1.5%). Two different used of percent are occurring: maximum actuator deviation is in percent of actuator travel and is a safety limit. Trim requests are a pure number between minus 100% and plus 100% and are non-safety requests.

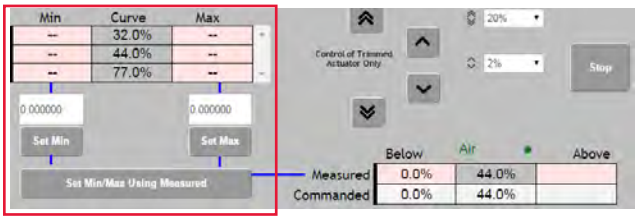
The controls shown below move the Trimmed actuator. The drop-down selectors are actually just a repeat of those you have already used. The normal up/down buttons that you have used can be used to move any selected actuator. However, the four up/down buttons shown above are unique. As the text describes they always move the Trimmed actuator, no matter what actuator is selected.

A table shows the status of the Trimmed actuator, Air in this case. The table automatically fills in and shows values on one side or the other, depending on whether the actuator is Below or Above the curve.



There are two ways to enter trim limit Min and Max values:

1. Enter numbers into the boxes and click the Set Min and/or Set Max buttons
2. Click the “Set Min/Max Using Measured” button.

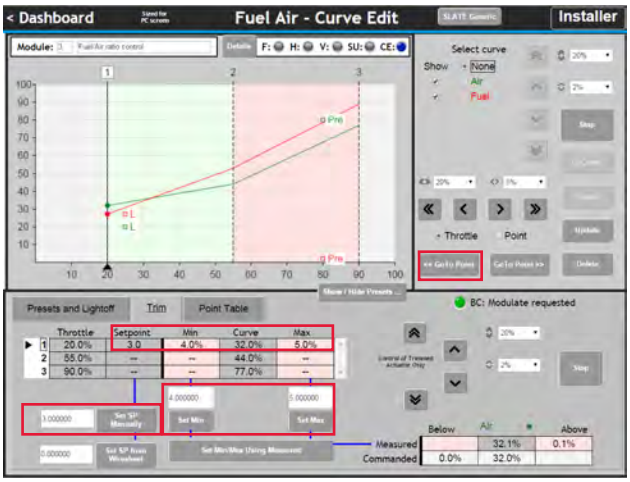


The latter button uses the measured value and it knows which to set. If the actuator is Below the curve it sets the Min value, and if it is Above the curve it sets Max. Normally Trim limits are set while watching a gas analyzer and making small adjustments to determine how far an actuator can deviate and still remain safe.

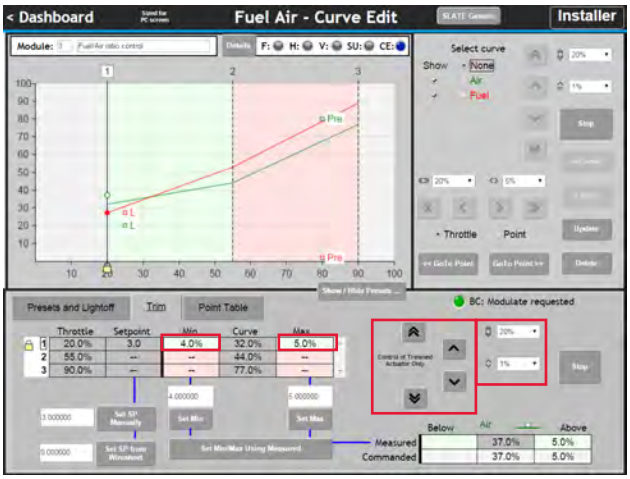
Trim also must be verified before the Fuel Air Ratio can be set for normal operation. Each limit extreme must be “visited” to turn the boxes from pink to green.

Use the “<<Goto Point” button to move point 1. Wait for the actuators to get there and the point to be selected. Your graph segment may stay pink or turn green; either is OK.

Manually enter a Trim Setpoint example of 3.0 and click “Set SP Manually”. Manually enter a Min of 4 and a Max of 5 and click “Set Min” and “Set Max”.

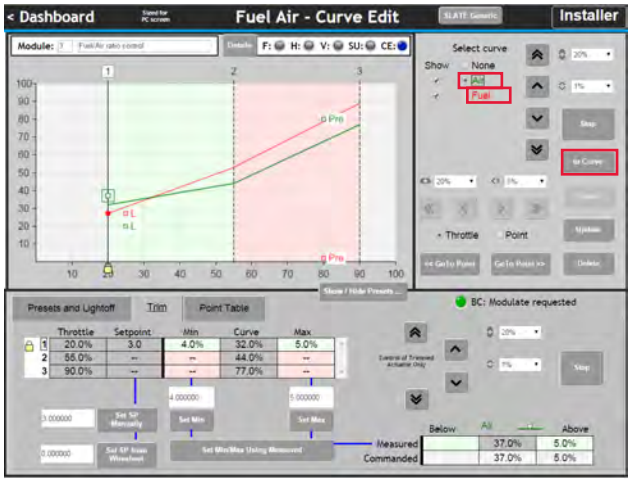


Next visit these two limits by using the trimmed actuator controls. Move the trimmed actuator up to Above limit (32 plus 5=37) and down the Below limit (32 minus 4 = 28). You’ll have to stop right on the limiting value. The boxes should turn green.



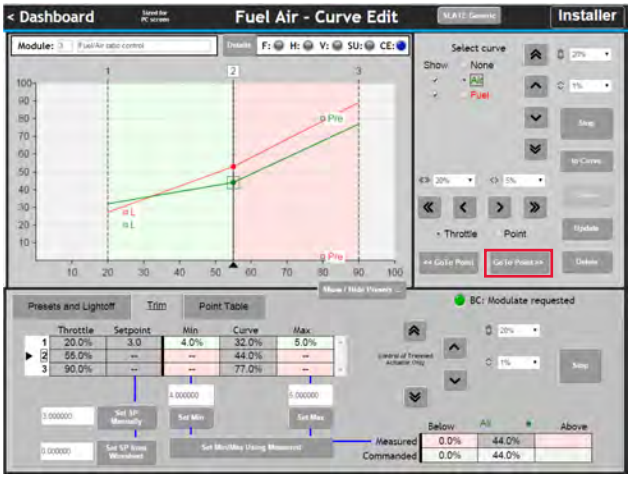
Tip! After visiting the second extreme (either below or above) to the actuator back to the curve quickly:

In the selector at the top, select the trimmed actuator (Air in this case). This will enable the “to Curve” button in the top section. Click that button to send the actuator back to the curve and unlock the throttle.

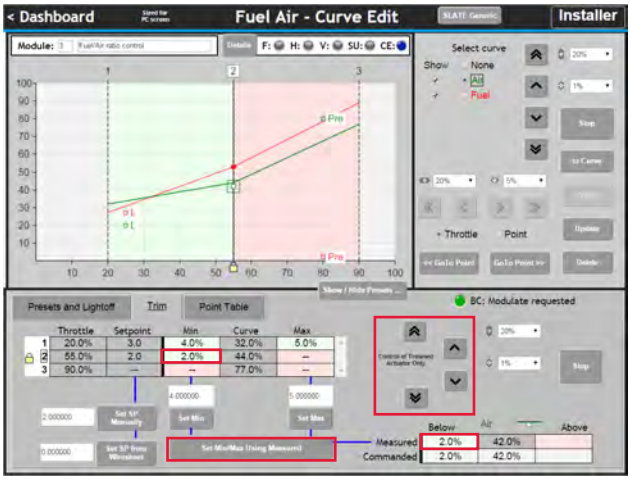


Use “Goto Point>>” to move the throttle to point 2. Again, normally this would be done slowly and one step at a time, while watching a gas analyzer.

If the segment between points 1 and 2 was pink before, it should now be green since all positions between 1 and 2 have been visited.



Set the Trim Setpoint to 2.0 by editing the box and clicking “Set SP Manually”. This time, set the Min value using the other method. First move the trimmed actuator down until it’s 2% below the curve, then click “Set Min/Max Using Measured”. Notice that it turns green right away because it’s already there.

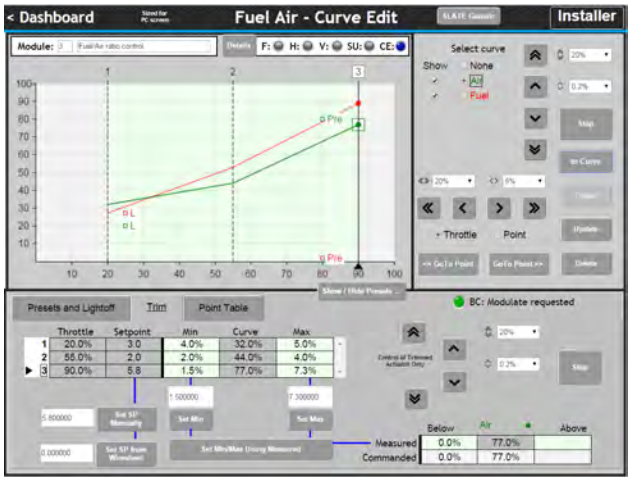


Set the Max value in the same way. Move the actuator up until it's 4% above the curve then click the "Set Min/Max Using Measured" button. When done, click "to Curve" to go back to the curve and unlock the throttle.

Note: You don't have to wait for the actuator to finish moving before advancing its commanded position again.



Finally, move to point 3. Set the final trim setpoint to 5.8, the Min to 1.5% and the Max to 7.3%, using any technique you prefer. Visit the trim limits. Make sure everything is green. Return the actuator to the curve. Click on the top left button in the title bar to go back to the dashboard.



Note that all of the blue check mark circles are complete. The final step is to select the "Enable normal operation" in the Current Fuel Air Mode dropdown. Red lights will occur and the system will shut down. This is normal.

Click the "Details" button and you will see that Verification is needed. Proceed with Verification and you will find just one parameter that needs verifying. It will be one that says the system is now ready to operate. Verify it. Then press the reset button to clear the fault on the SLATE Fuel Air Ratio Module and SLATE Burner Control Module.

The system should now start up, purge, ignite, and run, follow the curve for modulation and also trim according to trim commands.

Built-in screens let you monitor and control these, even if you don't have SLATE AX Tool Wire Sheets controlling the set up yet.

Chapter 8: SLATE Limit Module and Configuration



Overview

The R8001L8001 SLATE Limit Control Module is part of the SLATE Combustion System. The SLATE Limit Control Module provides the ability to bring in any type of analog signal and create limits on either pressure or temperature.

The R8001L8001 provides up to 12 limit blocks with each block monitoring any sensor or pair of sensors. One limit module can be used for multiple SLATE Burner Controls.

LED Array

There are three LEDs on the front of the SLATE Limit Control Module that provide quick identification of the system status and any problems that might have occurred. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable module.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No valid configuration
	Green	Running
Fault	Red	Fault
	No light	No fault

LED Display

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. They also have three-position LED colors to indicate the terminal states as shown below.

Color	Description
Green	Terminal is ON or is Normal
Red	Fault
No light	Terminal is OFF or Not in use

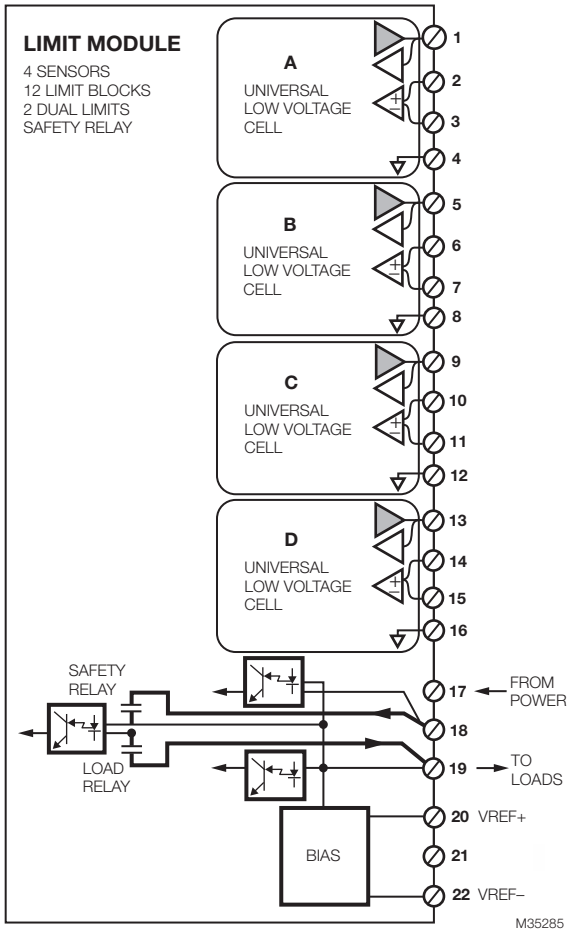
Select and Resent Buttons

The SLATE system modules have Select and Reset buttons located on the front of the modules and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.



Understanding the Terminals

The SLATE Limit Module contains 22 wired terminals. All terminals are 24VDC or 24-240VAC and automatically adapt to the applied system voltage. The Limit Module wiring terminal descriptions can be found below.



Terminal Functions				Min	Typical	Max	Units	
TF1	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out	Range	0.0	-	15.0	VDC	
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50	-	50	uA DC	4 to 20 mA
TF2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
TF3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA

[a] TF1 input terminal is held at constant 2.5VDC over allowable current range.

[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
TF2 & TF3	Type J	Range	-200.0		1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
TF3 & TF4	Type PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
TF3 & TF4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C

[a] Shielded cable required for reliable operation in noisy environment.

[b] NTC on terminal T4 is rated down to 0 °C.

[c] Temperatures refer to sense range.

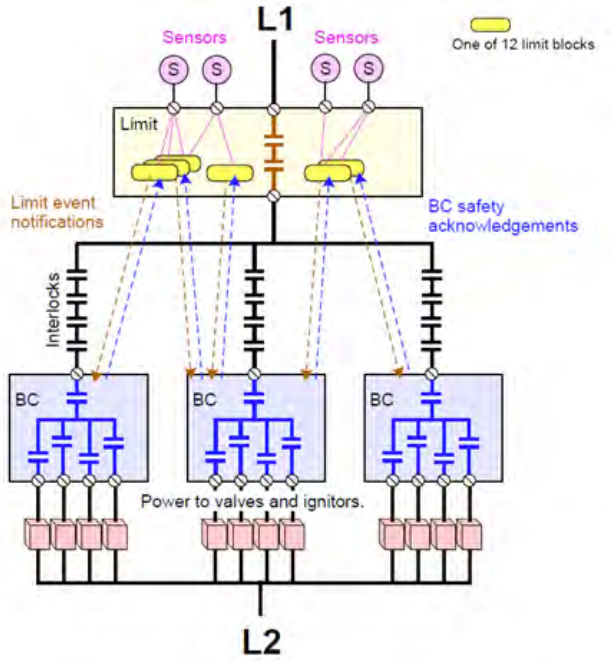
	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
TF1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	0-100% output allowed
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Range		2.0	-	1000.0	Hz	
	Min. "on" pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. "off" pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1.0	-	Hz	
	Accuracy		-5.0	-	0.0	%	Whichever is greater
			-1.0	-	0.0	Hz	
	PWM In						
TF2	Amplitude		5.0	10.0	15.0	VDC	
	Frequency		125.0	-	500.0	Hz	
	Min. "on" pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. "off" pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution			-	1.0	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Table 1. Suggested Sensor Selection based on Application.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16, or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Understanding the SLATE Limit Capabilities

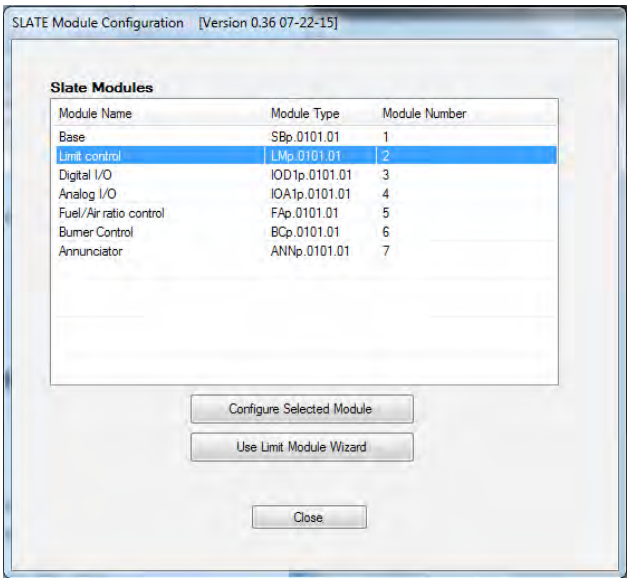


- There are 12 limit blocks
- Each can be a high limit, low limit or dual track limit
- Each block can monitor any sensor or a pair of sensors
- Each block can be assigned to one particular SLATE Burner Control. This is optional. Instead a blocky may cause a Limit lockout directly, or it may simply provide a non-safety notification status
- When the SLATE Limit notifies the SLATE Burner Control of an event, the Burner Control must acknowledge this notification, otherwise the Limit locks out

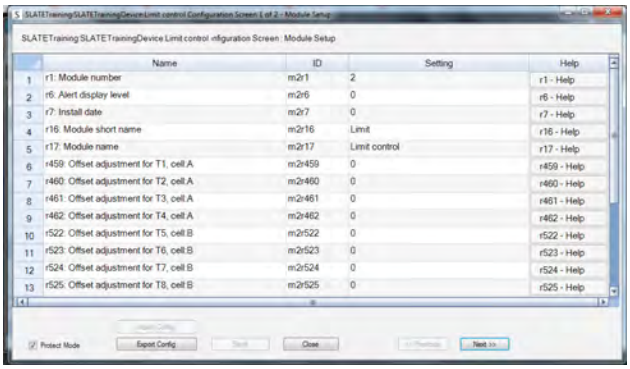
- The SLATE Burner Control must acknowledge, but the details how the SLATE Burner Control handles each limit event is a safety configuration parameter in the Burner Control.
- Limit blocks have names such as “Outlet High Temp” or “Low Gas Press”. To acknowledge notification, a limit event handler in the SLATE Burner Control must have a matching name. Both names are part of the safety data in each device
- Thus for a Limit lockout to be effective in the case of an acknowledgment failure, all SLATE Burner Controls using the limit for safety must get the power for their outputs via the SLATE Limit module.

Getting Started

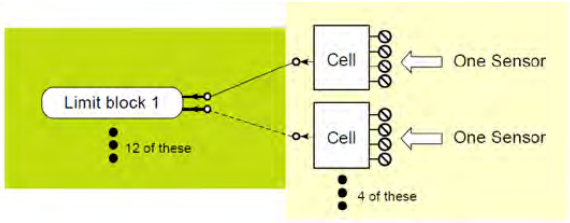
1. To access the configuration tool you will need to launch the SLATE AX Tool.
2. If you have not created a Station please refer to Chapter 2 of this manual to learn how to create a new station.
3. If you have created a Station open up the Navigation pane until to reach your SLATE Device. Double-click on the SLATE device to launch the Module Configuration Tool.
4. Select Limit Control



5. Configure the parameters in the configuration section based on the outcomes you need for your application.



Limit Block Concepts



A Limit Block is programmable logic inside the SLATE Limit Module. A SLATE Limit Module contains 12 limit blocks. They are all identical. Each can monitor one cell or two cells. A block may be configured to perform a simple function:

- High Limit- Compare the sensor reading vs. a threshold, react if it is too high
- Low Limit- Compare the sensor reading vs. a threshold, react if it is too low
- Dual Track Limit- Compare two sensors, react if the difference exceeds a threshold

Limit Block Configuration

Enable

- Block name- The name is a reminder of the purpose and is also used for the SLATE Burner Control notification
- Disable- A block that is not needed is disabled
- Status Only- A block may be used to provide only a status value
- Limit Lockout- The block will react by causing a lockout of Limit module
- SLATE Burner Control Notification- The block will react notifying a particular SLATE Burner Control
- Auto-ignition Burner Control Notification- The block will react by notifying a particular burner that the auto-ignition temperature has been reached (typically 1400°F)

Assignment

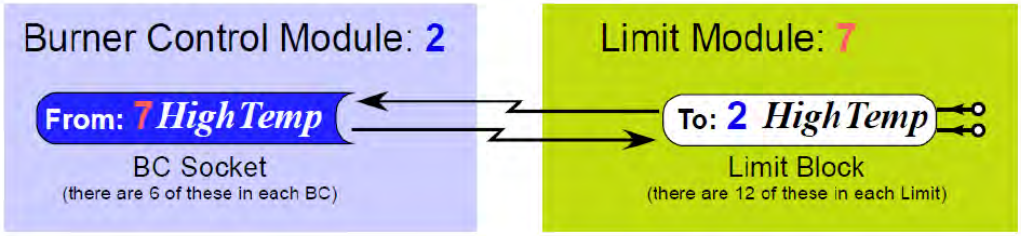
- A,B,C,D – The block may be assigned to cell A, B, C or D
- AB closest, AB average, CD closest, CD average, Dual Track AB, Dual Track CD- It can use the closest sensor to the threshold or can average two of them or it can compare them to each other

Threshold- This is the high limit, low limit or maximum difference for Dual Track

Hysteresis- Hysteresis currently is not used

Detection time- The threshold must be exceeded for this amount of time, before the block will react

Burner Control Notification

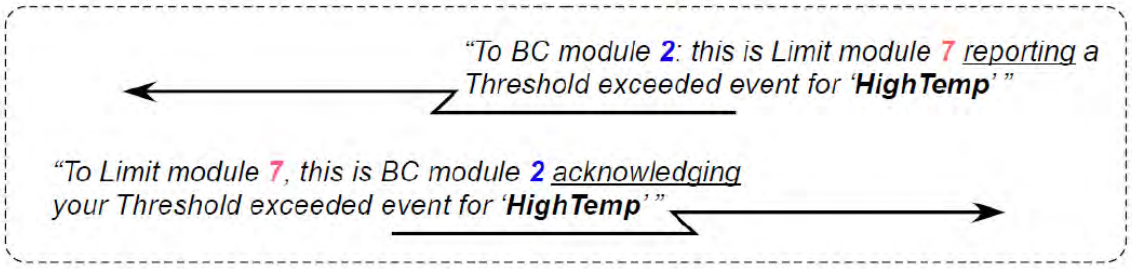


A socket is configured with the module number of a Limit module: 7

And a socket name: HighTemp

A block is configured to send notification to BC module: 2

using the Block's name: HighTemp



- The BC will only acknowledge a message from a Limit module whose number matches what is configured for the Socket, and only if it has an exactly matching socket name.

- The Burner Control implements 6 "sockets", which are logic blocks that can receive notifications from a Limit module.

- The response to the Limit's notification is determined by the configuration of the socket in the Burner Control. Each of the sockets has **Socket configuration parameters:**



- **Limit module number** This is the module number of the Limit which has a block that is set up to notify this burner control.
- **Limit name** The name in the socket must be and EXACT match for the block's name.
- **Limit response enable:** (also called Limit response "trigger")

  Disable
  Always
  Prepurge, Ignition, and Run
  Ignition and Run
  Flame is on
  Run

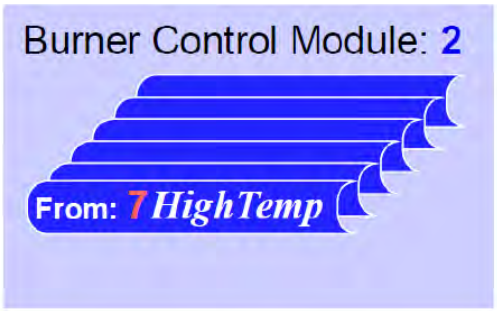
  The socket is Disabled if it is not used. Otherwise it can respond Always, or only when the BurnerControl is in a specific condition.

- **Limit response:**

  Recycle 1/2/3
  Soft or Hard Lockout
  Auto-ignition

  The response can be one of the three Recycle "recipes", a Soft Lockout, a Hard lockout, or can be the special case which notifies the BC that an autoignition temperature (1400 F is typical) has been reached and thus flame amp signals can be ignored.

• Each Socket provides a status register that reports whatever the Limit block is currently sending, for display or for wire sheet use. The values of the Limit block **status reported by a socket** may be:



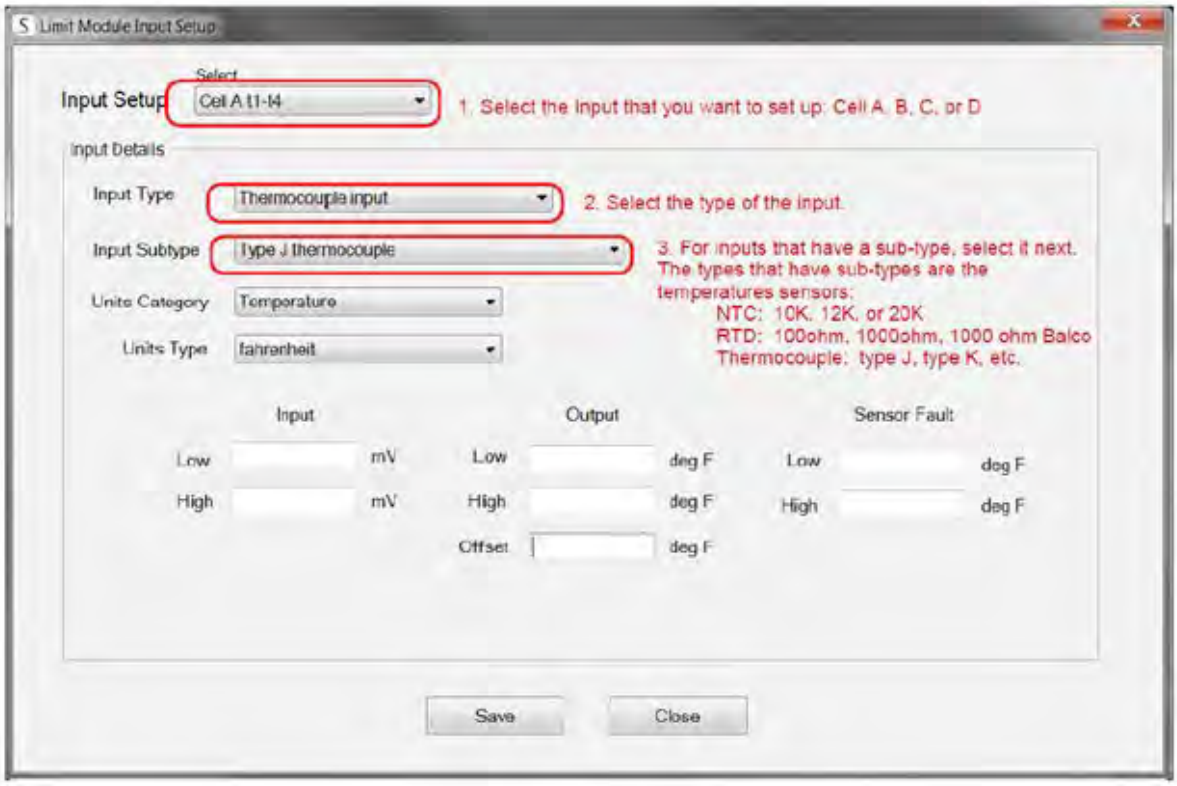
• **Limit status**

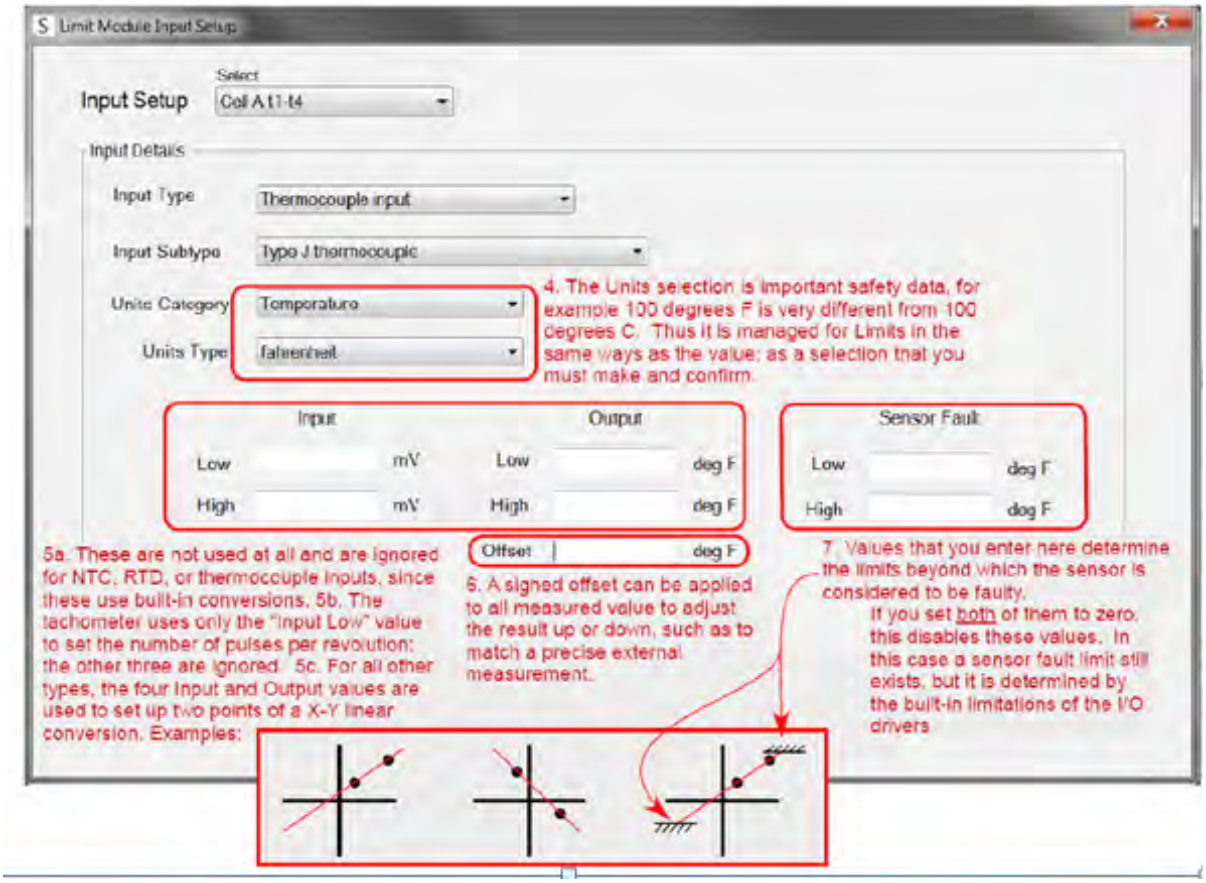
Unknown	**Unknown can occur briefly at startup time. Limit OK means the limit condition is normal. Limit Exceeded means the threshold has been exceeded (too high for a high limit, too low for a low limit, too far apart for a dual tracking limit). Limit Recovery means that the threshold was exceeded in the past, is OK now, but the recovery time has not yet elapsed.**
Limit OK **Limit Exceeded** **Limit Recovery**	
Autoignition threshold exceeded	**The report for autoignition has its own, separate value.**
Limit communication failure	**If the socket is set up but a Limit module is not communicating, then this value will occur.**
Sensor fault	**A sensor fault indicates that the Limit block is having trouble with the sensor reading.**

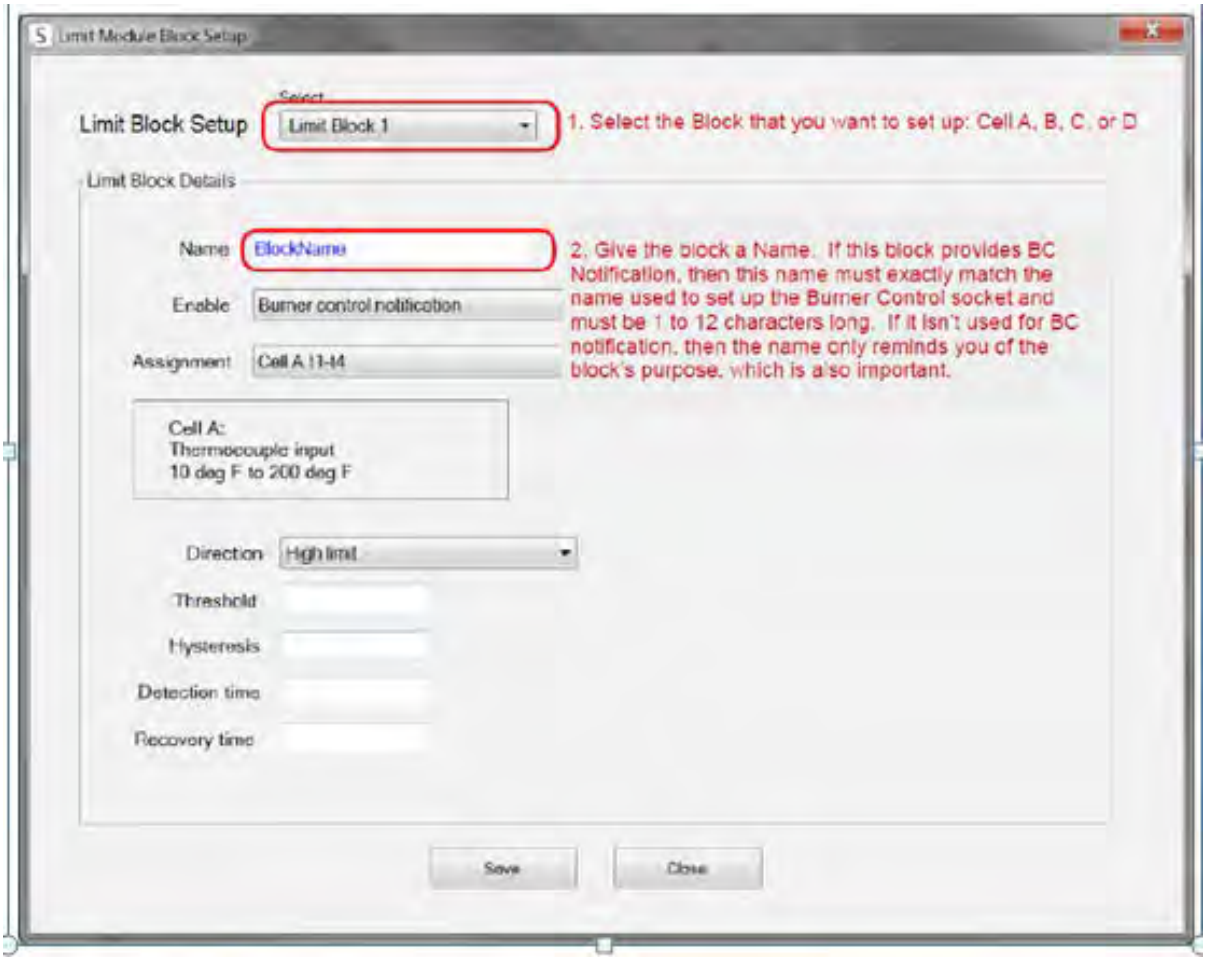
For a socket set up to monitor a limit threshold, any value other than Limit OK will cause a fault response.

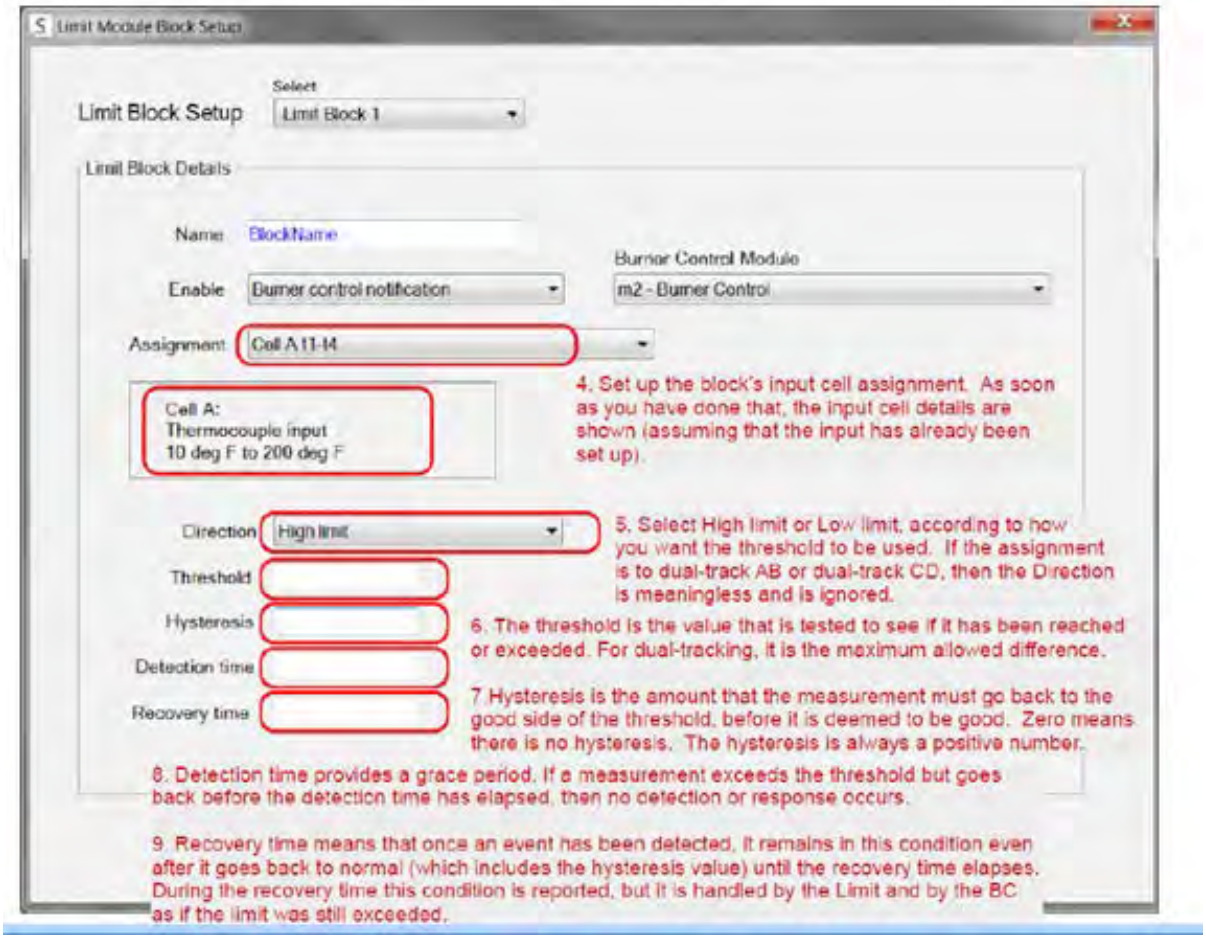
For a socket set up to receive autoignition notification, any value other than Autoignition threshold exceeded is treated as if the threshold is not exceeded.

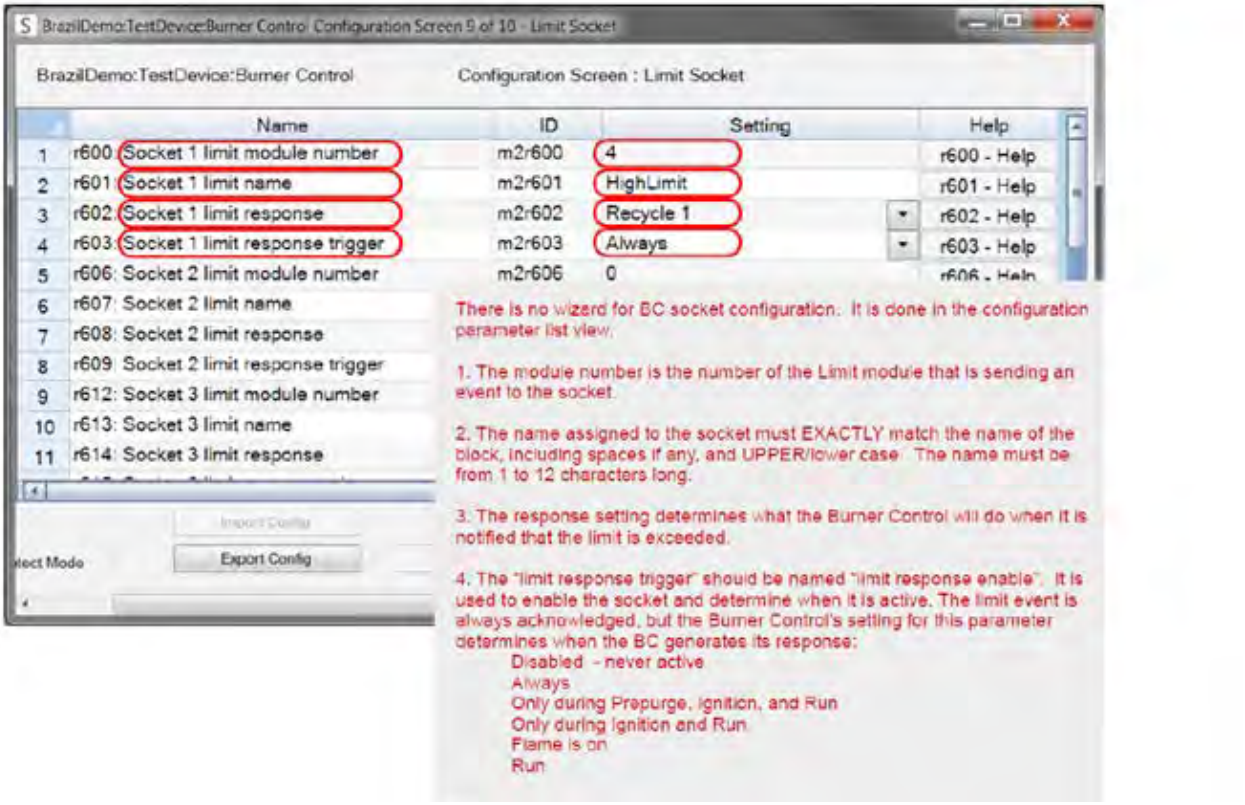
Setting up a Limit Input Cell only using the configuration wizard



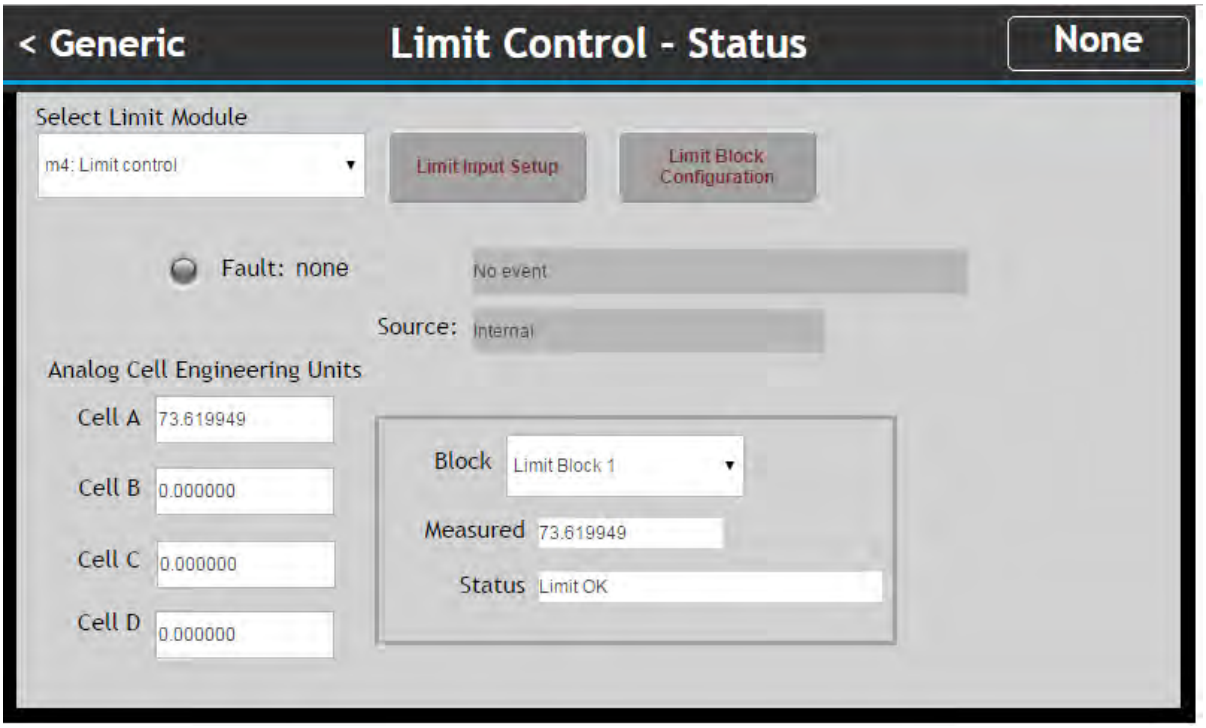

Limit Module Input Setup
Input Setup
Select
Cell A t1-t4
Input Details
Input Type
Thermocouple input
Input Subtype
Type J thermocouple
Units Category
Temperature
Units Type
fahrenheit
4. The Units selection is important safety data, for example 100 degrees F is very different from 100 degrees C. Thus it is managed for Limits in the same ways as the value; as a selection that you must make and confirm.
Input
Output
Low
mV
Low
deg F
High
mV
High
deg F
Sensor Fault
Low
deg F
High
deg F
Offset
deg F
5a. These are not used at all and are ignored for NTC, RTD, or thermocouple inputs, since these use built-in conversions. 5b. The tachometer uses only the "Input Low" value to set the number of pulses per revolution; the other three are ignored. 5c. For all other types, the four Input and Output values are used to set up two points of a X-Y linear conversion. Examples:
6. A signed offset can be applied to all measured value to adjust the result up or down, such as to match a precise external measurement.
7. Values that you enter here determine the limits beyond which the sensor is considered to be faulty.
If you set both of them to zero, this disables these values. In this case a sensor fault limit still exists, but it is determined by the built-in limitations of the I/O drivers


Limit Module Block Setup
Limit Block Setup
Select
Limit Block 1
1. Select the Block that you want to set up: Cell A, B, C, or D
Limit Block Details
Name
BlockName
Enable
Burner control notification
Assignment
Cell A I1-I4
2. Give the block a Name. If this block provides BC Notification, then this name must exactly match the name used to set up the Burner Control socket and must be 1 to 12 characters long. If it isn't used for BC notification, then the name only reminds you of the block's purpose, which is also important.
Cell A:
Thermocouple input
10 deg F to 200 deg F
Direction
High limit
Threshold
Hysteresis
Detection time
Recovery time
Save
Close


Limit Module Block Setup
Limit Block Setup
Select
Limit Block 1
Limit Block Details
Name
BlockName
Enable
Burner control notification
Burner Control Module
m2 - Burner Control
Assignment
Cell A 13-14
Cell A:
Thermocouple input
10 deg F to 200 deg F
4. Set up the block's input cell assignment. As soon as you have done that, the input cell details are shown (assuming that the input has already been set up).
Direction
High limit
Threshold
Hysteresis
Detection time
Recovery time
5. Select High limit or Low limit, according to how you want the threshold to be used. If the assignment is to dual-track AB or dual-track CD, then the Direction is meaningless and is ignored.
6. The threshold is the value that is tested to see if it has been reached or exceeded. For dual-tracking, it is the maximum allowed difference.
7 Hysteresis is the amount that the measurement must go back to the good side of the threshold, before it is deemed to be good. Zero means there is no hysteresis. The hysteresis is always a positive number.
8. Detection time provides a grace period. If a measurement exceeds the threshold but goes back before the detection time has elapsed, then no detection or response occurs.
9. Recovery time means that once an event has been detected, it remains in this condition even after it goes back to normal (which includes the hysteresis value) until the recovery time elapses. During the recovery time this condition is reported, but it is handled by the Limit and by the BC as if the limit was still exceeded.


BrazilDemo:TestDevice:Burner Control Configuration Screen 9 of 10 - Limit Socket
BrazilDemo:TestDevice:Burner Control
Configuration Screen : Limit Socket
Name
ID
Setting
Help
1 r600: Socket 1 limit module number m2r600 4 r600 - Help
2 r601: Socket 1 limit name m2r601 HighLimit r601 - Help
3 r602: Socket 1 limit response m2r602 Recycle 1 r602 - Help
4 r603: Socket 1 limit response trigger m2r603 Always r603 - Help
5 r606: Socket 2 limit module number m2r606 0
6 r607: Socket 2 limit name
7 r608: Socket 2 limit response
8 r609: Socket 2 limit response trigger
9 r612: Socket 3 limit module number
10 r613: Socket 3 limit name
11 r614: Socket 3 limit response
Export Config
There is no wizard for BC socket configuration. It is done in the configuration parameter list view.
1. The module number is the number of the Limit module that is sending an event to the socket.
2. The name assigned to the socket must EXACTLY match the name of the block, including spaces if any, and UPPER/lower case. The name must be from 1 to 12 characters long.
3. The response setting determines what the Burner Control will do when it is notified that the limit is exceeded.
4. The "limit response trigger" should be named "limit response enable". It is used to enable the socket and determine when it is active. The limit event is always acknowledged, but the Burner Control's setting for this parameter determines when the BC generates its response:
Disabled - never active
Always
Only during Prepurge, Ignition, and Run
Only during Ignition and Run
Flame is on
Run

SLATE Limit Standard Screens



Chapter 9: SLATE Analog I/O Module



Overview

The R8001U3001 SLATE Analog I/O module provides analog input and output capability for all combustion applications. SLATE has a concept of an analog cell per module. The SLATE analog sell allows you to configure multiple combinations of functionality. The SLATE Analog Module provides voltage inputs and outputs, current inputs and outputs, PWM, tach, RTD, NTD and support for type J and K thermocouples.

LED Array

There are three LEDs on the front of the SLATE Analog Module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No valid configuration
	Green	Running
Fault	Red	Fault
	No light	No fault

LED Displays

The SLATE system modules have three-character LED displays used for indicating the module number of the SLATE system. It also has a three position LED colors to indicate terminal states shown in the table below.

Color	Description
Green	Terminal is ON or is Normal
Red	Fault
No light	Terminal is OFF or Not in use

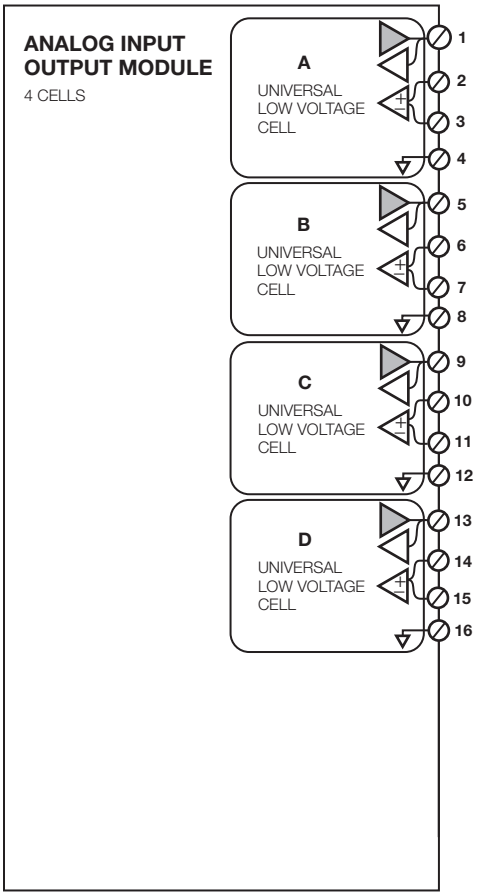
Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.



Understanding the Terminals

The SLATE Analog I/O module contains 16 wired terminals.



Terminal Functions and Configurations

Terminal	Description	Rating
1	Cell A (TF1)	See Tables Table 4-Table 7 for configuration options
2	Cell A (TF2)	See Tables Table 4-Table 7 for configuration options
3	Cell A (TF3)	See Tables Table 4-Table 7 for configuration options
4	Cell A (TF4)	See Tables Table 4-Table 7 for configuration options
5	Cell B (TF1)	See Tables Table 4-Table 7 for configuration options
6	Cell B (TF2)	See Tables Table 4-Table 7 for configuration options
7	Cell B (TF3)	See Tables Table 4-Table 7 for configuration options
8	Cell B (TF4)	See Tables Table 4-Table 7 for configuration options
9	Cell C (TF1)	See Tables Table 4-Table 7 for configuration options
10	Cell C (TF2)	See Tables Table 4-Table 7 for configuration options
11	Cell C (TF3)	See Tables Table 4-Table 7 for configuration options
12	Cell C (TF4)	See Tables Table 4-Table 7 for configuration options
13	Cell D (TF1)	See Tables Table 4-Table 7 for configuration options
14	Cell D (TF2)	See Tables Table 4-Table 7 for configuration options
15	Cell D (TF3)	See Tables Table 4-Table 7 for configuration options
16	Cell D (TF4)	See Tables Table 4-Table 7 for configuration options
17	Unused	---
18	Unused	---
19	Unused	---
20	Unused	---
21	Unused	---
22	Unused	---

Specifications based on worst case over ambient temperatures.

Terminal Functions				Min	Typical	Max	Units	
T1	Voltage	In	Range	0.0	-	15.0	VDC	Rin=1MOhm
			Resolution	-	2.43	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	Whichever is greater
				-1.0	-	1.0	%	
		Out[c]	Range	0.0	-	15.0	VDC	10KOhm load
			Resolution	-	4.0	-	mV DC	
			Null	100.0	-	100.0	mV DC	
			Accuracy	-50.0	-	50.0	mV DC	Whichever is greater
				-1.5	-	1.5	%	
	Current	In	Range	0.0	-	25.0	mA DC	[a]
			Resolution	-	7.4	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA
		Out[b,c]	Range	0.0	-	25.0	mA DC	Max Load = 500 Ω
			Resolution	-	4.0	-	mA Ω	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-300.0	-	300.0	uA DC	0 to 25 mA
				-50	-	50	uA DC	4 to 20 mA
T2	Voltage	In	Amplitude	0.0	-	15.0	VDC	
			Trip Point	-	3.0	-	VDC	Comparator Only
			Hysteresis	-	0.25	-	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
T3	Voltage	In	Range	0.0	-	15.0	VDC	
			Resolution	-	0.37	-	mV DC	
			Null	-25.0	-	25.0	mV DC	
			Accuracy	-25.0	-	25.0	mV DC	
	Current	In	Range	0.2	-	25.0	mA DC	
			Resolution	-	3.7	-	uA DC	
			Null	-0.5	-	0.5	mA DC	
			Accuracy	-1.5	-	1.5	%	0 to 25 mA

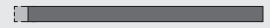
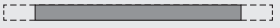
[a] T1 input terminal is held at constant 2.5VDC over allowable current range.
[b] Accuracy specification given is for 100 Ω load. Resolution specification can be converted to mA by dividing out load.
[c] Imax=25mA for Vout<10V
Imax=20mA for 10V<Vout<15V

	Complex Functions		Min	Typical	Max	Units	
	Thermocouple						
T2 & T3	Type J	Range	-200.0		1025.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	Type K	Range	-150.0	-	1000.0	°C	
		Resolution	-	0.1	-	°C	
		Accuracy	-5.0	-	5.0	°C	
	RTD						
T2 & T3 & T4	Type PT100[a]	Range	-135.0	-	250.0	°C	3 wire, 100 Ω
		Resolution	-	0.5	-	°C	
		Accuracy	-2.0	-	2.0	°C	
	Type PT1000	Range	-135.0	-	250.0	°C	3 wire, 1000 Ω
		Resolution		0.5		°C	
		Accuracy	-2.0	-	2.0	°C	
	NTC						
T1-T3, T1-T4	Type 10K	Range	-40.0[b]	-	175.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-40 °C to 25 °C
			-1.0	-	1.0	°C	25 °C to 125 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	125 °C to 175 °C
T1-T3, T1-T4	Type 12K	Range	-20.0	-	125.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-20 °C to 30 °C
			-1.0	-	1.0	°C	30 °C to 120 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	120 °C to 125 °C
T1-T3, T1-T4	Type 20K	Range	-25.0	-	150.0	°C	T4 rated to 0 °C
		Resolution	-	0.1	-	°C	
		Accuracy[c]	-2.0	-	2.0	°C	-25 °C to 50 °C
			-1.0	-	1.0	°C	50 °C to 135 °C
			-1.5	-	1.5	%	
			-3.0	-	3.0	°C	135 °C to 150 °C

[a] Shielded cable required for reliable operation in noisy environment.
[b] NTC on terminal T4 is rated down to 0 °C.
[c] Temperatures refer to sense range.

	Frequency / PWM Functions		Min	Typical	Max	Units	
	PWM Out						
T1	Amplitude		5.0	-	10.0	VDC	Low output state = 0V
	Frequency		100.0	-	1000.0	Hz	
	Duty Cycle		2.0	-	98.0	%DC	0-100% output allowed
	Resolution		-	1.0	-	%	
	Accuracy		-0.5	-	0.5	%DC	10V amplitude
	Frequency In						
T2-T4	Amplitude		5.0	10.0	15.0	VDC	
	Range		2.0	-	1000.0	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	2 – 100 Hz	2.0	-	98.0	%DC	10V amplitude
		1000 Hz	5.0	-	85.0	%DC	10V amplitude
	Resolution		-	1.0	-	Hz	
	Accuracy		-5.0	-	0.0	%	Whichever is greater
			-1.0	-	0.0	Hz	
	PWM In						
T2-T4	Amplitude[a]		5.0	10.0	15.0	VDC	
	Frequency		125.0	-	500.0	Hz	
	Min. “on” pulse width (low %DC)		-	50.0	-	usec	10V amplitude
	Min. “off” pulse width (high %DC)		-	130.0	-	usec	10V amplitude
	Duty Cycle	125 – 500 Hz	5.0	-	90.0	%DC	10V amplitude
	Resolution			-	1.0	%DC	
	Accuracy	125 Hz	-1.5	-	1.5	%DC	10V amplitude
		500 Hz	-7.5	-	7.5	%DC	10V amplitude

[a] Trip points = 3.0V +/- 0.25V
Hysteresis Voltage = 0.5V

Configuration		Min	Optimum Range for Performance	Max	
Thermocouple	J	-50°C		1025°C	± 4 °C
	K	-50°C		1000°C	± 4 °C
RTD		-135°C		250°C	± 2 °C
NTC		25°C		125°C	± 1°C
Current Out		4 mA		20 mA	± .05 mA
Voltage: In / Out		2 V		10 V	0.3 %, typical

Application	Recommended Wire Size	Recommended Part Numbers
Analog Cell terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Chapter 10: SLATE Digital I/O Module



Overview

The R8001D4001 SLATE Digital I/O module offers universal 14 opto inputs or 6 relays for a wide variety of combustion applications. It automatically adapts to 24 VDC or 24VAC to 240 VAC (one voltage per module).

Status LEDs

There are 3 LEDs on the front of the Digital Module provides quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	Fault
	No light	Running

There are 16 separate LEDs for each of the Digital Module terminals. Refer to the table below for module LED descriptions

Color	Description
Green	Terminal is on
Red	Fault
No light	Not in use

LED Display

All SLATE system modules have seven-segment, three positioned LED display for indicating the assigned module number of the SLATE System. See figure below.

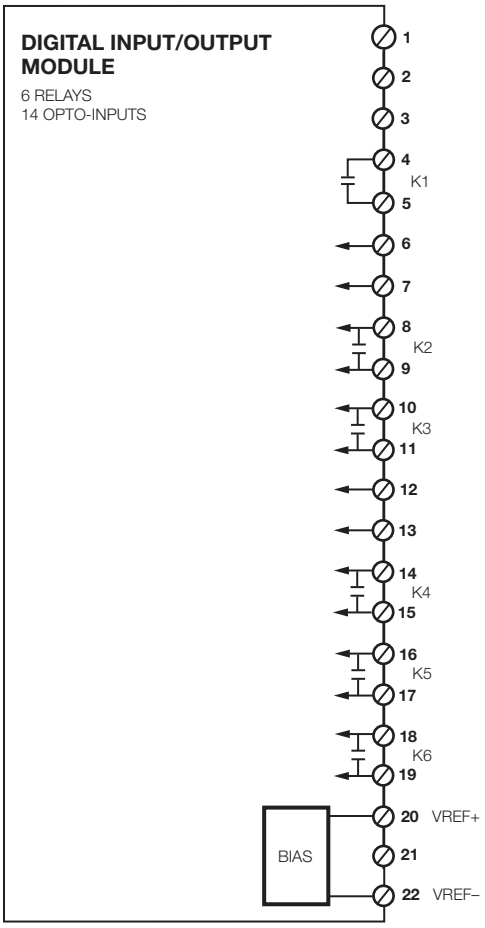
Select and Reset Buttons

All SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment the segment display information.



Understanding the Terminals

The SLATE Digital Module contains 18 wired terminals. Refer to the diagram below. All digital terminals are 24 VDC or 24 -240 VAC and automatically adapt to the applied system voltage.



M35286

Wiring

The following table highlights the wiring for the SLATE Digital I/O Module.

Terminal	Description	Rating
1	Unused	---
2	Unused	---
3	Unused	---
4	K1 Relay Dry Contacts	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
5	K1 Relay Dry Contacts	(see Terminal 4 above)
6	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
7	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
8	K2 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
9	K2 Relay Dry Contacts or Input	(see Terminal 8 above)
10	K3 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
11	K3 Relay Dry Contacts or Input	(see Terminal 10 above)
12	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
13	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
14	K4 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
15	K4 Relay Dry Contacts or Input	(see Terminal 14 above)
16	K5 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
17	K5 Relay Dry Contacts or Input	(see Terminal 16 above)
18	K6 Relay Dry Contacts or Input	**Relay:** 9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC **Input:** 24VDC (0.5mA), 24-240VAC (0.2mA)
19	K6 Relay Dry Contacts or Input	(see Terminal 18 above)
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85–264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Terminal 20 above)

Note: Only one voltage can be used per module.

Recommended Wire Size

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C

Application	Recommended Wire Size	Recommended Part Numbers
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Chapter 11: SLATE Annunciator Module

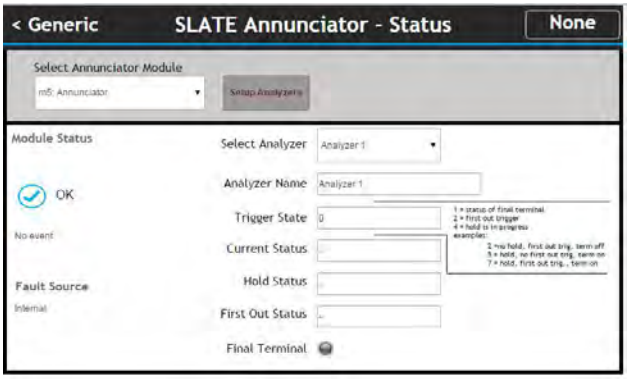


Overview

The R8001N7001/U Annunciator Module is designed to monitor the status of individual components in a series wiring of limits, control and/or interlock contacts wired to the SLATE Burner Control Module on a commercial or industrial burner.

The Annunciator Module acts as a system monitor, providing first-out annunciation of individual components for effective burner and system troubleshooting. In the SLATE AX Tool, the 14 available annunciator terminal labels may be renamed to reflect the actual connected device. Additionally, extra diagnostic text may be added to further enhance diagnostic user information. All modified annunciator terminal labels and additional diagnostic text will be reflected on the Annunciator Module HMI screen.

The SLATE Annunciator Module also contains one programmable relay output, which can be configured from the wire sheet.



Status LEDs

There are 3 LEDs on the front of the Annunciator Module that provide quick identification of system status and problems. This status is broadcast to other modules on the platform bus in case they are affected by the inoperable module(s).

LED	Color	Description
Power	No light	System does not have power.
	Green	System has power.
CPU	Red	No Wiresheet (SLATE) loaded. Remove Limit System Status).
	Green	Running
Fault	Red	Fault
	No light	Running

There are also 16 separate LEDs for each of the Annunciator Module terminals.

Color	Description
Green	Terminal is on
Red	Fault
No light	Not in use

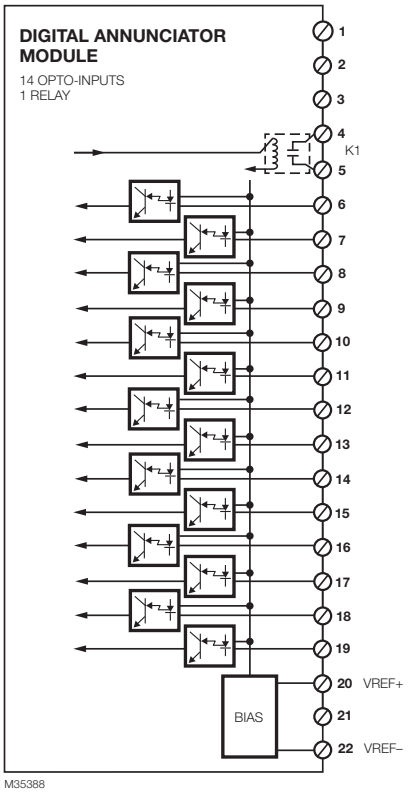
LED Display

All SLATE system modules have a seven-segment, three-position LED display for indicating the assigned module number of the SLATE system.

Select and Reset Buttons

All SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.





Understanding the Terminals

The SLATE Annunciator Module contains 18 wired terminals. All annunciator terminals are 24VDC or 24-240VAC and automatically adapt to the applied system voltage.

Terminal	Description	Rating
1	Unused	---
2	Unused	---
3	Unused	---
4	K1 Relay Dry Contacts	9.8 FLA, 58.8 LRA @ 120VAC, 4A (0.5 PF), 20A inrush @ 240VAC, 2A cont, 10A inrush @ 24VDC
5	K1 Relay Dry Contacts	(see above)
6	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
7	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
8	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
9	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
10	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
11	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
12	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
13	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
14	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
15	Input	24VDC (0.5mA), 24-240VAC (0.2mA)

Terminal	Description	Rating
16	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
17	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
18	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
19	Input	24VDC (0.5mA), 24-240VAC (0.2mA)
20	Vref+	24VDC (0.1mA), 24VAC (0.1mA), 85-264VAC (0.2mA)
21	Unused	---
22	Vref-	(see Vref+ above)

Note: Only one voltage can be applied per module (same at all terminals)

Wiring

For installation and wiring information, refer to document 32-00012, the SLATE Annunciator Module Installation Instructions.

Any series string of limits, control and/or interlock contacts wired to the SLATE Burner Control Module may be wired to the Annunciator Module. Sample wiring diagrams are shown below.

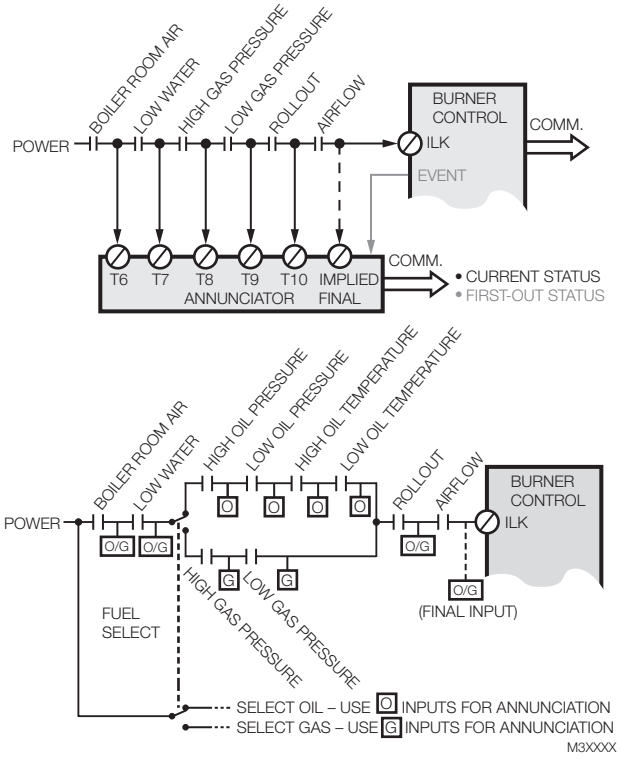
For clarity, there are some guidelines regarding Annunciator terminal wiring and usage:

- Lower numbered terminals must be closer to the source of power than higher numbered terminals
- A series string input to the Annunciator should utilize contiguous Annunciator terminals because that is easiest to understand, however it is not necessary.
- Multiple Annunciator Modules can be used with a single SLATE device.
- A series string input to the Annunciator cannot be split up between two different Annunciator modules. The entire string must fit on a single Annunciator.
- Each series string can have an Implied Final input. It is the last item in the Annunciator input series string and is not wired to the Annunciator. It is not wired to the Annunciator because it's the last component in the wiring string going into the Burner Control Module and thus is directly monitored by the Burner Control; if all other contacts in the string are closed and powered, then it is the Implied Final (last) component which is causing the fault. Using Implied Final inputs allows the use of fewer terminals.
- The longest series string input that can be monitored is 15 contacts including the 14 inputs on the Annunciator & the Implied Final input.

The SLATE AX Tool is used to configure the Analyzer (trigger) input string, the SLATE Trigger Module, Module Trigger Type, rename the Annunciator terminal labels and add additional diagnostic text.

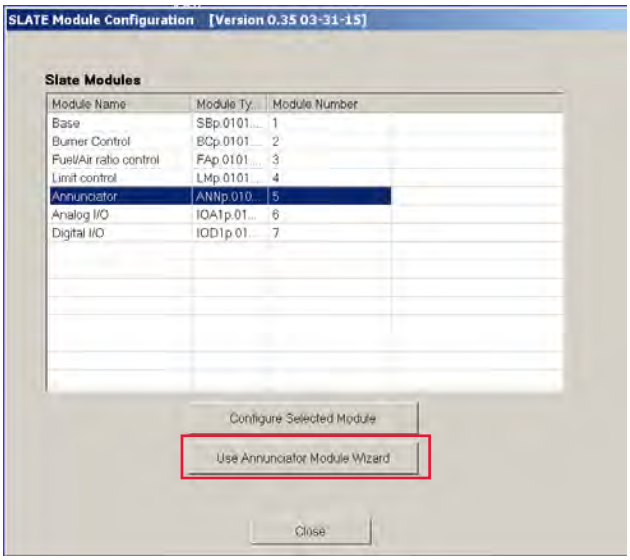
The Annunciator safety relay output can be used for any purpose, thus the wiring will be application specific.

It is important to lie out and understand the series string circuits which are to be monitored by the Annunciator Module before proceeding with configuration.



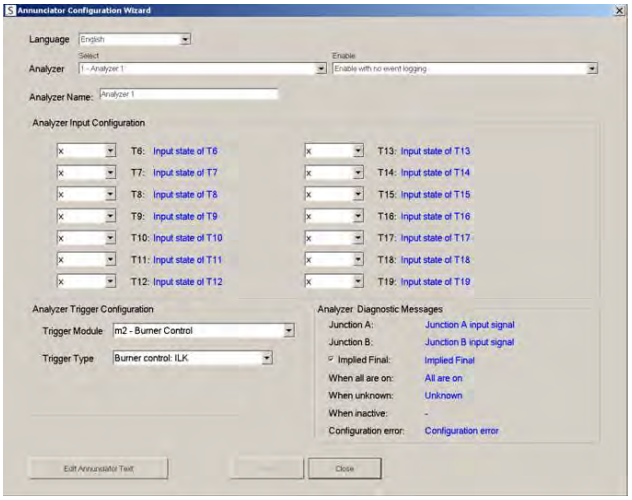
Getting Started

1. To access the configuration tool you will need to launch the SLATE AX Tool.
2. If you have not created a Station please refer to Chapter 2 of this manual to learn how to create a new station.
3. If you have created a Station open up the Navigation pane until to reach your SLATE Device. Double-click on the SLATE device to launch the Module Configuration Tool.
4. Next click on "Use Annunciator Wizard"



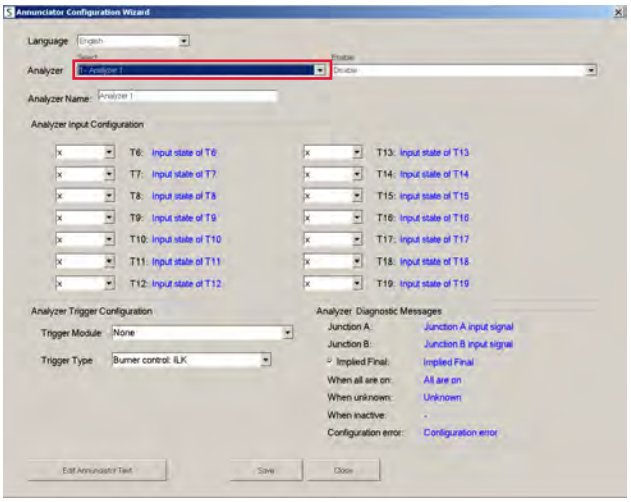
5. You should be taken to the Annunciator Configuration Wizard, which allows you to set up the Annunciator Module input terminals. This is how the SLATE Annunciator Module is configured for use. There are 14 Annunciator terminal inputs that will need to be configured (T6-T19). After you have configured all of the terminals you will need to click the Save button.

   Once you are done with all of the SLATE programming and configuration it will be stored as a kit file as explained in Chapter 15 and Loading a SLATE Kit.



6. Each separate input string to the Burner Control Module is considered an Analyzer (trigger). Examples of Analyzer (trigger) input strings are the burner control interlock, airflow switch/ lockout input, pre-ignition interlock, limit control inputs for fuel 1 or fuel 2, limit module LCI input or other wire sheet user-defined triggers.

   Define your input string to the Annunciator Module by selecting the Analyzer (trigger) from the drop-down menu. Type in a descriptive Analyzer Name as desired. Up to 6 Analyzers are available.

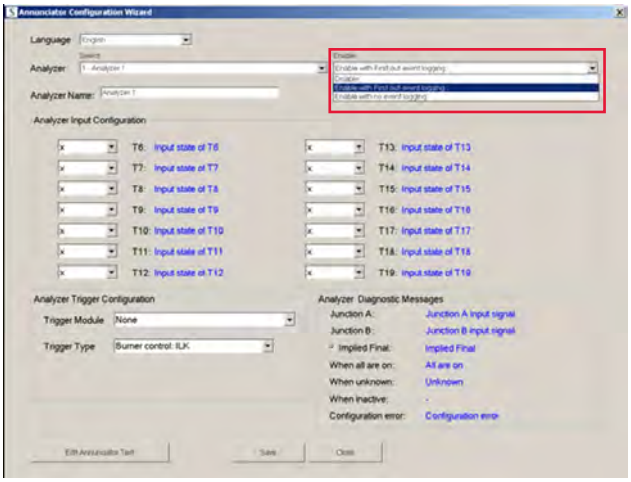


7. Next select how the Annunciator will handle the input string via the Enable drop-down menu. The options are:

   Disable: All configuration and setup values can be edited but no action is taken at run time until the Analyzer (trigger) is enabled.

   Enable with First out event logging: Whenever a first-out trigger is detected, a time-stamped event log record is generated, describing the result of the first-out analysis.

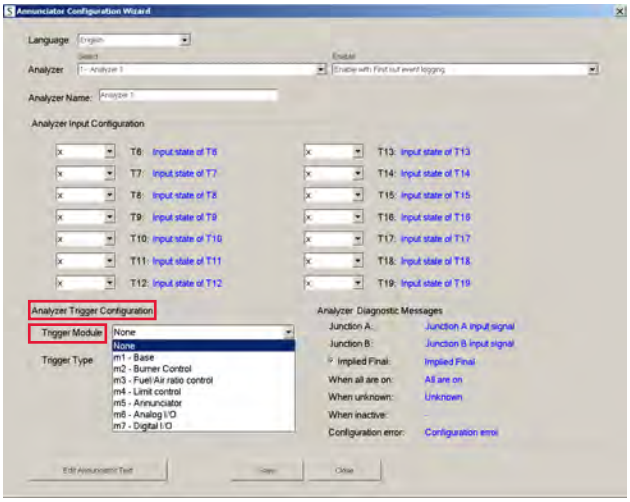
   Enable with no event logging: All of the first-out actions are still generated, however, the Annunciator does not generate any event log records. It shows live status only.



8. The Analyzer Trigger Configuration attaches the Analyzer to a trigger source. Next select the Trigger Module for this particular Analyzer (trigger). The options are:

   - None
   - m1 - Base
   - m2 - Burner Control
   - m3 - Fuel/Air ratio control
   - m4 - Limit control
   - m5 - Annunciator

- m6 - Analog I/O
- m7 - Digital I/O



9. The next step is to select the Trigger Type for the previously selected Trigger Module. There are 5 specific Burner Control Module triggers, 1 specific Limit Module trigger and 6 generic wire sheet triggers.

The 6 generic wire sheet triggers allow the annunciator to monitor a series string that the SLATE designer creates for some purpose related to the SLATE Control Program (i.e. wire sheet) on the Base Module. For any of the 6 generic annunciator triggers, a standard wire sheet Modulating Output block may be bound to the corresponding generic annunciator trigger register. The trigger value is sent whenever the wire sheet changes its value, thus no special action is needed to cause the trigger to be sent.

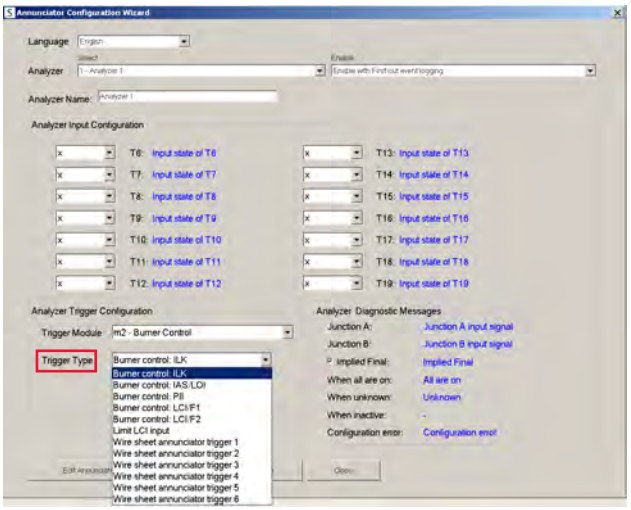
Explanations of the available Trigger Types are shown below.

Burner control: ILK	Interlock string (T19 on Burner Module)
Burner control: IAS/LOI	Interrupted airflow switch / lockout input (T16 on Burner Module)
Burner control: PII	Pre-ignition interlock (proof of closure switch) (T14 on Burner Module)
Burner control: LCI/F1	Limit control input for fuel 1 (T13 on Burner Module)
Burner control: LCI/F2	Limit control input for fuel 2 (T12 on Burner Module)
Limit LCI input	Limit Module load control input (T18 on Limit Module)
Wire sheet annunciator trigger 1-6	Wire sheet user-defined triggers

Since the Limit Module contacts might be connected downstream of other contacts, it has a separate trigger for its safety relay input.

Note: Each Analyzer (trigger) will have its own:

- Enable
- Trigger Module
- Trigger Type
- Analyzer Input Configuration



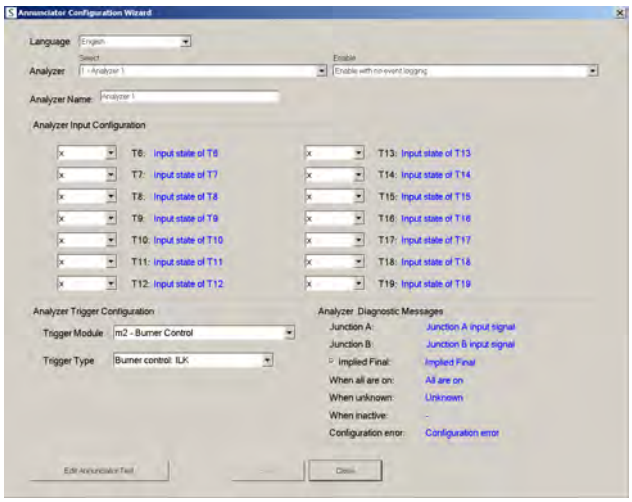
10. After completing setup of your various Analyzers (triggers), you can begin to define the input string on each Analyzer. This includes:

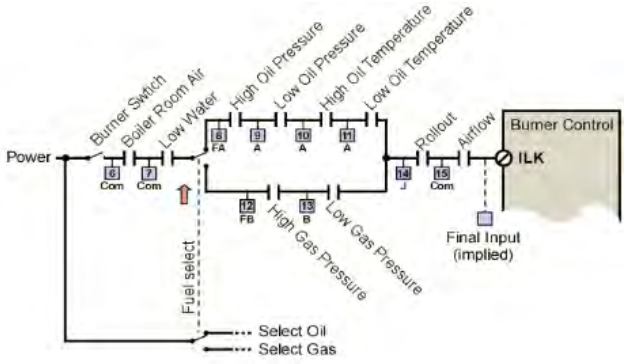
Naming the contacts in the input string – this is a global feature (optional)

Defining their location in each string – this is Analyzer specific

Select the specific Analyzer you wish to edit. To name the inputs, click on the Edit Annunciator Text button.

The following pages will utilize the example shown below, which illustrates a dual string path (dual fuel system).





11. Under Annunciator Input Text, type in the desired name of each Analyzer Input string contact (T6-T19) in all of the strings used (refer to your application-specific wiring diagram). This function is not Analyzer specific; it's done at the Annunciator level so names can be written for all Analyzers (triggers) in this window. The following steps illustrate the dual path example provided in the image above.

Note: On the screen shown below, T8 and T12 are both named "Low water". The duplication occurs because an input is needed on either side of fuel changeover switch for the dual fuel example shown above to allow the analyzer to discern the position of the switch. In this case, both T8 and T12 annunciate the set of contacts that directly proceed them in the series string; the Low Water.

Under Annunciator Diagnostic Text, type in the desired description for the input string location item. Refer to the extended descriptions below, step 12. and the image above for elaboration on input string locations. This function is Analyzer specific; it must be done for each individual Analyzer. The Analyzer is chosen on the previous page.

Notes:

It may be more efficient to complete this task after completing step 12 in which the location of each contact in the specific Analyzer input string is identified.

For the dual path (fuel) example above, T14 is the junction point of path A and B, monitoring the Low Oil Temperature in path A and the Low Gas Pressure in path B. Thus in the Annunciator Diagnostic Text section, the two monitoring points are separately identified.

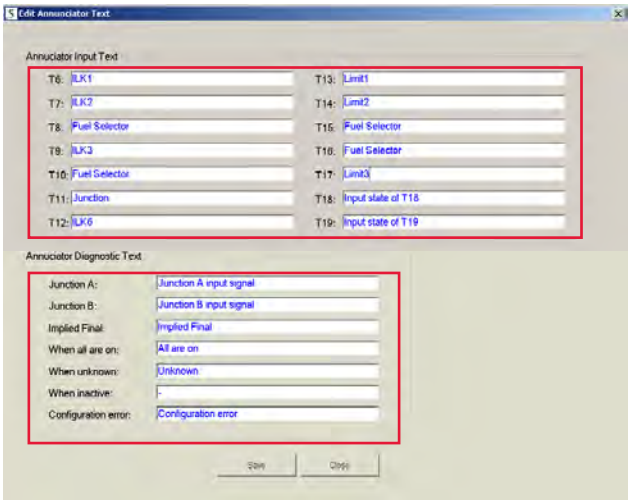
Annunciator Diagnostic Text can be individually assigned to the Implied Final input for each Analyzer (trigger) in order to provide diagnostic indications. The Implied Final input is the last connection (the wire) between the Annunciator and the Analyzer (trigger) which is not wired to the Annunciator. It is not wired to the Annunciator because it is the last component in the wiring string going into the Burner Control Module and thus is directly monitored by the Burner Control; if all other contacts in the string are closed and powered, then it is the Implied Final (last) component which is causing the fault.

For example, if the Implied Final input (last terminal in the string) is closed yet the Analyzer (trigger) is showing 0.0V, then the issue could be a broken wire or an unmonitored contact on that wire. In this case, the Analyzer Diagnostic Text might show "broken wire or an unmonitored contact on that wire". Refer to the SLATE AX Tool page below and the image above.

Descriptions of the available field in the Annunciator Diagnostic Text section are shown below.

Junction A	Used when the last terminal in string path A of a dual path (fuel) string causes an event.
Junction B	Used when the last terminal in string path B of a dual path (fuel) string causes an event.
Implied Final	Used when the last connection between the Annunciator and the Analyzer (trigger) is the event cause.
When all are on	Used when the Analyzer detects that nothing is interrupting power to the terminal.
When unknown	Used when some anomalous condition prevents the analyzer from making sense of the inputs that it is receiving.
When inactive	Used when the first out or hold status registers contain no values. This may be an empty string, a "-" or any other preferred value.
Configuration error	Used when some error in setup prevents the annunciator from working.

After you are finished on this screen, click the Save button.



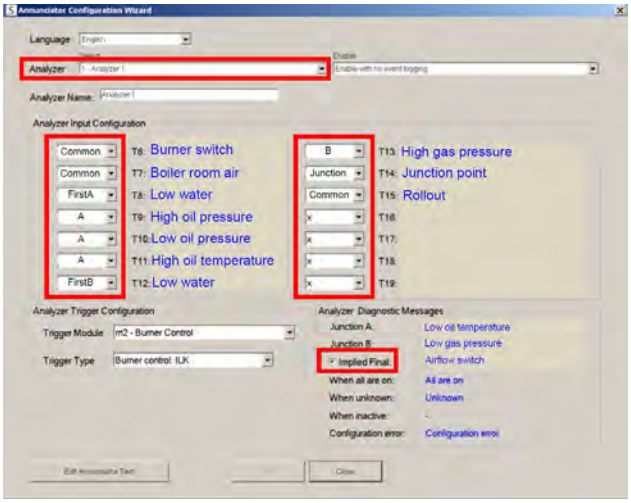
12. Return to the main page of the Annunciator Configuration Wizard. In order to facilitate proper Annunciator diagnostics, you will need to indicate where in the input string each contact lies for a particular Analyzer.

Notes:

This function is Analyzer specific; it must be done for each individual Analyzer.

Make sure to check the Implied Final check box in order to enable the diagnostic message for it (if applicable).

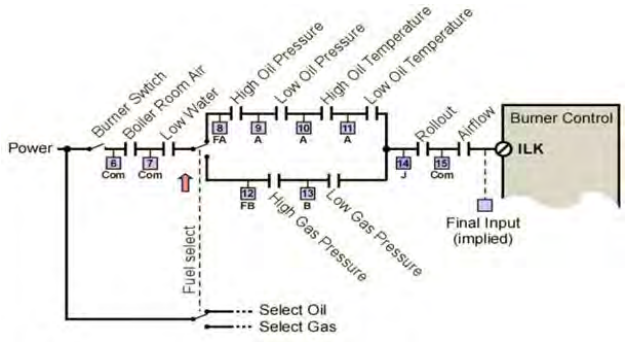
Note that the Annunciator Diagnostic Text entered on the previous screen now appears in the lower right-hand corner of this screen under Analyzer Diagnostic Messages.



For each Analyzer Input Configuration (T6-T19), select the proper item from the drop-down menu. The possible input string location options are shown below. In all cases, the Annunciator terminal annunciates the set of contacts which directly precede it in the series wiring string. The screen above reflects a dual fuel example.

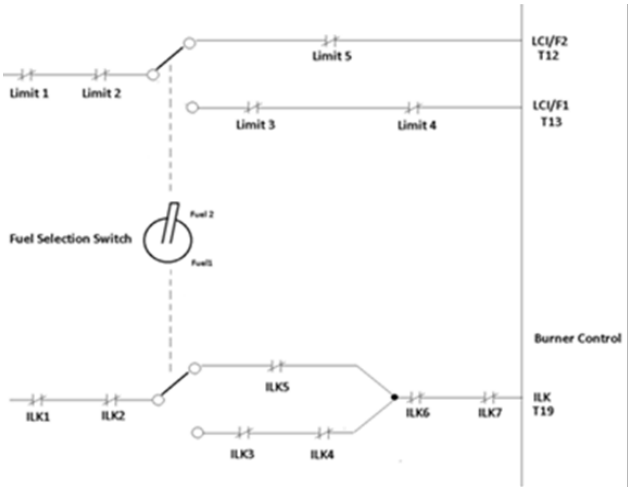
x	Lower case x indicates the input is unused by this Analyzer
A	Indicates a terminal in string path A
B	Indicates a terminal in string path B
FirstA	Indicates the first terminal in string path A of the dual paths
FirstB	Indicates the first terminal in string path B of the dual paths
Common	Indicates that the input is common to both string paths
Junction	Indicates the terminal where string paths A and B rejoin. Annunciates the last terminal in each string path. In Fig. 5 it is Low Oil Temperature or Low Gas Pressure.

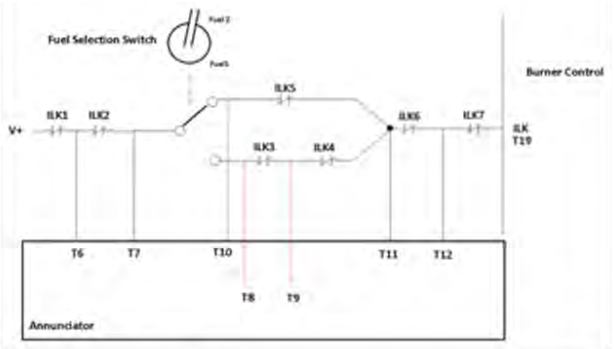
The illustration below shows how the above possible options for the Analyzer Input Configuration in a dual string path (dual fuel system) might look.

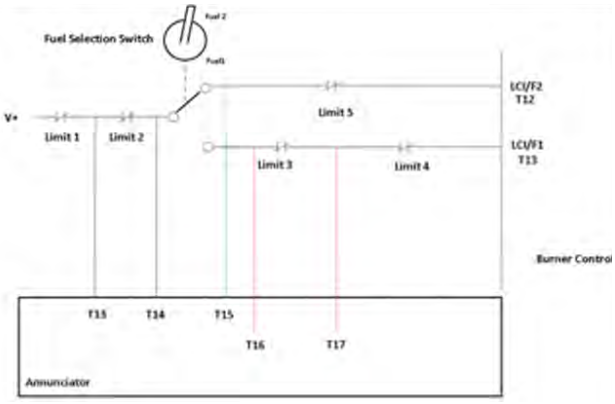


Example

The example below is for a dual fuel system with 3 Analyzers or series string input to the Burner Control Module that utilizes the Annunciator Module.



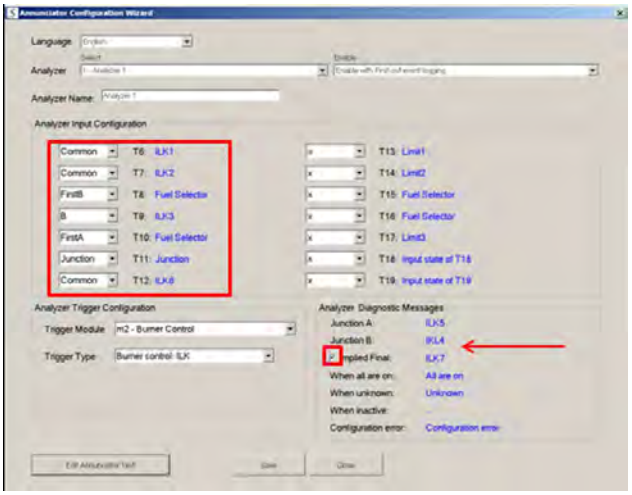


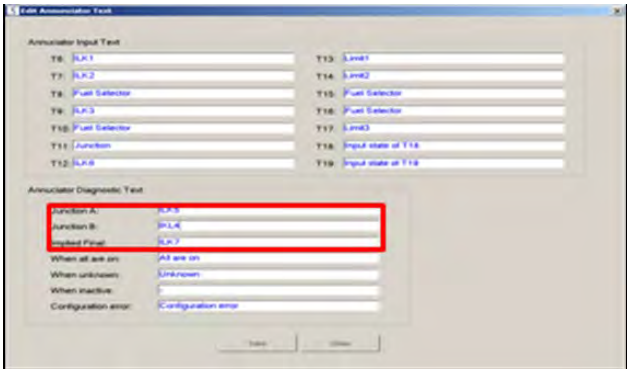


Analyzer	Trigger	Components	Annunciator Terminals	Path Designations
1: ILK	Burner control: ILK	Path A: ILK1, ILK2, Fuel Selector, ILK5, ILK6, ILK7	6, 7, 10, 11, 12	T6 = ILK1 (Common) T7 = ILK2 (Common) T10 = Fuel Selector (FirstA) T11 = ILK5 (Junction A) and ILK4 (Junction B) T8 = Fuel Selector (FirstB) T9 = ILK3 (B) T12 = ILK6 (Common) Implied Final = ILK7
		Path B: ILK1, ILK2, Fuel Selector, ILK3, ILK4, ILK6, ILK7	6, 7, 8, 9, 11, 12	
2: LCI/F2	Burner control: LCI/F2	Limit1, Limit2, Fuel Selector, Limit5	13,14, 15, Implied Final	T13 = Limit1 (A) T14 = Limit2 (A) T15 = Fuel Selector (A) Implied Final = Limit5
3: LCI/F1	Burner control: LCI/F1	Limit1, Limit2, Fuel Selector, Limit3, Limit4	13, 14, 16, 17, Implied Final	T13 = Limit1 (A) T14 = Limit2 (A) T15 = x (not used) T16 = Fuel Selector (A) T17 = Limit3 (A) Implied Final = Limit4

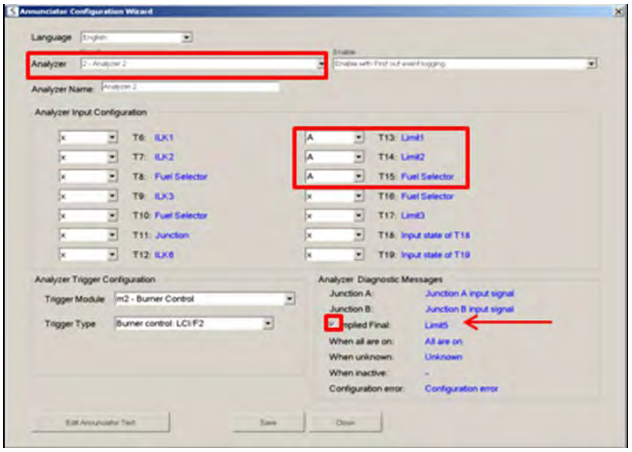
Below are the completed Annunciator Configuration Wizard pages for each Analyzer in the example.

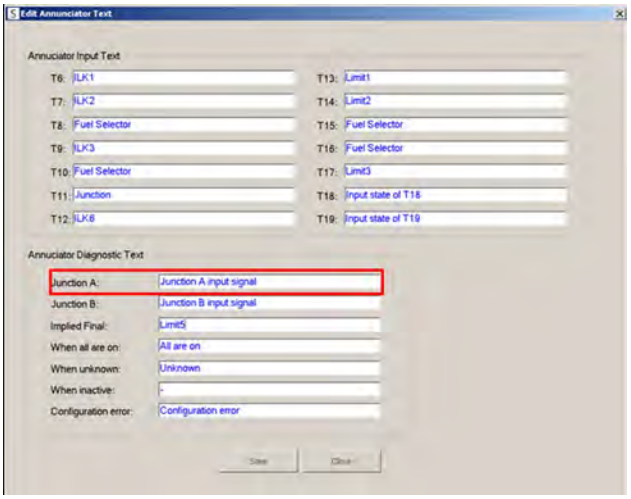
1: ILK Analyzer



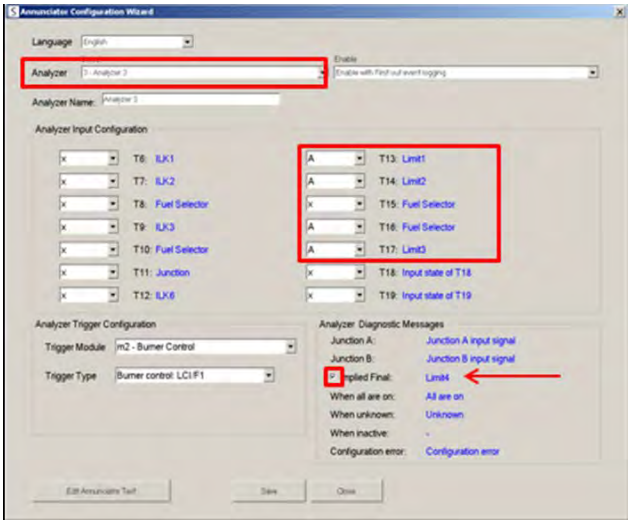


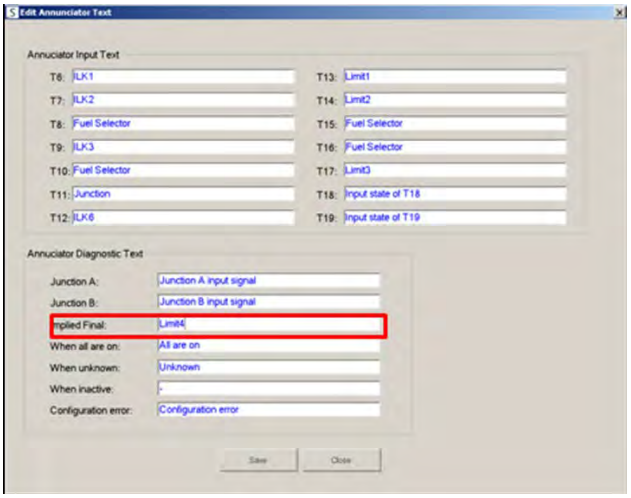
2: LCI/F2 Analyzer



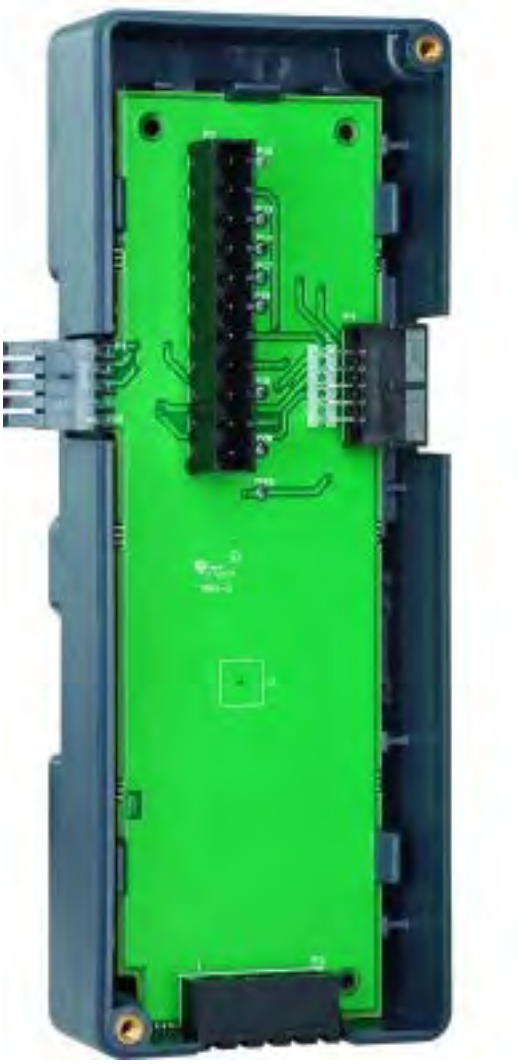


3: LCI/F1 Analyzer





Chapter 12: SLATE Sub-Base

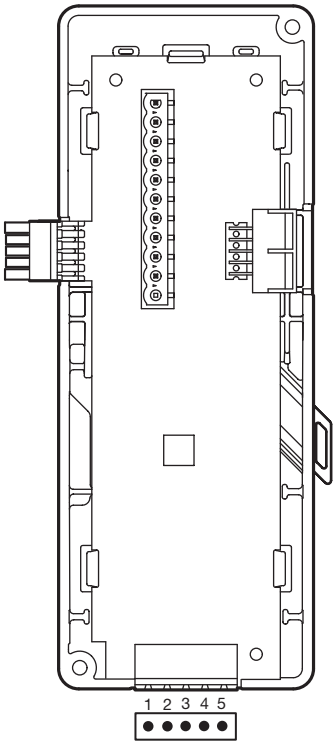


Overview

The R8001S9001 SLATE Sub-Base Module provides the ability for the SLATE system to be mounted via DIN Rail in a panel. All SLATE modules need this sub-base except for the SLATE Base Module.

Understanding the Sub-Base

Terminal	Description	Rating
1	18 V Power	2.5 A max including modules
2	18 V Ground	---
3	Remote Reset (Burner Control and Limit modules only)	Connect to Terminal 2 (18 V Ground) via external pushbutton
4	B (Remote Bus RS485)	Used for Remote mounted flame amplifiers
5	A (Remote Bus RS485)	Used for Remote mounted flame amplifiers

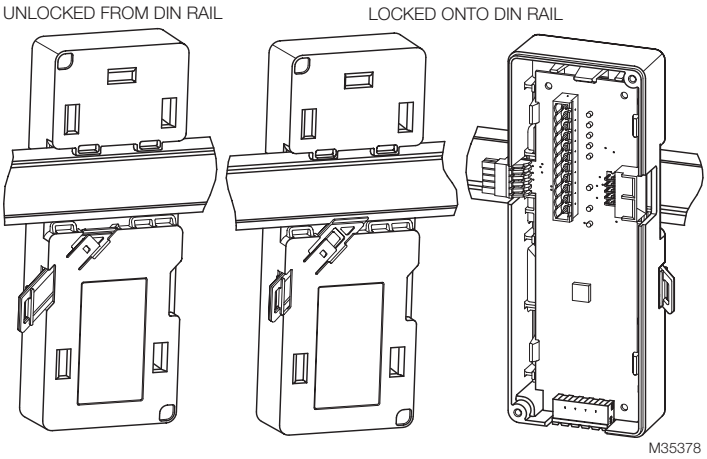


TERMINAL	DESCRIPTION
1	18V POWER
2	18V GROUND
3	REMOTE RESET (BURNER CONTROL AND LIMIT MODULES ONLY)
4	B (REMOTE BUS RS485)
5	A (REMOTE BUS RS485)

M35430

Mounting

1. The sub-base module can be mounted on type C 20 DIN Rail
2. Mount the sub-base module first. The sub-base has locking mechanisms on both sides of the module. Pull to unlock position.



3. Slide sub-base on the DIN rail and lock into place.
4. When securing subsequent sub-base modules make sure communication ports are aligned and locked into place.
5. After securing the sub-base module, snap the SLATE module into place and secure the module to the sub-base using screws which are included with SLATE.

Chapter 13: SLATE Display



Overview

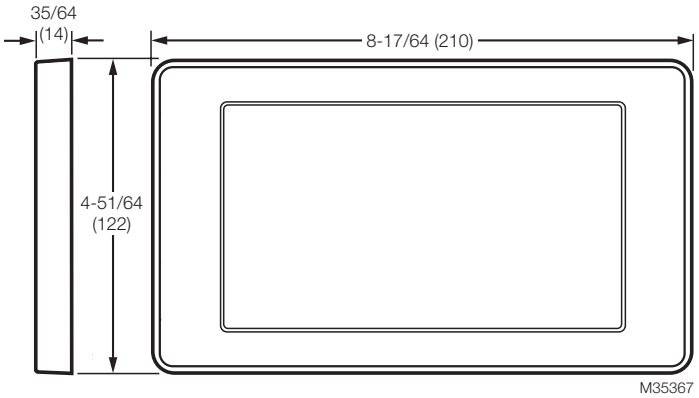
The R8001K5001 SLATE Color Touch Screen Display provides users with the ability to create vivid application displays using web technology. The screen is web enabled and with the SLATE Web Editor tool creating screens is simple and easy.

Power Plug Recommendations

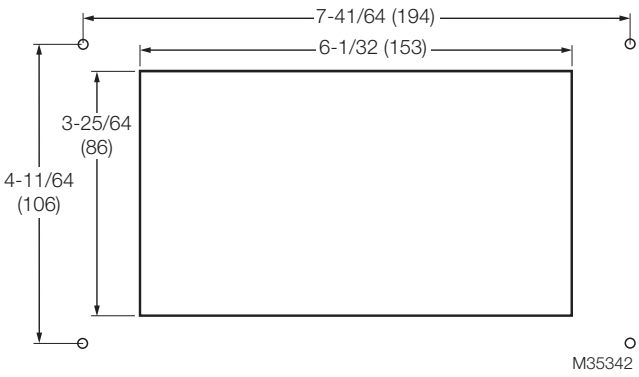
The SLATE Color Touch Screen display does not come with a power plug or power plug connector. You have the option of purchasing the SLATE Display connector kit and transformer (Honeywell OS 32008001-002) or source through your own vendors. The following are recommendations for the power connection.

- 24VAC Wall Plug-in Transformer
  (Input Voltage: 120VAC, 60HZ – Output Voltage: 24VAC ±5%).
  Honeywell p/n 32006131 or equivalent.
- 18AWG wire
- Plug-in connectors (or equivalent):
  - Phoenix - p/n 1757019
  - EBY Electro - p/n EB1508-02-500
  - Dinkle – p/n 2ESDV-02P
  - Molex – p/n 0395300002

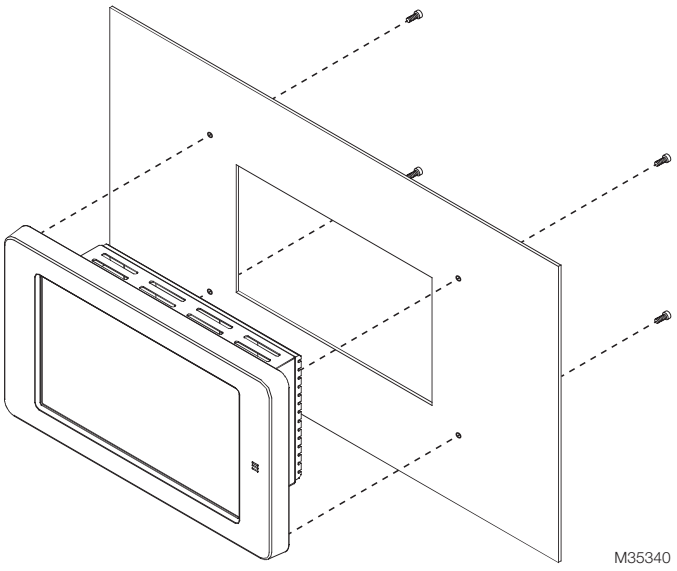
Cutout and Mounting



Dimensions in in. (mm).



Mounting dimensions of color touch screen display in in. (mm).



Principle Technical Features

The R8001K5001 color touch screen display provides a web-based user interface for viewing system status, and viewing, creating, or modifying configurations.

Communication and Networking

The R8001K5001 color touch screen display interfaces directly with the SLATE system using a standard Ethernet connection, and can connect directly to the Base module or via an Ethernet switch.

The R8001K5001 color touch screen display locates all base modules on an IP subnet using a subnet broadcast message, and once located allows users to select one to initiate a connection to that SLATE system.

User Interface and Technology

The R8001K5001 color touch screen display is based on Google Chrome browser and supports HTML5.

A double tap on any web screen activates then Home, Back, and Help buttons, URL address bar, plus other controls that are normally hidden from view. Double tapping again activates these controls.

Chapter 14: SLATE Wiring Basics

Overview

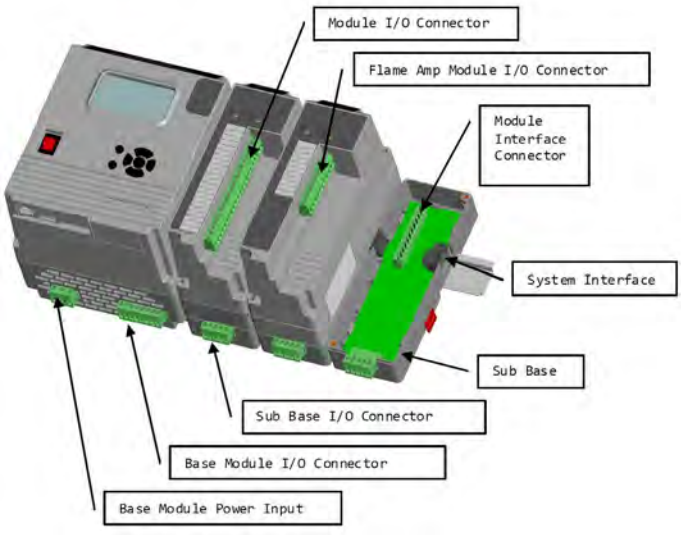
This overview is intended to aid the SLATE system integrator in choosing the best method for ground and power connections. Every installation is different, but following these recommendations will greatly reduce potential for damaged equipment and incorrect I/O readings.

The figure below shows the different connections possible on the assembled Slate system.

Base Module Power Input	Provides the main power interface for the Base module and modules on the DIN rail.
Base Module I/O	Supplies the auxiliary power output, and the BACnet interface and alarm relay contacts.
Sub Base	The sub base provides I/O module mounting.
Sub Base I/O	The I/O on this connector provides access to the system power supply (18VDC) and the flame safety bus if a flame amp is mounted.
Module Interface Connector	Connects the I/O module signal to the main system interface.
System Interface	Contains the module power[1] (18VDC) and the inter module communication lines.
Module I/O	The standard 22 terminal connector for most I/O modules.
Flame Amplifier Module I/O	The 11 terminal connector for the flame amplifier modules.

[1]Information only, not intended for user interface. General Terminology

Slate Connector Definitions



SLATE System Ground: The ground for the 18V system power supply.

Single Point Ground (SPG): This term refers to a wiring point which provides little or no voltage differential between connections. A metal bar or a barrier terminal block with shorting bars between terminals is the most common type of implementation. Wiring which uses “daisy chain” connections is not considered to be a SPG and should be avoided.

Digital Reference: Terminals labeled “Vref+” and “Vref-“used on the Limit, Burner, Digital, and Annunciator modules. The “Vref-“term should not be confused with the V+ or V- on the flame amplifiers. These references are electrically isolated from each other have different purposes.

General Description of the SLATE Power and Ground

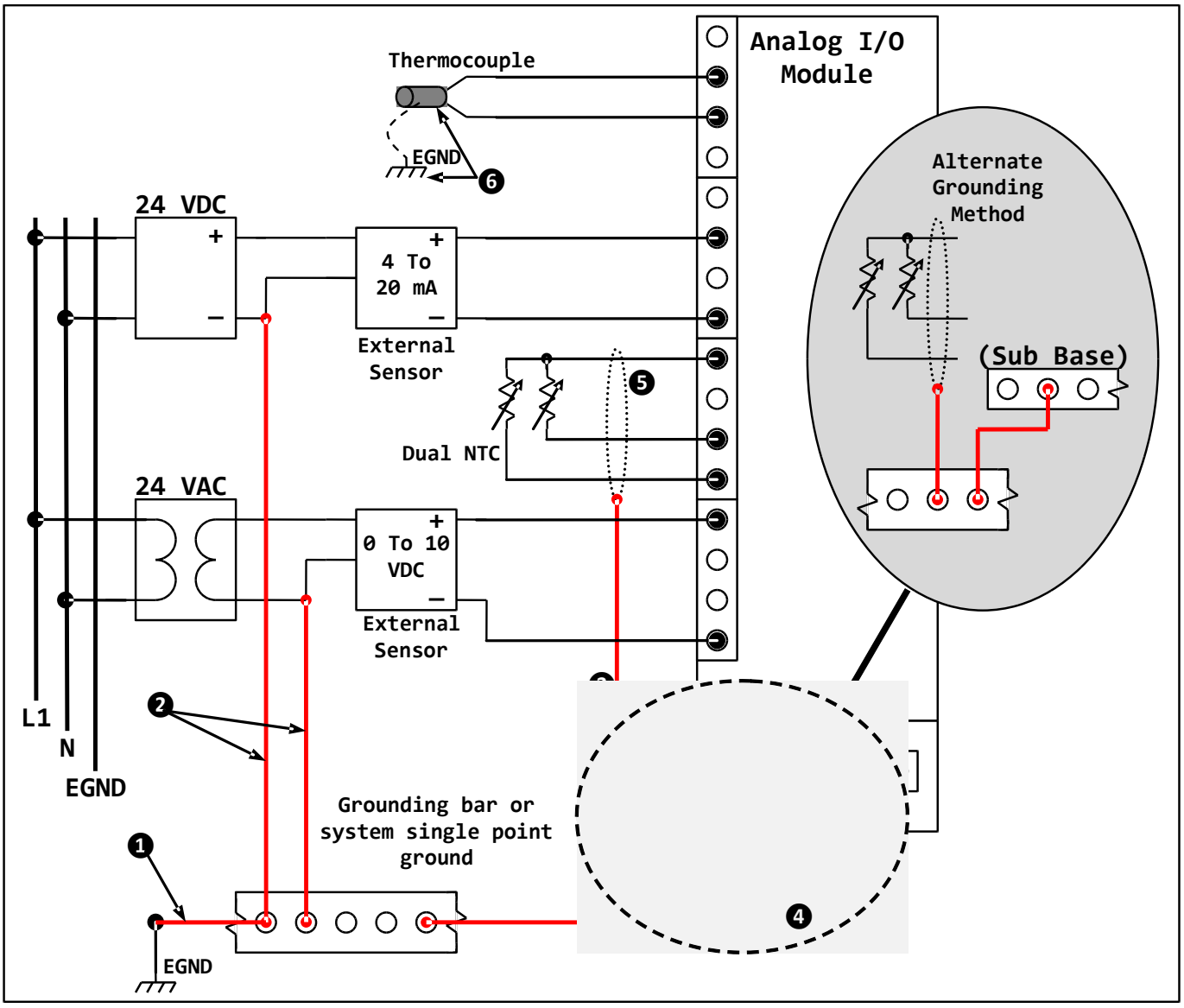
The SLATE system power supply (18VDC output) is isolated from the system power input (i.e. not internally connected to Earth ground).

Unless application specifics preclude it, it is advisable to reference the SLATE system power supply to Earth ground by attaching a wire from terminal 2 on the sub-base I/O connector of any module to Earth ground, or alternatively to terminal 6 on the Base Module I/O connector or the G terminal on the flame amp.

Analog Modules (Analog I/O, Limit, Fuel/Air)

The analog cell terminals within these modules are not isolated; they are all referenced to the SLATE system ground.

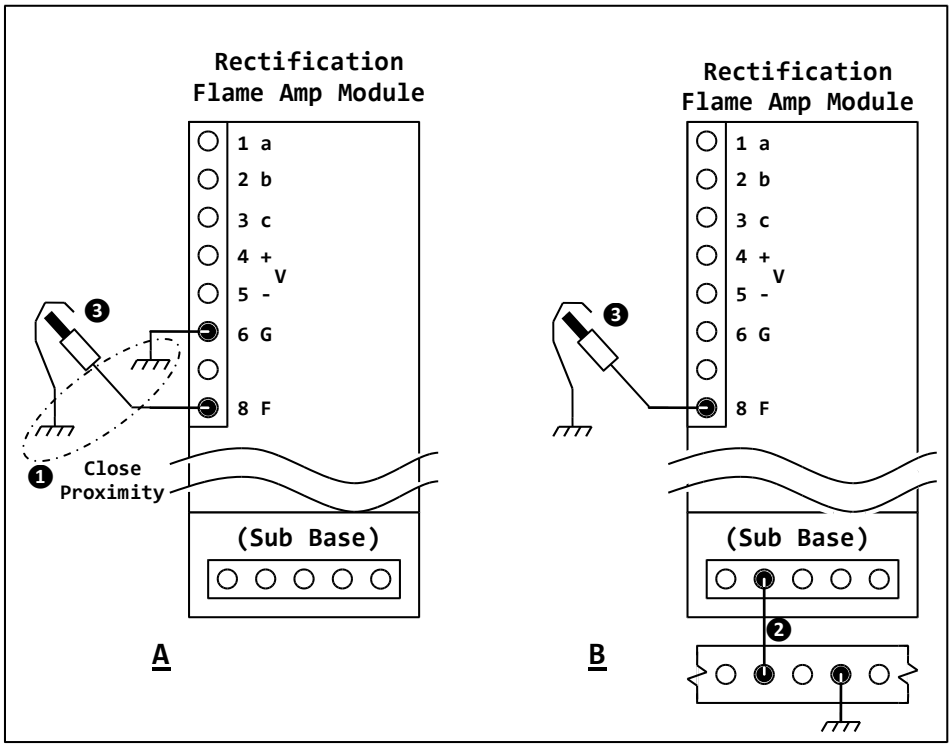
An externally powered sensor (such as voltage, current or PWM input) to an analog cell must come from a power supply that is ground referenced to the Slate system ground. Failure to do so may result in inaccurate sensor readings and possible damage to the analog cell or sensor. The power supply generating the voltage or current input should have its ground/common connected to terminal 2 of the sub-base I/O connector of the module utilizing the analog function. None of the four terminals of an analog cell are intended for grounding external equipment. The image below shows proper ground connections.



1. Recommended unless application specifics preclude this.
2. Applications using external power supplies to power external sensors must have their ground reference terminal(s) in common with the SLATE system ground.
3. Shields for sensor cabling should be tied to SLATE system ground (terminal 2 of the sub base I/O connector) or the single point ground.
4. Add this connection when external supplies are present (**2**) or when tying shields directly to single point ground.
5. Shielded cable recommended for applications where electrical noise exists.
6. Thermocouples must be isolated from SLATE system ground, Earth ground or any conductive path.

Flame Rectification Amplifier Modules

The Rectification Flame Amplifier module requires the SLATE system ground be connected to the burner ground (typically Earth ground). Drawing A below shows best practice for a SLATE system that does not have any other points tied to earth ground. If the SLATE system ground is already connected to burner (Earth) ground, the wire from terminal G to earth ground is not required (see drawing B).



1. The connection from the flame rod return (G lead wire) should use the shortest direct path back to the Flame Amplifier Module. For best practice, the flame rod return (G lead wire) should be in close proximity with the F lead wire.
2. Grounding bar or system single point ground.
3. The Rectification Flame Rod.

Digital Reference Terminals

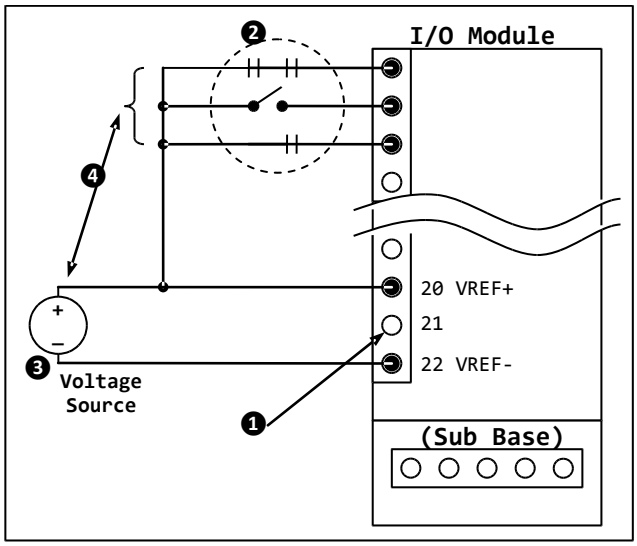
The terminals labeled “Vref+” and “Vref-“ (found on the Limit, Burner, Digital, and Annunciator modules) are electrically isolated from the Slate system power supply and the Slate system ground. These terminals are used only to configure the digital (relay) inputs of a module for operation at various voltage levels (24VDC, 24 VAC or line voltages).

The digital reference terminals have no impact on analog cell functionality.

Any device providing voltage to the digital inputs or receiving voltage from the relay outputs of these modules must be referenced to the Vref- terminal. The voltage must be the same phase and magnitude of the Vref+ reference voltage. Failure to comply may result in erroneous terminal readings or possible damage to the Slate module or connected device.

The Vref terminals on a module are unique to that specific module. Different modules may use different Vref voltages.

Proper connections are shown in the image below. It is not permissible to make any connections the terminal 21.



1. Do not make any connections to this terminal.
2. Typical application shown.
3. Voltage source may be 240 / 120 VAC, 24 VAC. or 24 VDC.
4. The voltage being sensed at the module I/O connector must originate from the same voltage source at the VREF terminals.

Shielded cables

It is strongly advised that the shielded cable be used for analog signals that are sensitive to electrical noise and for digital or line voltage signals that can radiate electrical noise.

The RS-485 cables to the actuator can be an electrical noise radiator and should be grounded at one end of the cable. The actuator interface provides a terminal for grounding the shield(s). If this connection at the actuator is not made, or a different actuator used, then the cable shield should be tied to Earth ground at module using terminal 2 on the sub base I/O connector.

Do not ground both ends of the cable shield as a possible loop current may occur producing offsets in the analog signals.

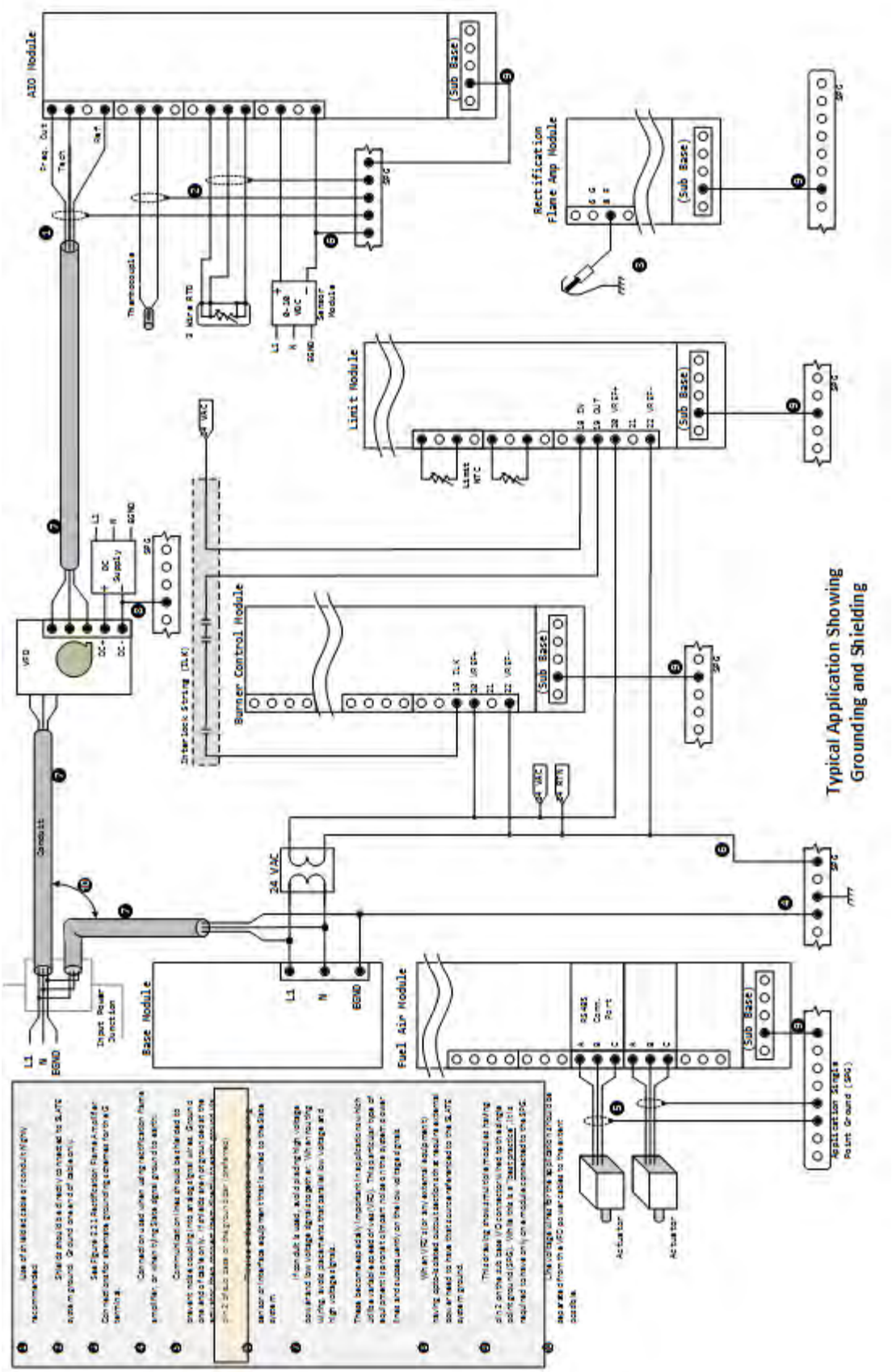
Thermocouple and RTD signals are susceptible to electrical noise and it is recommended that shielded cabling be used with the shield tied to system or Earth ground (preferred). The connection point of the shield should be made at the SLATE end of the cable.

All analog signals should be separated from VFD (if present) cabling. Avoid running analog wires parallel to VFD wires (especially line voltage). The analog wires should never be placed in conduit with line voltage or VFD wires.

Thermocouples

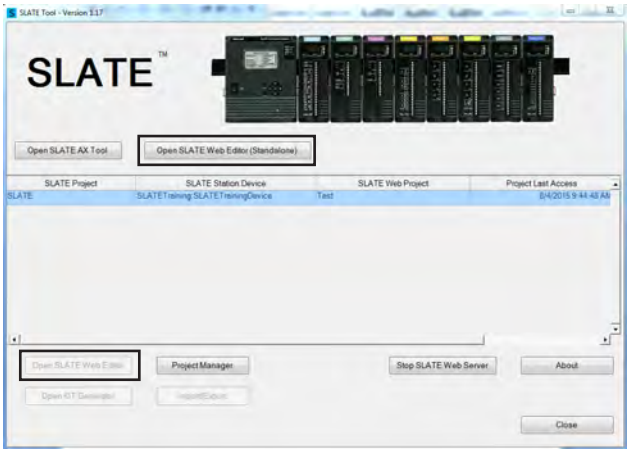
The thermocouple circuit in the SLATE module uses a biasing voltage that is present on the wire sensing junction. Although the analog cell's input is heavily protected against static and short term over voltages, it still possible to damage the input if care is not exercised in placement of the sense point (junction).

The thermocouple sense point (junction) is required to be isolated from ground and other conductive paths. Failure to isolate the sense point may also result in additional electrical noise pickup on the thermocouple signals or offset readings.


AIO Module
(Sub Base)
Rectification Flame Amp Module
Limit Module
Burner Control Module
Interlock String (ILK)
24 VAC
Base Module
Fuel Air Module
Actuator
Actuator
Typical Application Showing
Grounding and Shielding

Chapter 15: SLATE Web Editor

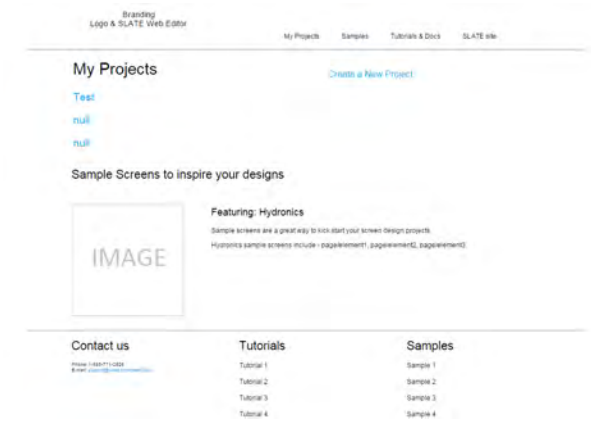
The SLATE Web Editor is an environment within the SLATE AX Tool to configure and design HMI (Human Machine Interface) screens for your application. This editor is installed at the time of the SLATE AX installation.



The Web Editor can be accessed through the SLATE Tools Start Page. In version 1.17 there are two ways to access the Web Editor. If you do not have any SLATE projects available you can use the Open SLATE Web Editor (Standalone) button to launch the Web Editor to work on screens without attaching them to a project.

If you have projects have been built and you want to associate them with your Web Editor screens you can also select the Open SLATE Web Editor button after you highlight the SLATE project as shown above.

Click on either button.



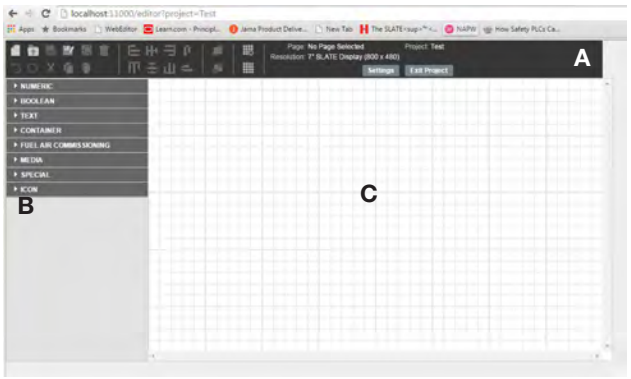
You will be taken to the My Projects section of the Web Editor Tool. This page is designed to organize your projects. When you select

Create a New Project you will be prompted to name that project through the following wizard.



You will enter a new Project Name and Project ID. (Caveat we need to know what Project ID is). When the project is saved in the list, simply click on the project to take you to the Web Editor Designer.

Using the Editor



The page is divided three sections:

Section A contains the information about edited file, project and buttons for widget operations.

Section B contains the structured list of available widgets.

Section C is the main editor area, where you will place desired widgets for your application

When you expand selections in section B, you open another environment that allows you to customize widgets by setting their individual properties. It can be enlarged by clicking on the arrow in the upper left corner.



Adding new widgets is performed by making a selection from the given set and dragging it anywhere on the Editor Area (Section C). Whenever a single widget is selected, its attributes appear to the side of the work space. From this section you have the ability to "bind" the widget to a specific module, specific category and register. Some changes may be immediately visible on the widget, such as color, while some are invisible, such as register mapping. When you are satisfied with the editor content you can save it via the Save or or Save As . You can preview your work in simulation mode by clicking Preview or symbol. You need to save the work to preview it.

Linking Dynamic Widgets

Some widgets are static. They appear exactly the same way at all times. Bust some widgets can be dynamic and reflect values obtained from the SLATE Base Module (in the production mode) or from the local server (in the development mode). The widget can be linked to registers in the SLATE modules. For example, if you select an output widget (Numeric Output, Gauge, or Vertical Bar) it periodically asks for the value of the register and accordingly updates its value, image or shape. If you select an input widget, it displays the value provided by the server and if the user chooses to change it, the widget propagates this change to the server. As long as the widget is selected, it is not updated, so the user can perform the change.

Editor Commands

The SLATE Web Editor Commands are summarized in the table below.

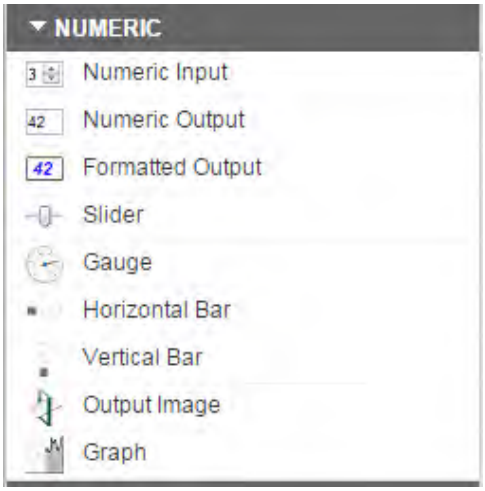
Button	Shortcut	Effect
New		Clears the editor content and file name.
Open		Loads the content of the chosen file into the editor area.
Save	Ctrl+S	Saves the editor content into the previously chosen file, or asks for a file name if none was specified.
Save As		Asks for a file name and saves the editor content into this file.
Preview		Opens a new tab with the saved page in the simulation mode.
Undo	Ctrl+Z	Reverts the last action.
Redo	Ctrl+Y	Re-performs the last reverted action.
Copy	Ctrl+C	Copies selected widget(s) into the editor clipboard.
Cut	Ctrl+X	Copies selected widget(s) into the editor clipboard and removes the widget(s).
Paste	Ctrl+V	Pastes the widget(s) from the editor clipboard to the editor area.
	Ctrl+A	Selects all widgets.
Up	Alt+U	Shifts the selected widget(s) to the front (above all other widgets).
Down	Alt+D	Shifts the selected widget(s) to the bottom (below all other widgets).
Align Buttons	Alt+Num Arrows	Aligning all selected widgets in the particular direction: 2 is down, 6 is right, 8 is up, 4 is left.
Vertical Align	Alt+V	Align widgets by their center vertically
Horizontal Align	Alt+H	Align widgets by their center horizontally
Vertical Distribute	Alt+B	Evenly distribute widgets vertically
Horizontal Distribute	Alt+J	Evenly distribute widgets horizontally
In Grid Options	Alt+Q	Increase grid (for snapping when shift is held while dragging)
In Grid Options	Alt+A	Decrease grid
In Settings		When designing page different from the default project resolution, the width and height can be changed here.
Exit Project		Navigates the browser back to the welcome page.
Delete	Del	Deletes the selected widgets.

The remaining operations are described in the following table.

Operation	Effect
Right Click	Invokes the context menu (on the widget or on the editor area).
Ctrl + Left Click	Toggles selection for the widget that has been clicked.
Left Click widget + Drag	If a widget was selected in the editor area, this widget is moved.
Left Click resizing handle + Drag	If the right or bottom bound or right bottom corner arrow is clicked, the widget is resized.

Operation	Effect
Left Click to open area + Drag	A rectangle is shown, which can be used to select all widgets contained in or touched by the rectangle.
Left Click to open area + Drag + Ctrl	With the control key the selection rectangle behavior is modified to select only those widgets that are completely contained within the rectangle.
Right Click anywhere + Drag	By using a right-click, only a selection rectangle occurs, that is if a widget happens to be at the position of the mouse-down it does not move, whereas a left click would select and move that widget. A rectangle is shown, which can be used to select all widgets contained in or touched by the rectangle.
Right Click anywhere + Drag + Ctrl	With the control key the selection rectangle behavior is modified to select only those widgets that are completely contained within the rectangle.
Ctrl + Arrows	Moves the selected widget(s) by one pixel.
Alt	Removes handles for resizing (to enable dragging of small widgets) and borders (to get a better idea about the final look of the page)
Ctrl + Drag	“Snap to object” feature is active while dragging (can be changed in Grid Options)
Shift + Drag	“Snap to grid” feature is active while dragging (can be changed in Grid Options)

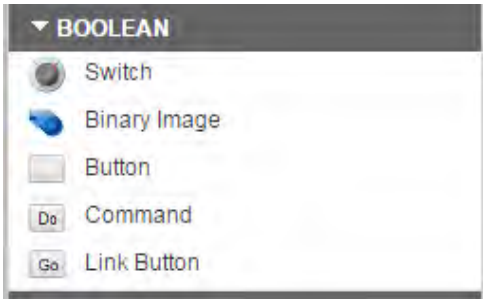
Numeric Section



The numeric section contains “widgets” that will work with numerical values. These widgets will display values from particular registers, slider bars that will allow you to change a numerical value to a particular register, gauges that will display values of registers using a gauge and a horizontal bar. The Output Image would allow you to display a specific image according to the numeric value of a register. It can compare the value to the stored conditions and display the image of a satisfied condition. It is possible to change the form of the conditions. The allowed operators are:

- Less than or equal to
- Less than
- Greater than or equal to
- Greater than
- Equal to
- Not equal to

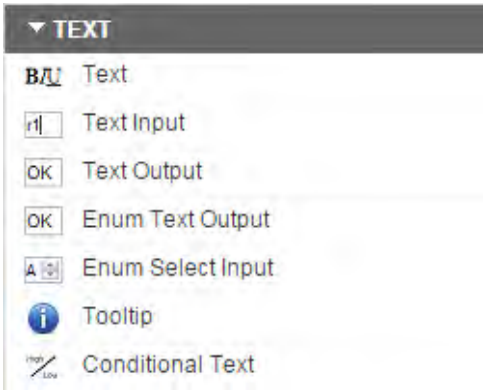
Boolean Section



The Boolean section contains the following widgets:

- **Switch:** a dynamic read/write widget working with two states on or off.
- **Binary Image:** dynamic read only version of the Switch widget. It operates only with an On value. If On value is read from a register it shows an On state.
- **Button:** a widget that represents a button commonly used in HMI applications. The functionality can be specified by the designer
- **Command:** dynamic write only widget which sends specified values to a specified register when clicked
- **Link button:** static widget acting as a link. When clicked, the user is navigated to a specific page

Text Section

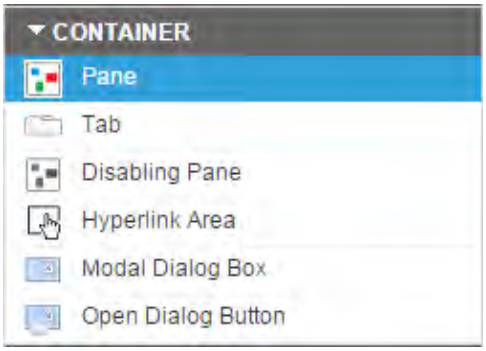


The text section contains tools to create text on your display screens.

- **Text selection:** provides rich formatted text.
- **Text Input:** provides dynamic read/write widgets allowing you to change the text values of a particular register
- **Text Output:** provides read only which displays the text value of a particular register

- **Enum Text Output:** dynamic read only widget which works with enumeration values of the register
- **Enum Select Input:** dynamic read/write widget which works with enumeration values as a enumerated text output but it also allows you to change the value
- **Tooltip:** allows you to create tool tips when hovering mouse over a specific area
- **Conditional Text:** dynamic read-only variant of the output image widget with the ability to handle texts instead of images

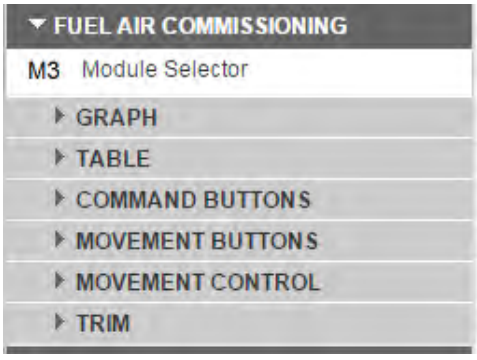
Container Section



This group contains widgets, into which other widgets can be placed.

- **Pane:** static widget which can be used for inheritance or styling reason
- **Tab:** static widget useful for diving the content into tabs that can be added and removed
- **Disabling Pane:** widget that reads a given register value and compare it with a given value
- **Hyperlink Area:** widget that allows you to define areas that when clicked takes you to a specified location
- **Model Dialog Box:** tightly linked to the Open Dialog Button widget. Allows you to create custom modal dialog windows and buttons to invoke them.
- **Open Dialog Button:** the only widget that can invoke Modal Dialog windows

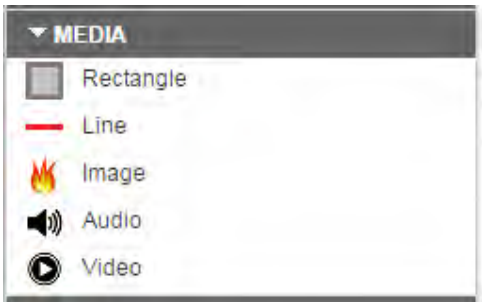
Fuel Air Commissioning Section



This section is dedicated to fuel air commissioning.

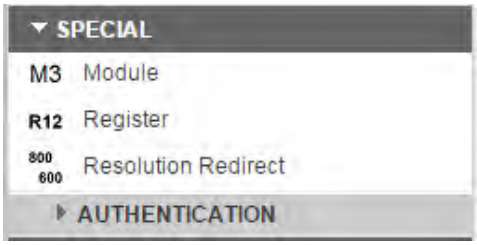
- **Graph:** displays the curves, points, throttle positions, presets, status of the throttle, validity of the segments and curve selection
- **Table:** all fuel air widgets are designed in a way that the form a table. Always displays all available curves in columns
- **Command Buttons:** widgets representing buttons sending a fixed value to a fixed register of a module defined by Fuel Air Module selector widget
- **Movement Buttons:** widgets that simply send the movement commands to the server
- **Movement Control:** widgets having impact on movement
- **Trim:** widgets dedicated to fuel air trimming

Media Section



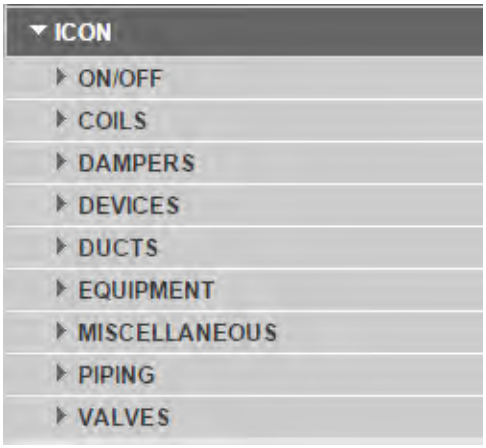
- **Rectangle:** widgets representing rectangles with a wide variety of options for styling
- **Line:** widgets representing lines with a wide variety of options for styling and placement
- **Image:** a widget representing an image that can be given a link
- **Audio:** allows you to play audio with audio files
- **Video:** allows you to play videos with video files

Special Section



- **Module:** widgets having impact on inheritance
- **Register:** widgets having impact on inheritance
- **Resolution Redirect:** special widget that can be sued to react to different browser resolutions
- **Authentication:** widgets contained in this section are tightly related to the user authentication, logging in and out, password management and widgets to the logged user

Icon

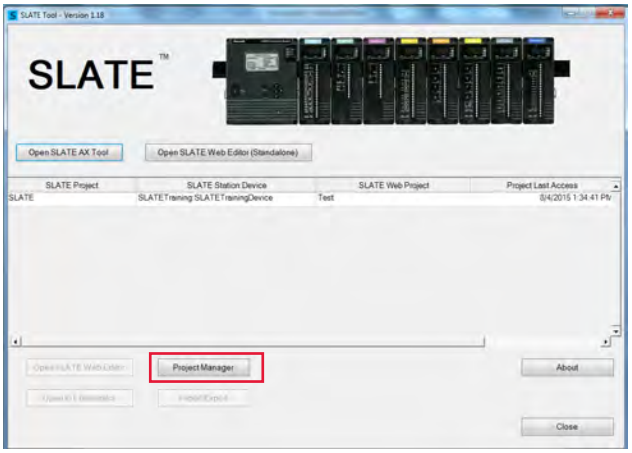


This section provides a library of widgets for use that are indicative of commercial or industrial equipment.

Chapter 16: SLATE Project Manager and Kit Loading

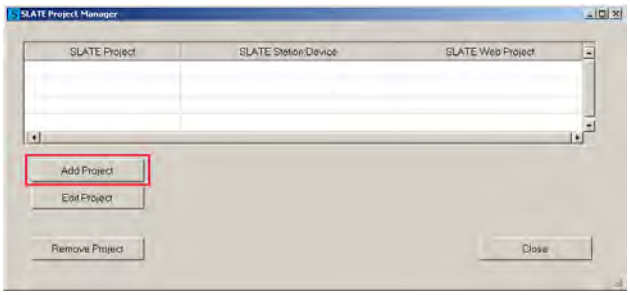
Overview

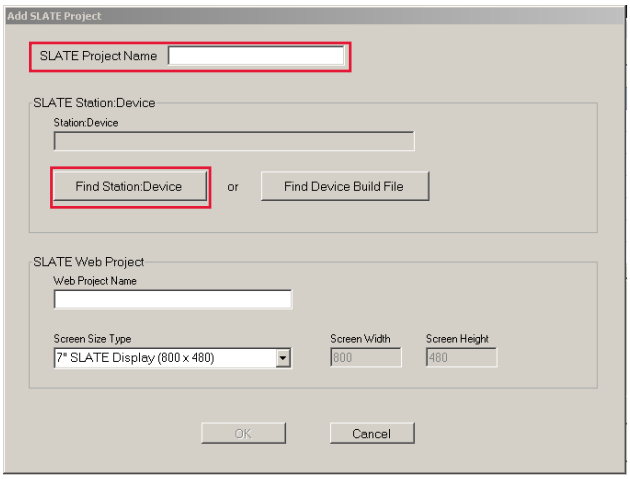
The SLATE Project Manager function allows the user to tie the SLATE AX wire sheet to the Web Editor and transfer the required files as necessary. It is the first step to creating a SLATE Kit. In order to use the Project Manager function, a SLATE device must exist in SLATE AX Tool. Click the “Project Manager” button.



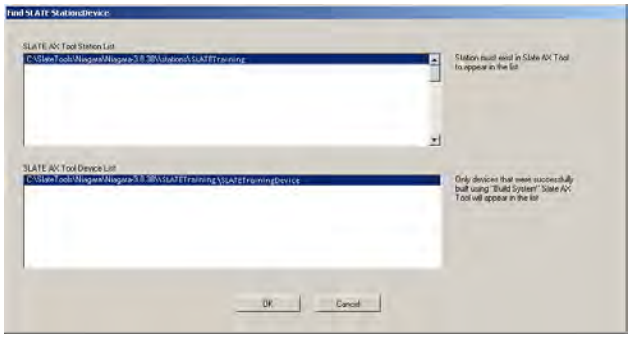
The SLATE Project Manager window will show all existing projects. Click the “Add Project” button to add a project.

You will enter a wire sheet project name.





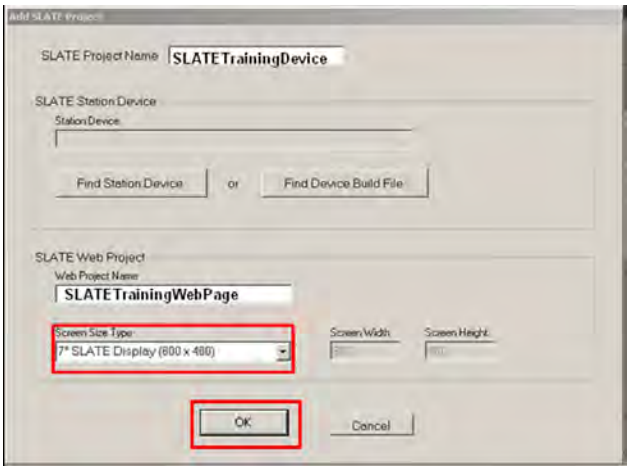
Click the “Find Station Device” button to locate the SLATE device we want to add. The SLATE AX Tool Station list shows all created stations and the SLATE AX Tool Device List shows all created and built devices with that station.



Next, name the web portion of the kit. See example below.

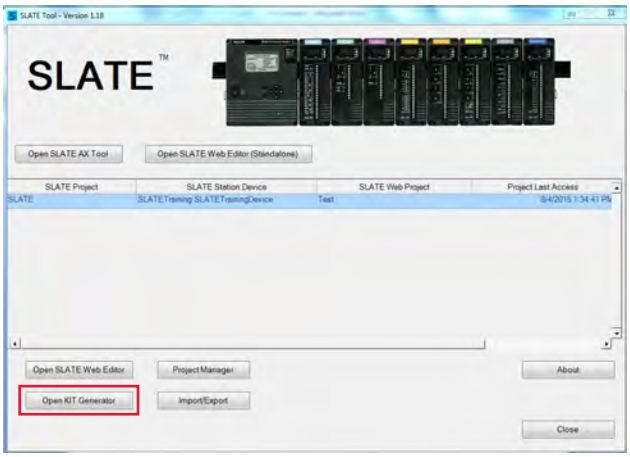


You can select the screen size for which your web pages will be designed. This will limit the size of the Web Editor work space to that available on a screen with the selected resolution.

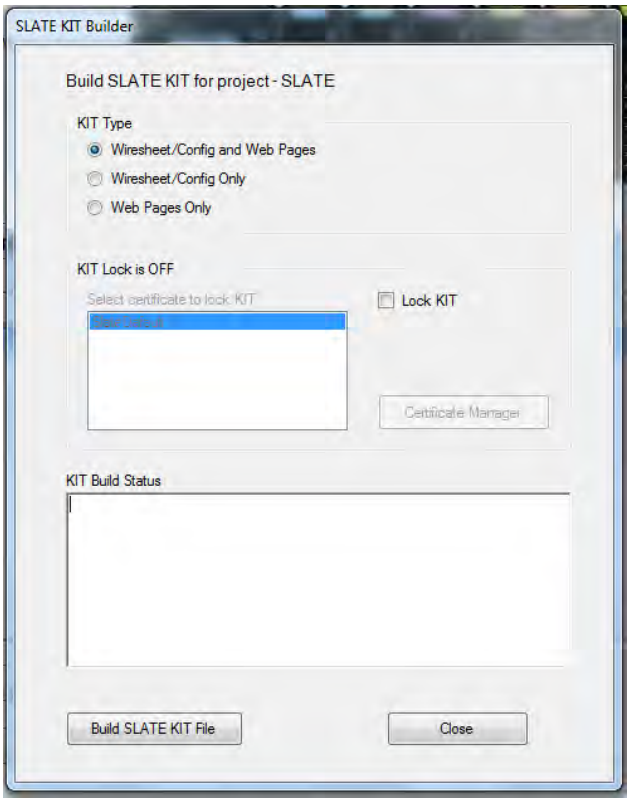


Click the “OK” button when you are finished.

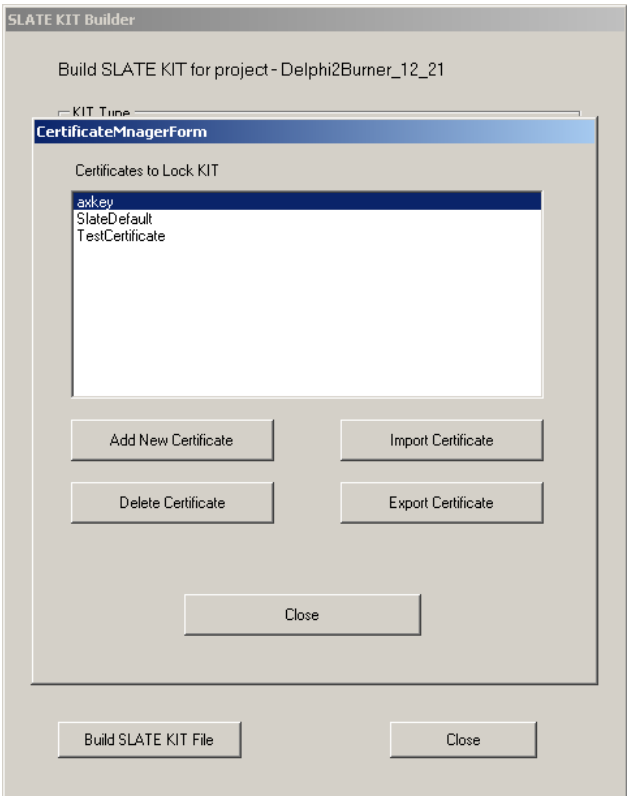
Now that you have a SLATE project identified and named you can highlight it and build a kit. Click on the “Open Kit Generator.”

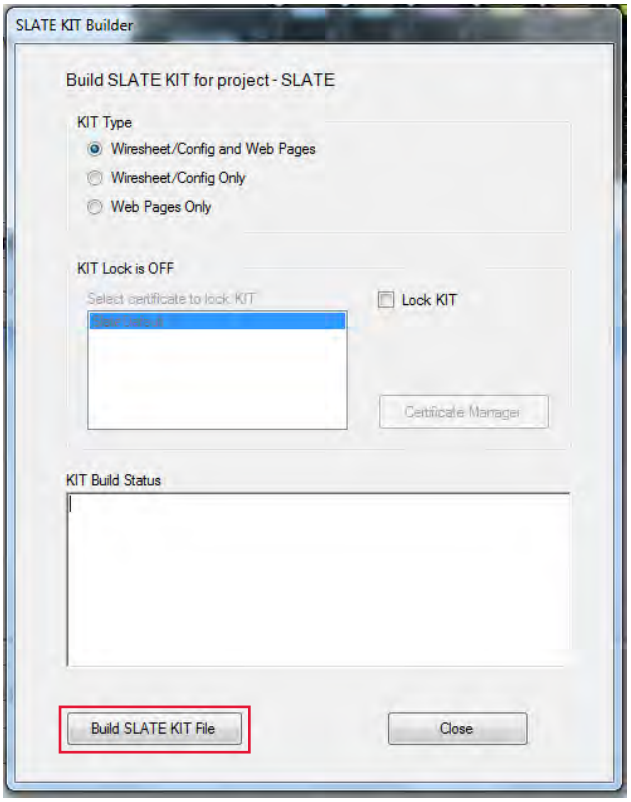


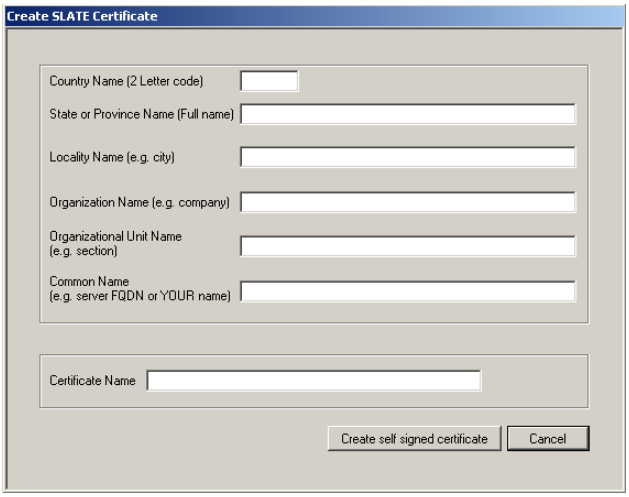
You will need to define what elements the kit will contain.



You are also given the option to lock kits down. Locking the kit insures that no one will have access to make any changes to the SLATE Base without the key certificate. Certificates are a way of protecting the kit. The screen shots below allows you to create access and locks the base down only allowing you to create kits for that specific base.

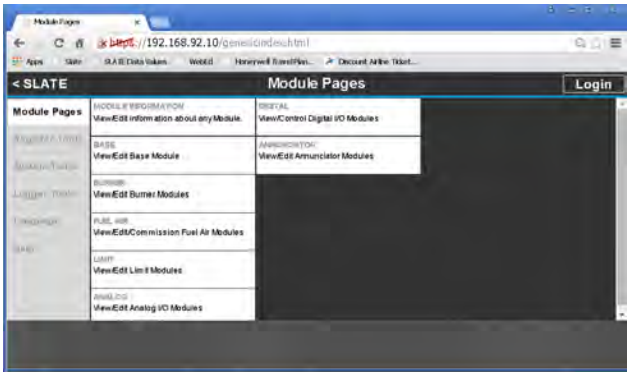




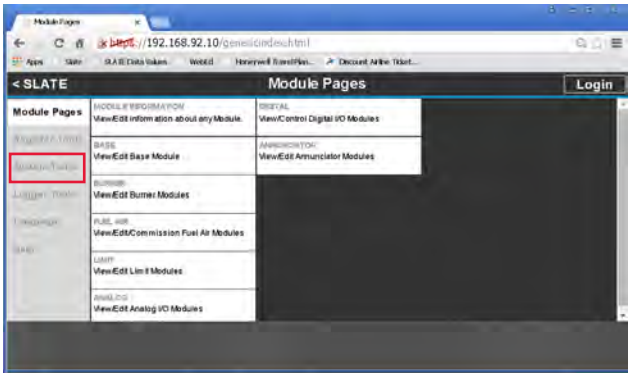


When you have selected the kit type, click the “Build SLATE Kit File” button and save the kit to your preferred location. The kit is installed into the SLATE base via a thumb drive.

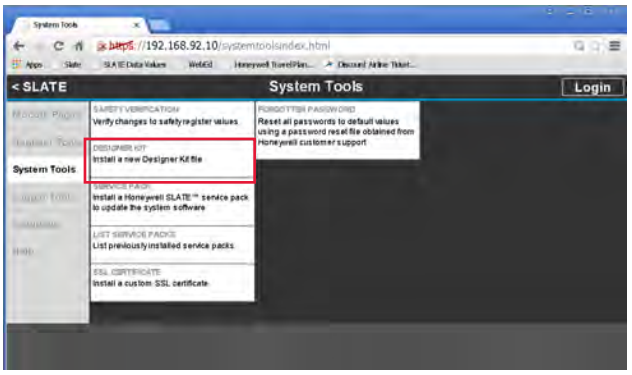
The next step to loading the kit once it is saved to a thumb drive is to open up your Chrome browser and accessing the SLATE Base via the PC on the network or to go to the generic menu on the 7” display on the network. Default URL: 192.168.92.10



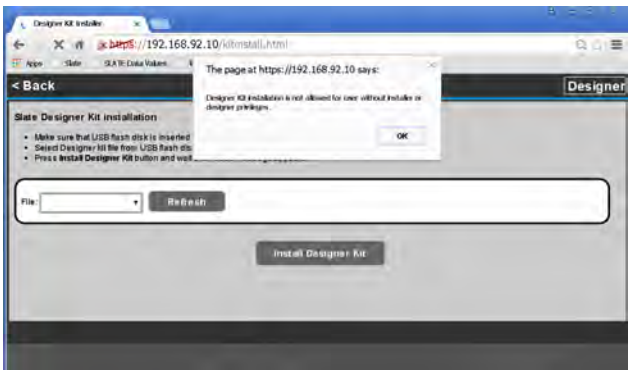
Click the System Tools



Click the “DESIGNER KIT” button

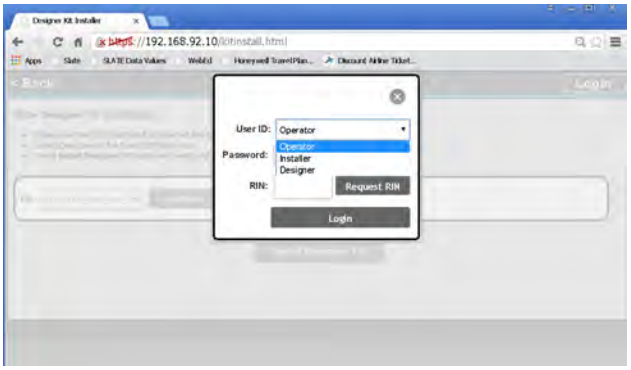


At this point, the user must have either Designer or Installer access in order to load a kit into the SLATE base. Logging in with the appropriate credentials is required.



Click the “OK” button to proceed to the log-in window.

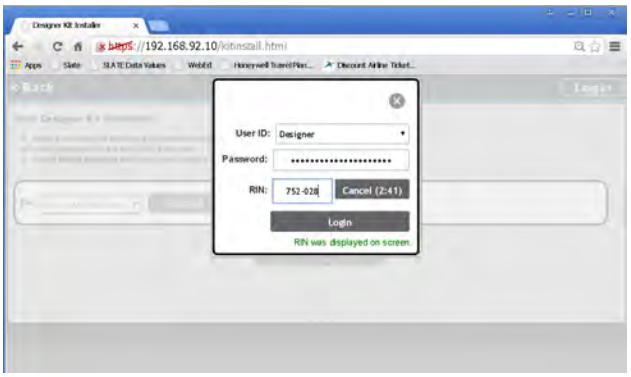
Select the credential level from the “User ID” drop down menu. Select “Designer” or “Installer”



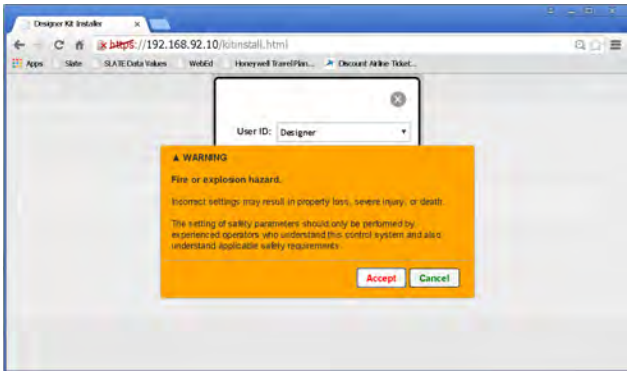
The default Password for the Designer ID is “SlateDesignerPassword” or “SlateInstallerPassword”. Capitalize the password as written.

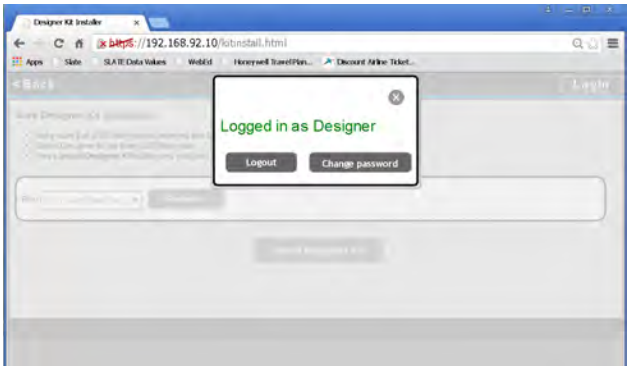
Once you have selected “Designer” for the User ID and typed in the password, click the “Request RIN” button and check the SLATE base display for a six digit number. Type in the number in the RIN field and include the dash! You have 3 minutes before the system times out.

If the system times out, you can re-initiate a log-in procedure from the top. The SLATE system forces a local presence at the SLATE base in order to log in (and load a kit or carry on any other function requiring log-in.



At this point you are given the option of changing the password. At this time do not change the password.





Click on the “X” to close the log-in window. You will be logged in as either Designer or Installer. But the screen shot above indicates Designer as an example. You are now returned to the Designer Kit page.

Find your project in the “File” field and click the “Install Designer Kit” button.



Allow the kit to load. This process may take a few minutes so be patient! At the end of a successful load you will see “Kit Loaded Successfully.”



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SLATE™

UV Ampli-Check Flame Amplifier

R8001S1071

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001S1071 UV Ampli-Check module responds to an ultraviolet signal from an ultraviolet type flame detector to indicate the presence of flame. This flame amplifier is used with the C7027 and C7035 detector series.

Features

- Module display for flame signal strength
- 0.0 to 8.0 VDC flame signal strength reading range

Specifications

Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 3)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

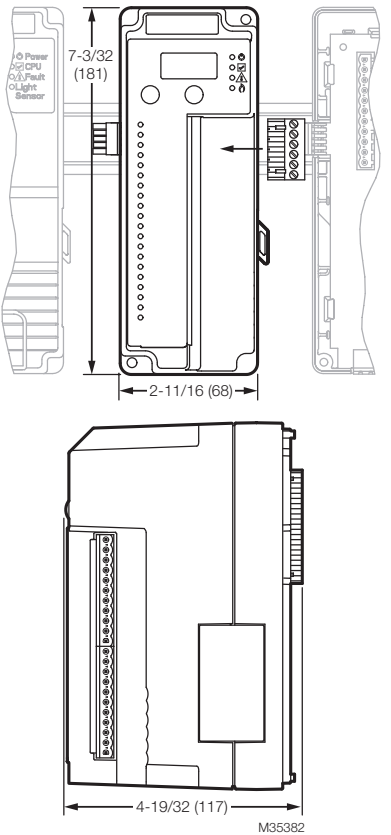


Fig. 1. Mounting dimensions of UV Ampli-Check Flame Amplifier in in. (mm).

LED Array

There are four LEDs on the front of the Ampli-Check Flame Amp module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating flame strength. It is also used to identify the module number of the SLATE system.

Color	Description
Terminal T2	
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Select button is used to scroll through the segment display information.

Selector Switch

The SLATE Burner Control Module is designed to operate with only one Flame Amplifier Module. The Flame Amplifier Module has a rotary switch on its back side which is factory set to 1. It must be set to 1 for the system to operate properly. See Fig. 2.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Verify the Selector Switch is set to 1. See Fig. 2.

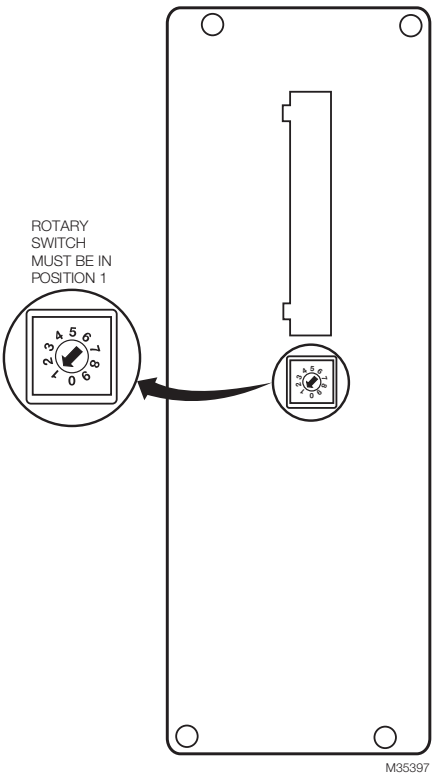


Fig. 2. Flame Amplifier Module Selector Switch.

3. Install the Flame Amplifier on the Sub-Base. See Fig. 3.

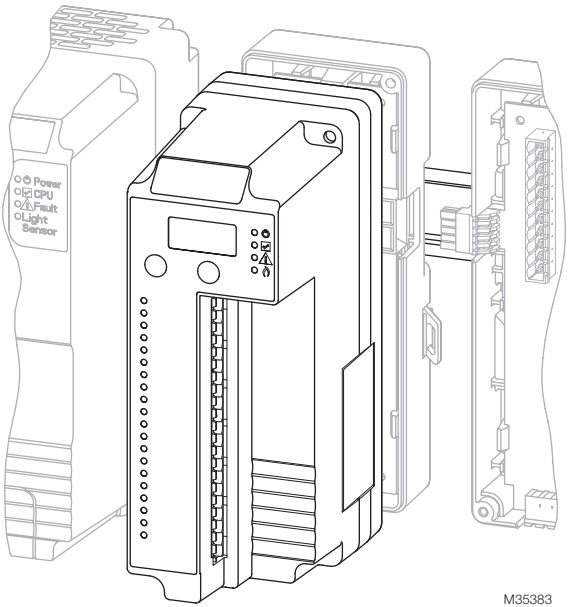


Fig. 3. Installing the UV Ampli-Check Flame Amplifier on the Sub-Base Module.

IMPORTANT

1. *Wiring must comply with all applicable codes, ordinances and regulations.*
2. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
3. *The R8001S1071 should not interfere with the propersafety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.*

The SLATE Flame Amplifier module must be mounted in an electrical enclosure with adequate clearance for servicing, installation, and removal of modules.

⚠ CAUTION

Equipment Damage Hazard.
Incorrect combination of relay module, amplifier and flame detector can cause equipment damage.

Installing the Flame Detector

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the Burner Control Module, then it must be externally wired to it via the remote bus connections.

Wiring

1. Refer to Fig. 4 for proper flame detector wiring.
2. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

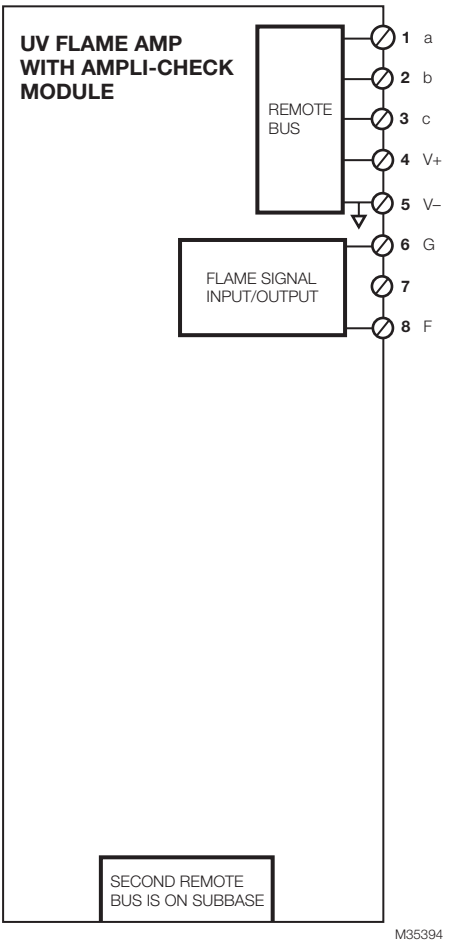


Fig. 4. R8001S1071 SLATE UV Ampli-Check Flame Amplifier wiring.

3. All wiring must comply with appropriate electrical codes, ordinances and regulations including NEC Class 1 (Line Voltage) wiring where required.

4. Use recommended wire size and type no. 18 copper conductors TTW (60C) or THW (75C) or THNN (90C).

5. Use recommended wire routing:
   - **a.** Keep the flame signal leadwire as short as possible from the detector to the SLATE module. The maximum permissible leadwire length depends on the type of leadwire, conduit type and leadwire diameter. The ultimate limiting factor for flame signal length is the flame signal voltage.
   - **b.** Do not run high voltage ignition transformer wires in the same conduit with the flame detection wiring.
   - **c.** If the flame detector leadwires are not long enough to reach the SLATE electrical connectors, make splices in a junction box.
     - **(1)** Enclose scanner wiring without armor cable in metal cable or conduit.
     - **(2)** Follow flame detector Instructions.

6. Check wiring, see Fig. 4.

Checkout

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminal screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus connector secured to SLATE Burner Control Module.
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the flame detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector wiring for defects including:
   - **a.** Incorrect connections.
   - **b.** Wrong type of wire.
   - **c.** Deteriorated wire.
   - **d.** Open circuits.
   - **e.** Short circuits.
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
3. For all optical detectors, clean the detector viewing window, lens, and inside of the sight pipe as applicable.
4. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:
   - **a.** Add a heat block to stop conducted heat traveling up the sight pipe.
   - **b.** Add a shield or screen to reflect radiated heat.

   c. Add cooling (refer to sight pipe ventilation in the detector Instructions).

5. Make sure that the flame adjustment is not too lean.
6. Make sure the optical detector is properly sighting the flame.
7. If necessary, resight or reposition the detector.
8. If you cannot obtain proper operation, replace the plug-in amplifier.
9. If you cannot yet obtain proper operation, replace the flame detector.

IMPORTANT

If you make any changes to the flame detection system, repeat all required Checkout tests in Checkout section of the Instructions for the applicable SLATE module.



For more information and detailed instructions on the R8001S1071 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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SLATE™

UV Shutter-Check Flame Amplifier

R8001S1051

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001S1051 UV Shutter-Check module responds to an ultraviolet signal from an ultraviolet type flame detector to indicate the presence of flame. This flame amplifier is used with the C7061 detector series.

Features

- Module display for flame signal strength
- 0.0 to 8.0 VDC flame signal strength reading range flame signal strength reading range

Specifications

Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: Refer to Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

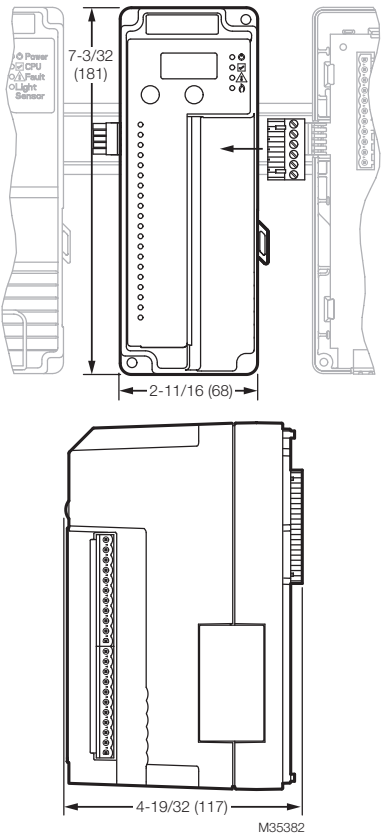


Fig. 1. Mounting dimensions of UV Shutter-Check Flame Amplifier in in. (mm).

LED Array

There are four LEDs on the front of the Shutter-Check Flame Amp module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating flame strength. It is also used to identify the module number of the SLATE system.

Color	Description
Terminal T2	
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Select button is used to scroll through the segment display information.

Selector Switch

The SLATE Burner Control Module is designed to operate with only one Flame Amplifier Module. The Flame Amplifier Module has a rotary switch on its back side which is factory set to 1. It must be set to 1 for the system to operate properly. See Fig. 2.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Verify the Selector Switch is set to 1. See Fig. 2.

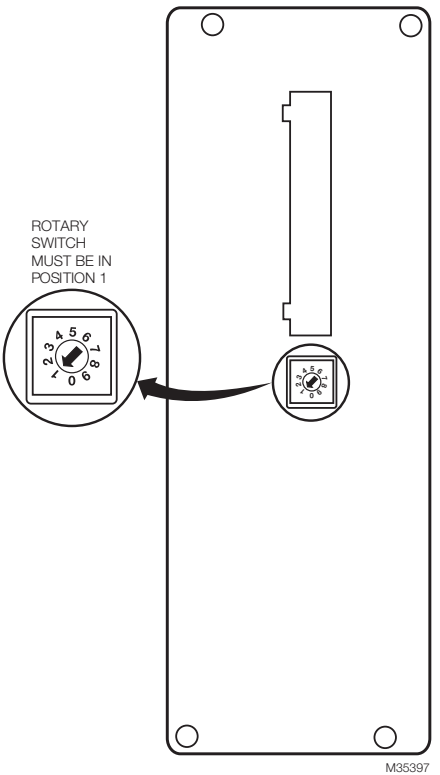


Fig. 2. Flame Amplifier Module Selector Switch.

3. Install the Flame Amplifier on the Sub-Base. See Fig. 3.

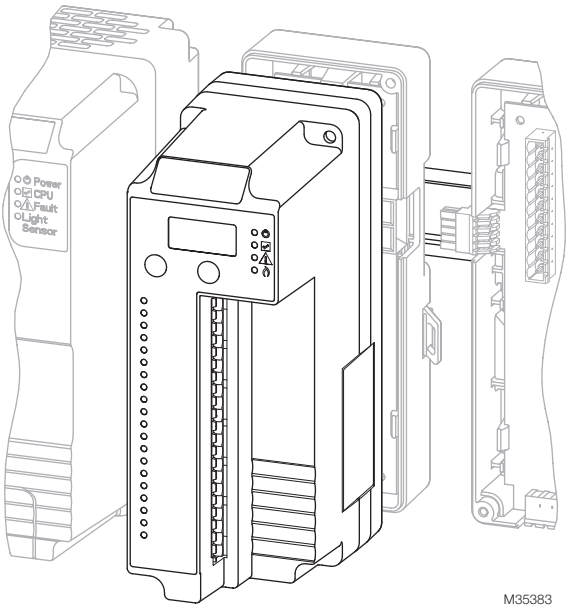


Fig. 3. Installing the UV Shutter-Check Flame Amplifier on the Sub-Base Module.

IMPORTANT

1. *Wiring must comply with all applicable codes, ordinances and regulations.*
2. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
3. *The R8001S1051 should not interfere with the propersafety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.*

⚠ CAUTION

Equipment Damage Hazard.
Incorrect combination of relay module, amplifier and flame detector can cause equipment damage.

Installing the Flame Detector

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the Burner Control Module, then it must be externally wired to it via the remote bus connections.

Wiring

1. Refer to Fig. 4 for proper flame detector wiring.
2. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

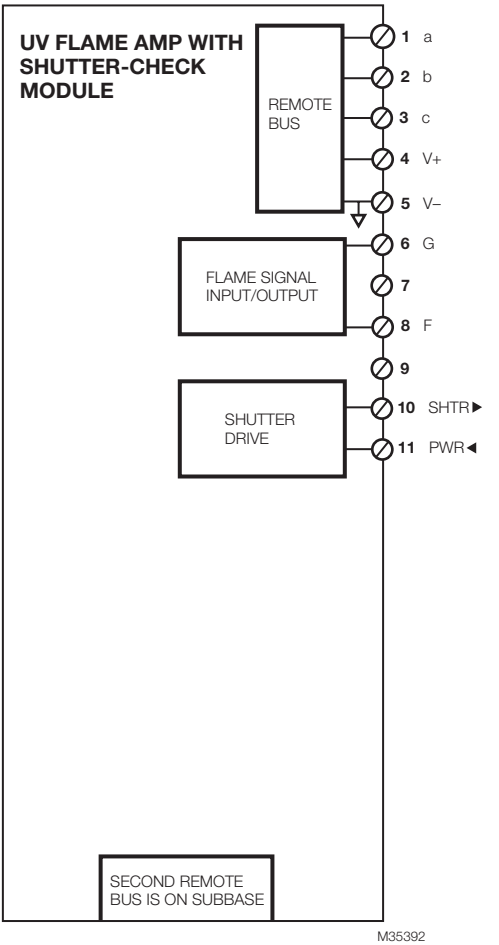


Fig. 4. R8001S1051 SLATE UV Shutter-Check Flame Amplifier wiring.

3. All wiring must comply with appropriate electrical codes, ordinances and regulations including NEC Class 1 (Line Voltage) wiring where required.

4. Use recommended wire size and type no. 18 copper conductors TTW (60C) or THW (75C) or THNN (90C).

5. Use recommended wire routing:
   - **a.** Keep the flame signal leadwire as short as possible from the detector to the SLATE module. The maximum permissible leadwire length depends on the type of leadwire, conduit type and leadwire diameter. The ultimate limiting factor for flame signal length is the flame signal voltage.
   - **b.** Do not run high voltage ignition transformer wires in the same conduit with the flame detection wiring.
   - **c.** If the flame detector leadwires are not long enough to reach the SLATE electrical connectors, make splices in a junction box.
     - **(1)** Enclose scanner wiring without armor cable in metal cable or conduit.
     - **(2)** Follow flame detector Instructions.

6. Check wiring, see Fig. 4.

Checkout

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminal screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus connector secured to SLATE Burner Control Module.
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

NOTE: R7824C, Series 2 or greater, pulse shutter when signal of 1.5 Vdc is sensed. Display readings of 0.7 to 2.4 Vdc are common.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the flame detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector wiring for defects including:
   - **a.** Incorrect connections.
   - **b.** Wrong type of wire.
   - **c.** Deteriorated wire.
   - **d.** Open circuits.
   - **e.** Short circuits.
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
3. For all optical detectors, clean the detector viewing window, lens, and inside of the sight pipe as applicable.
4. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:

   a. Add a heat block to stop conducted heat traveling up the sight pipe.
   b. Add a shield or screen to reflect radiated heat.
   c. Add cooling (refer to sight pipe ventilation in the detector Instructions).
5. Make sure that the flame adjustment is not too lean.
6. Make sure the optical detector is properly sighting the flame.
7. If necessary, resight or reposition the detector.
8. If you cannot obtain proper operation, replace the plug-in amplifier.
9. If you cannot yet obtain proper operation, replace the flame detector.

IMPORTANT

If you make any changes to the flame detection system, repeat all required Checkout tests in Checkout section of the Instructions for the applicable SLATE module.



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For more information and detailed instructions on the R8001S1051 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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Honeywell

SLATE™

IR Ampli-Check Flame Amplifier

R8001F1041

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001F1041 IR Ampli-Check Flame Amplifier module responds to an infrared signal from an infrared type flame detector to indicate the presence of flame. This flame amplifier is used with the C7915 detector series.

Features

- Module display for flame signal strength
- 0.0 to 10.0 VDC flame signal strength reading range

Specifications

Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals
Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting
DIN Rail (See Fig. 1)

Required Components
R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

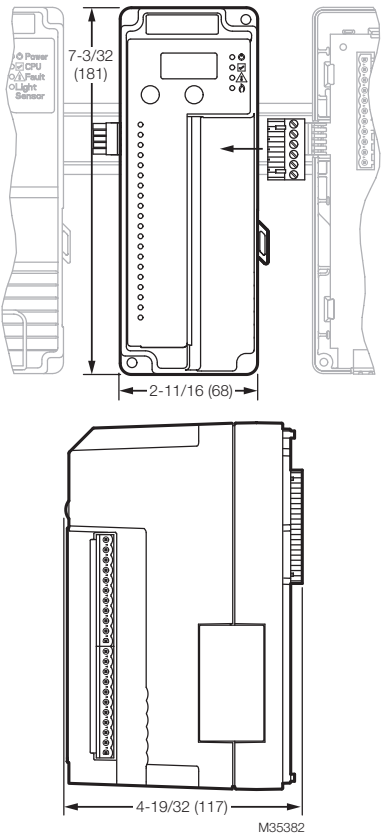


Fig. 1. Mounting dimensions of IR Ampli-Check Flame Amplifier in. (mm).

LED Array

There are four LEDs on the front of the IR Ampli-Check Flame Amplifier module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating flame strength. It is also used to identify the module number of the SLATE system.

Color	Description
Terminal T2	
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Selector Switch

The SLATE Burner Control Module is designed to operate with only one Flame Amplifier Module. The Flame Amplifier Module has a rotary switch on its back side which is factory set to 1. It must be set to 1 for the system to operate properly. See Fig. 2.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Verify the Selector Switch is set to 1. See Fig. 2.

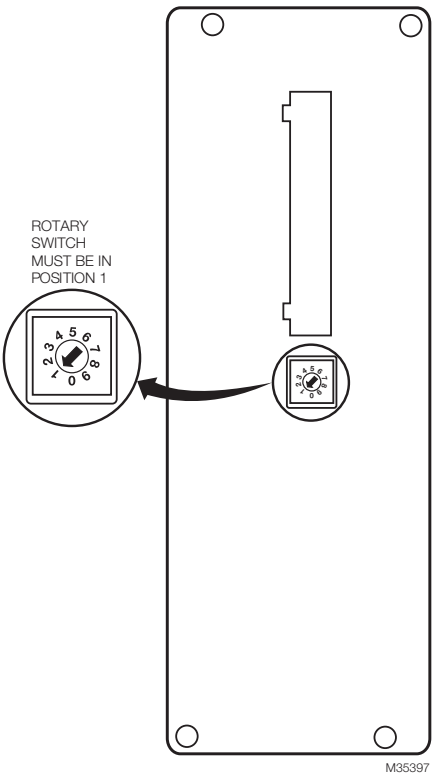


Fig. 2. Flame Amplifier Module Selector Switch.

3. Install the Flame Amplifier on the Sub-Base. See Fig. 3.

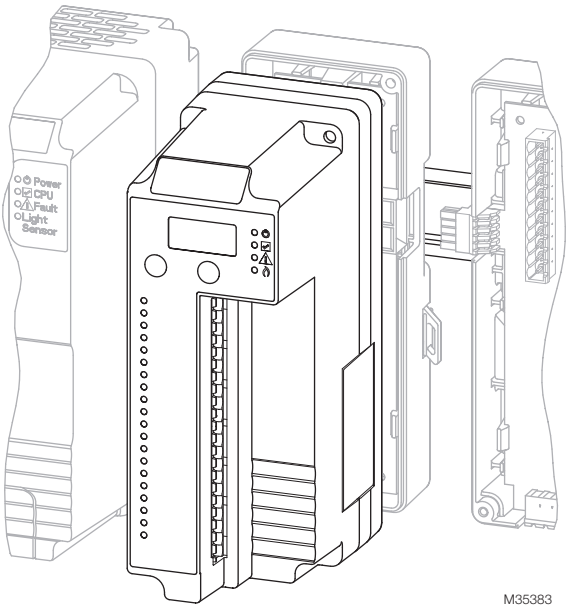


Fig. 3. Installing the IR Ampli-Check Flame Amplifier on the Sub-Base Module.

IMPORTANT

1. *Wiring must comply with all applicable codes, ordinances and regulations.*
2. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
3. *The R8001F1041 should not interfere with the propersafety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.*

⚠ CAUTION

Equipment Damage Hazard.
Incorrect combination of relay module, amplifier and flame detector can cause equipment damage.

Installing the Flame Detector

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the Burner Control Module, then it must be externally wired to it via the remote bus connections.

Wiring

1. Refer to Fig. 4 for proper flame detector wiring.

2. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

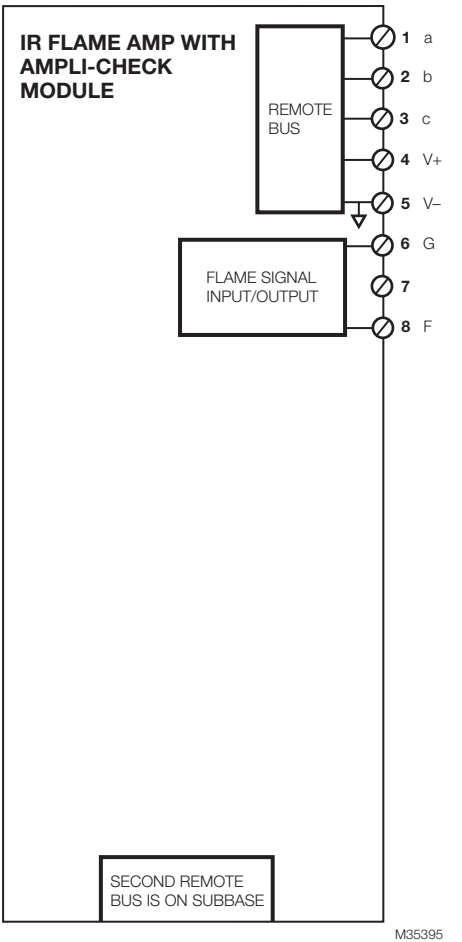


Fig. 4. R8001F1041 SLATE IR Ampli-Check Flame Amplifier wiring.

3. All wiring must comply with appropriate electrical codes, ordinances and regulations including NEC Class 1 (Line

Voltage) wiring where required.

4. Use recommended wire size and type no. 18 copper conductors TTW (60C) or THW (75C) or THNN (90C).
5. Use recommended wire routing:
   - **a.** Keep the flame signal leadwire as short as possible from the detector to the SLATE module. The maximum permissible leadwire length depends on the type of leadwire, conduit type and leadwire diameter. The ultimate limiting factor for flame signal length is the flame signal voltage.
   - **b.** Do not run high voltage ignition transformer wires in the same conduit with the flame detection wiring.
   - **c.** If the flame detector leadwires are not long enough to reach the SLATE electrical connectors, make splices in a junction box.
     - **(1)** Enclose scanner wiring without armor cable in metal cable or conduit.
     - **(2)** Follow flame detector Instructions.
6. Check wiring, see Fig. 4.

Checkout

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminal screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus connector secured to SLATE Burner Control Module.
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

NOTE: R7824C, Series 2 or greater, pulse shutter when signal of 1.5 Vdc is sensed. Display readings of 0.7 to 2.4 Vdc are common.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the flame detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector wiring for defects including:
   - **a.** Incorrect connections.
   - **b.** Wrong type of wire.
   - **c.** Deteriorated wire.
   - **d.** Open circuits.
   - **e.** Short circuits.
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
3. For all optical detectors, clean the detector viewing window, lens, and inside of the sight pipe as applicable.
4. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:

   a. Add a heat block to stop conducted heat traveling up the sight pipe.
   b. Add a shield or screen to reflect radiated heat.
   c. Add cooling (refer to sight pipe ventilation in the detector Instructions).
5. Make sure that the flame adjustment is not too lean.
6. Make sure the optical detector is properly sighting the flame.
7. If necessary, resight or reposition the detector.
8. If you cannot obtain proper operation, replace the plug-in amplifier.
9. If you cannot yet obtain proper operation, replace the flame detector.

IMPORTANT

If you make any changes to the flame detection system, repeat all required Checkout tests in Checkout section of the Instructions for the applicable SLATE module.



32-00021-01

For more information and detailed instructions on the R8001F1041 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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SLATE™

UV Visible Ampli-Check Flame Amplifier

R8001F1091

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001F1091 UV Visible Ampli-Check Flame Amplifier module responds to an ultraviolet/visible light signal from an UV/visible light type flame detector to indicate the presence of flame. This flame amplifier is used with the C7927 (UV), C7962 (Visible) detector series.

Features

- Module display for flame signal strength
- 0.0 to 5.0 VDC flame signal strength reading range

Specifications

Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals

Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting

DIN Rail (See Fig. 1)

Required Components

R8001A1001 SLATE Base Controller
R8001S9001 SLATE Sub-Base Module

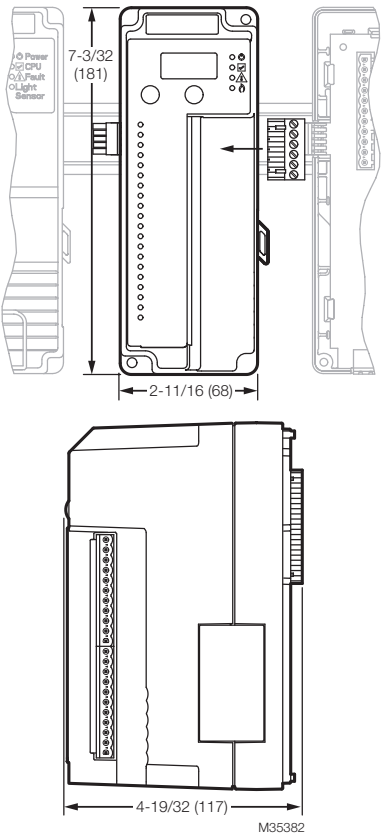


Fig. 1. Mounting dimensions of UV Visible Ampli-Check Flame Amplifier in. (mm).

LED Array

There are four LEDs on the front of the UV Visible Ampli-Check Flame Amp module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating flame strength. It is also used to identify the module number of the SLATE system.

Color	Description
Terminal T2	
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Selector Switch

The SLATE Burner Control Module is designed to operate with only one Flame Amplifier Module. The Flame Amplifier Module has a rotary switch on its back side which is factory set to 1. It must be set to 1 for the system to operate properly. See Fig. 2.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructionS.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Verify the Selector Switch is set to 1. See Fig. 2.

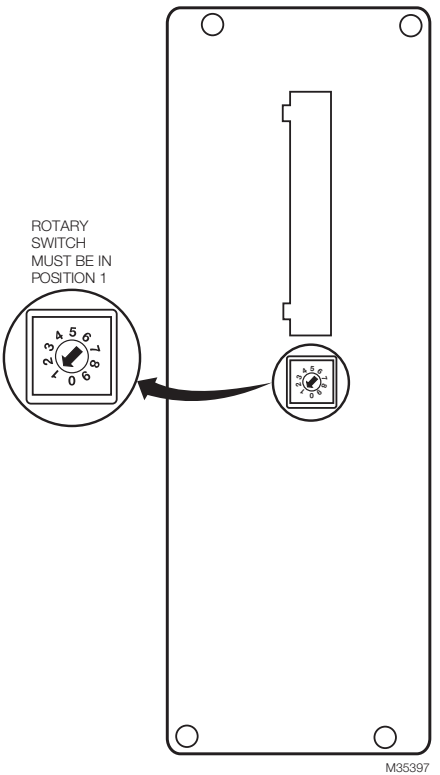


Fig. 2. Flame Amplifier Module Selector Switch.

3. Install the Flame Amplifier on the Sub-Base. See Fig. 3.

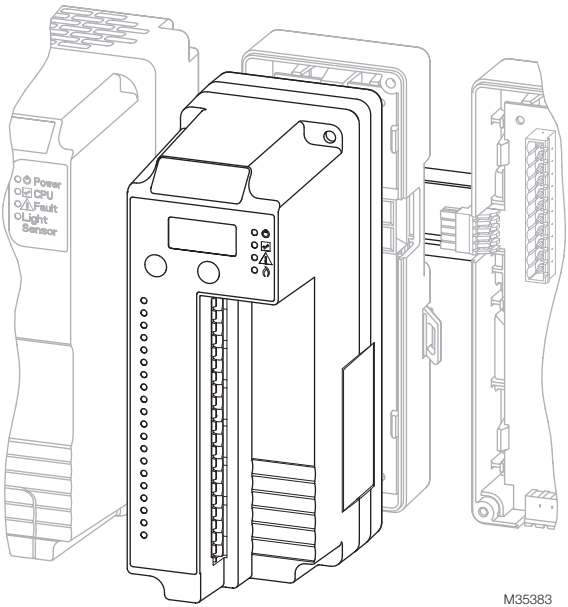


Fig. 3. Installing the UV Visible Ampli-Check Flame Amplifier on the Sub-Base Module.

IMPORTANT

1. *Wiring must comply with all applicable codes, ordinances and regulations.*
2. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
3. *The R8001F1091 should not interfere with the propersafety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.*

⚠ CAUTION

Equipment Damage Hazard.
Incorrect combination of relay module, amplifier and flame detector can cause equipment damage.

Installing the Flame Detector

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the Burner Control Module, then it must be externally wired to it via the remote bus connections.

Wiring

1. Refer to Fig. 4 for proper flame detector wiring.
2. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

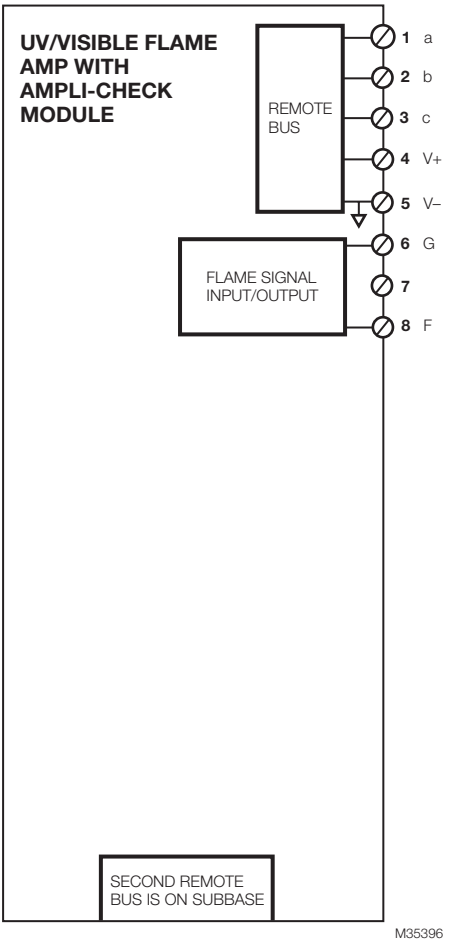


Fig. 4. R8001F1091 SLATE UV Visible Ampli-Check Flame Amplifier wiring.

3. All wiring must comply with appropriate electrical codes, ordinances and regulations including NEC Class 1 (Line Voltage) wiring where required.

4. Use recommended wire size and type no. 18 copper conductors TTW (60C) or THW (75C) or THNN (90C).

5. Use recommended wire routing:
   a. Keep the flame signal leadwire as short as possible from the detector to the SLATE module. The maximum permissible leadwire length depends on the type of leadwire, conduit type and leadwire diameter. The ultimate limiting factor for flame signal length is the flame signal voltage.
   b. Do not run high voltage ignition transformer wires in the same conduit with the flame detection wiring.
   c. If the flame detector leadwires are not long enough to reach the SLATE electrical connectors, make splices in a junction box.
      (1) Enclose scanner wiring without armor cable in metal cable or conduit.
      (2) Follow flame detector Instructions.

6. Check wiring, see Fig. 4.

Checkout

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminal screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus connector secured to SLATE Burner Control Module.
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

NOTE: R7824C, Series 2 or greater, pulse shutter when signal of 1.5 Vdc is sensed. Display readings of 0.7 to 2.4 Vdc are common.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the flame detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector wiring for defects including:
   - **a.** Incorrect connections.
   - **b.** Wrong type of wire.
   - **c.** Deteriorated wire.
   - **d.** Open circuits.
   - **e.** Short circuits.
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
3. For all optical detectors, clean the detector viewing window, lens, and inside of the sight pipe as applicable.
4. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:

   a. Add a heat block to stop conducted heat traveling up the sight pipe.
   b. Add a shield or screen to reflect radiated heat.
   c. Add cooling (refer to sight pipe ventilation in the detector Instructions).

5. Make sure that the flame adjustment is not too lean.

6. Make sure the optical detector is properly sighting the flame.

7. If necessary, resight or reposition the detector.

8. If you cannot obtain proper operation, replace the plug-in amplifier.

9. If you cannot yet obtain proper operation, replace the flame detector.

IMPORTANT

If you make any changes to the flame detection system, repeat all required Checkout tests in Checkout section of the Instructions for the applicable SLATE module.



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For more information and detailed instructions on the R8001F1091 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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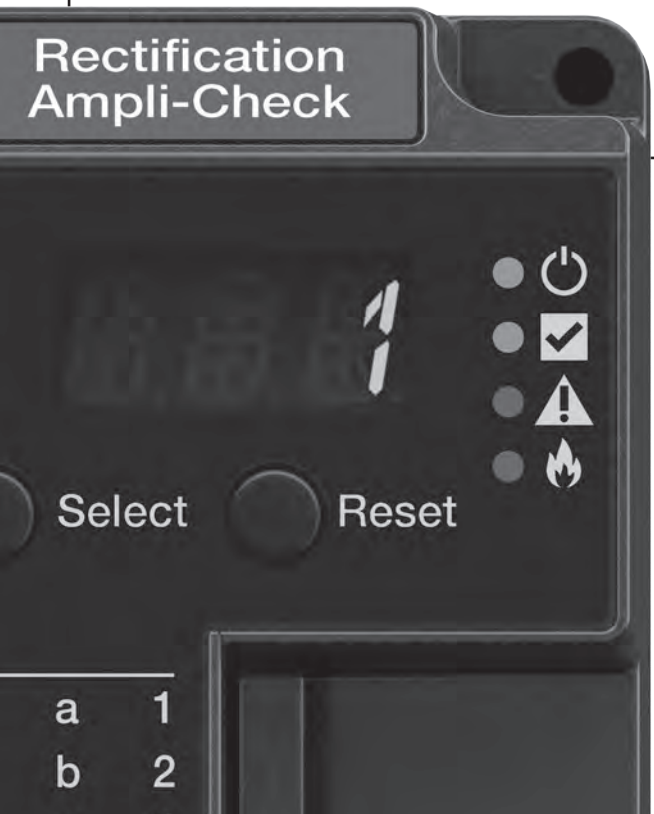
Honeywell

SLATE™

Rectification Ampli-Check Flame Amplifier

R8001V1031

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application—offering virtually limitless development opportunities with far less complexity.

The R8001V1031 Rectification Ampli-Check module responds to a rectified signal from a rectification type flame detector to indicate the presence of flame. This flame amplifier is used with the C7000X detector series.

Features

- Module display for flame signal strength
- 0.0 to 20.0 VDC flame signal strength reading range

Specifications

Electrical Ratings:
Base Voltage and Frequency
24 VDC (± 15%),
24 VAC (± 15%), 50/60 Hz,
85–264 VAC, 50/60 Hz

Environmental Ratings:
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C).

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 2 lb 1 oz (0.94 Kg)

Approvals

Underwriters Laboratories Inc. Listed, File: MP268
IRI Acceptable
Federal Communications Commission: Part 15, Class A
Must be mounted inside a grounded metal enclosure.

Mounting

DIN Rail (See Fig. 3)

Required Components

R8001A1001 Base Module
R8001S9001 Sub-base Assembly

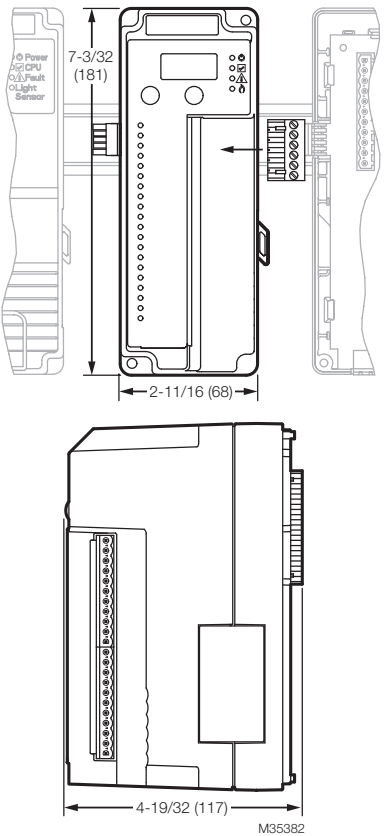


Fig. 1. Mounting dimensions of Rectification Ampli-Check Flame Amplifier in in. (mm).

Principal Technical Features

The R8001S1071 UV Ampli-Check module responds to a rectified signal from a rectification type flame detector to indicate the presence of flame. This flame amplifier is used with the C7027 and C7035 detector series.

LED Array

There are four LEDs on the front of the Ampli-Check Flame Amp module that provide quick identification of the system status and any problems that might occur. The status is broadcast to other modules on the platform bus in case they are affected by the inoperable modules. See Table 1 for descriptions.

LED	Color	Description
Power	No light	System does not have power
	Green	System has power
CPU	Red	No wire sheet or problem with the wire sheet
	Green	Running
Fault	Red	SLATE Burner Control Module has detected a fault
	No light	Running
Flame	Yellow	Weak flame is detected
	No light	No flame is detected

Table 1. LED Descriptions.

LED Display

The SLATE system modules have a seven-segment, three-position LED display used for indicating the module number of the SLATE system. The LED colors indicate the terminal state as shown in Table 2.

Color	Description
Terminal T2	
Green	Communicating with burner
Red	Communication fault
Terminal T8	
Green	Flame
Off	No flame

Table 2. Terminal LED Meanings.

Select and Reset Buttons

The SLATE system modules have Select and Reset buttons located on the front of the module and beneath the segment display. The Reset button is used to clear a lockout and reset the module. The Select button is used to scroll through the segment display information.

Selector Switch

The SLATE Burner Control Module is designed to operate with only one Flame Amplifier Module. The Flame Amplifier Module has a rotary switch on its back side which is factory set to 1. It must be set to 1 for the system to operate properly. See Fig. 2.

Installation

⚠ WARNING

Fire or Explosion Hazard
Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. After installation is complete, check out the product operation as provided in these instructions.
4. The SLATE module must be mounted in an electrical enclosure with adequate clearance for servicing, installation and removal of modules.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Verify the Selector Switch is set to 1. See Fig. 2.

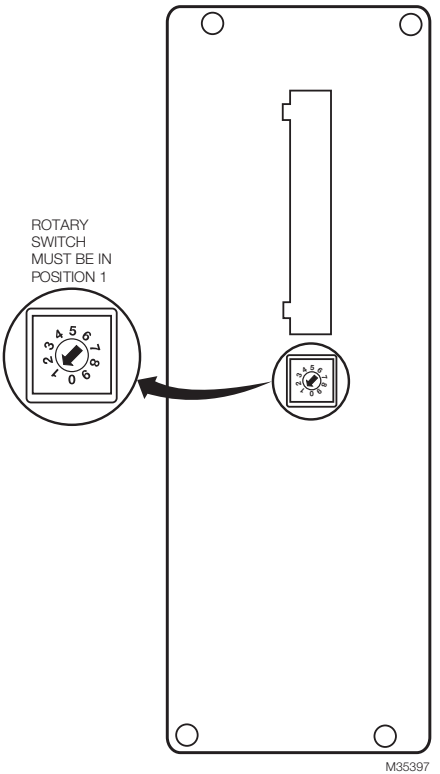


Fig. 2. Flame Amplifier Module Selector Switch.

3. Install the Flame Amplifier on the Sub-Base. See Fig. 3.

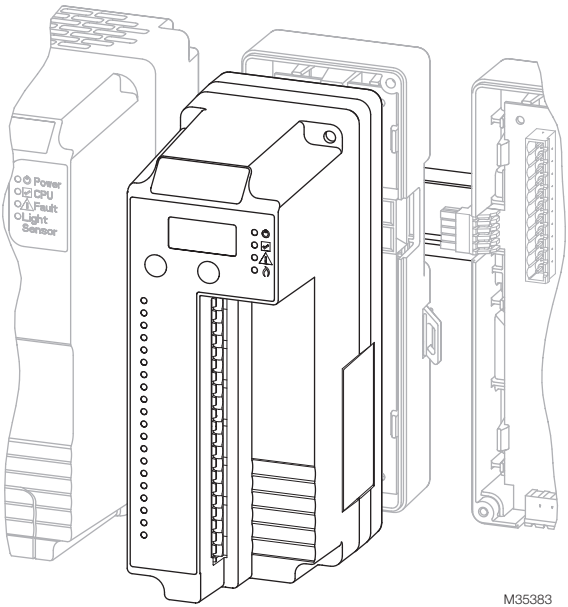


Fig. 3. Installing the Rectification Ampli-Check Flame Amplifier on the Sub-Base Module.

IMPORTANT

1. *Wiring must comply with all applicable codes, ordinances and regulations.*
2. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
3. *The R8001V1031 should not interfere with the propersafety operation of the controls, limits and interlocks it is monitoring. After installation, check each control, limit and interlock to ensure that it is operating properly. DO NOT PLACE JUMPER WIRES ACROSS THE INSTALLATION CONTROLS, LIMITS AND INTERLOCKS.*
4. *G terminal on the flame amplifier must be connected to earth ground.*

⚠ CAUTION

Equipment Damage Hazard.
Incorrect combination of relay module, amplifier and flame detector can cause equipment damage.

Installing the Flame Detector

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the SLATE system. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. However, the ultimate limiting factor for the flame detector leadwire is the flame signal.

If the flame amplifier is mounted on the DIN rail, it must be placed immediately to the right of the Burner Control Module that it is communicating with.

If the flame amplifier is not placed immediately to the right of the Burner Control Module, then it must be externally wired to it via the remote bus connections.

Wiring

1. Refer to Fig. 4 for proper flame detector wiring.
2. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

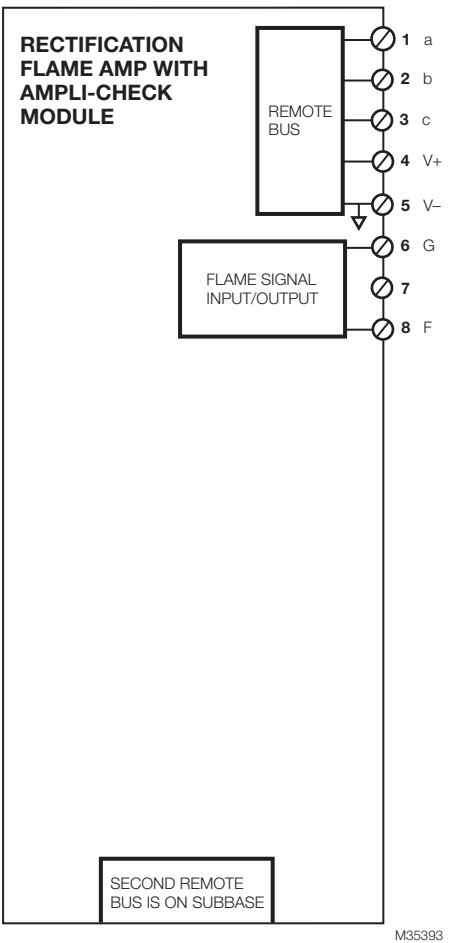


Fig. 4. R8001V1031 SLATE Rectification Ampli-Check Flame Amplifier wiring.

3. All wiring must comply with appropriate electrical codes, ordinances and regulations including NEC Class 1 (Line Voltage) wiring where required.

4. Use recommended wire size and type no. 18 copper conductors TTW (60C) or THW (75C) or THNN (90C).

5. Use recommended wire routing:
   - **a.** Keep the flame signal leadwire as short as possible from the detector to the SLATE module. The maximum permissible leadwire length depends on the type of leadwire, conduit type and leadwire diameter. The ultimate limiting factor for flame signal length is the flame signal voltage.
   - **b.** Do not run high voltage ignition transformer wires in the same conduit with the flame detection wiring.
   - **c.** If the flame detector leadwires are not long enough to reach the SLATE electrical connectors, make splices in a junction box.
     - **(1)** Enclose scanner wiring without armor cable in metal cable or conduit.
     - **(2)** Follow flame detector Instructions.

6. Check wiring, see Fig. 4.

Checkout

Preliminary Inspection

Make certain that:

1. Wiring connections are correct and all terminal screws and electrical connections are tight.
2. Proper flame failure response time is selected.
3. Amplifier is securely mounted on the DIN Rail and bus connector secured to SLATE Burner Control Module.
4. Detectors are properly positioned and cleaned according to Detector Instructions.
5. Correct combination of amplifier and flame detector is used.

NOTE: R7824C, Series 2 or greater, pulse shutter when signal of 1.5 Vdc is sensed. Display readings of 0.7 to 2.4 Vdc are common.

The flame signal for the pilot alone, the main burner flame alone, and both together must be steady and a minimum of 0.8V. If the flame signal is unsteady, or less than the minimum acceptable voltage, check the flame detector installation and circuitry in the following procedure.

1. Check the supply voltages. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency and is sinusoidal.
2. Check the detector wiring for defects including:
   - **a.** Incorrect connections.
   - **b.** Wrong type of wire.
   - **c.** Deteriorated wire.
   - **d.** Open circuits.
   - **e.** Short circuits.
   - **f.** Leakage paths caused by moisture, soot or accumulated dirt.
3. For a flame rod, make sure:
   - **a.** There is enough ground area.
   - **b.** The flame rod is properly located in the flame.
   - **c.** Temperature at the flame rod insulator is no greater than 500°F (260°C).

4. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:
   a. Add a heat block to stop conducted heat traveling up the sight pipe.
   b. Add a shield or screen to reflect radiated heat.
   c. Add cooling (refer to sight pipe ventilation in the detector Instructions).
5. Make sure that the flame adjustment is not too lean.
6. Make sure the optical detector is properly sighting the flame.
7. If necessary, resight or reposition the detector.
8. If you cannot obtain proper operation, replace the plug-in amplifier.
9. If you cannot yet obtain proper operation, replace the flame detector.

IMPORTANT

If you make any changes to the flame detection system, repeat all required Checkout tests in Checkout section of the Instructions for the applicable SLATE module.



32-00024-01

For more information and detailed instructions on the R8001V1031 and the entire SLATE system please refer to the SLATE User Guide located on our website at http://combustion.honeywell.com/SLATE

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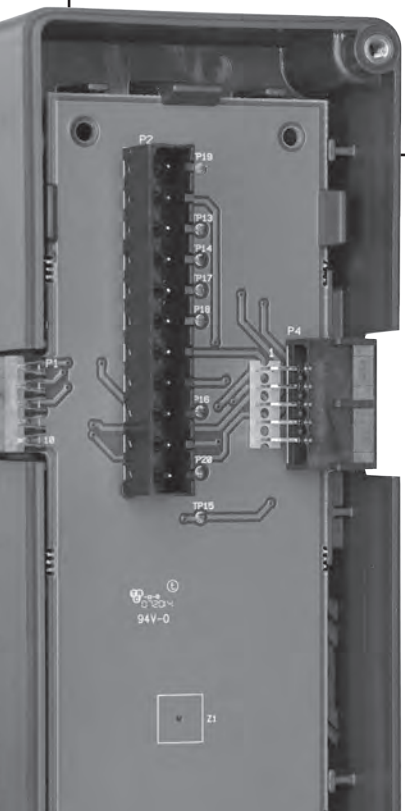
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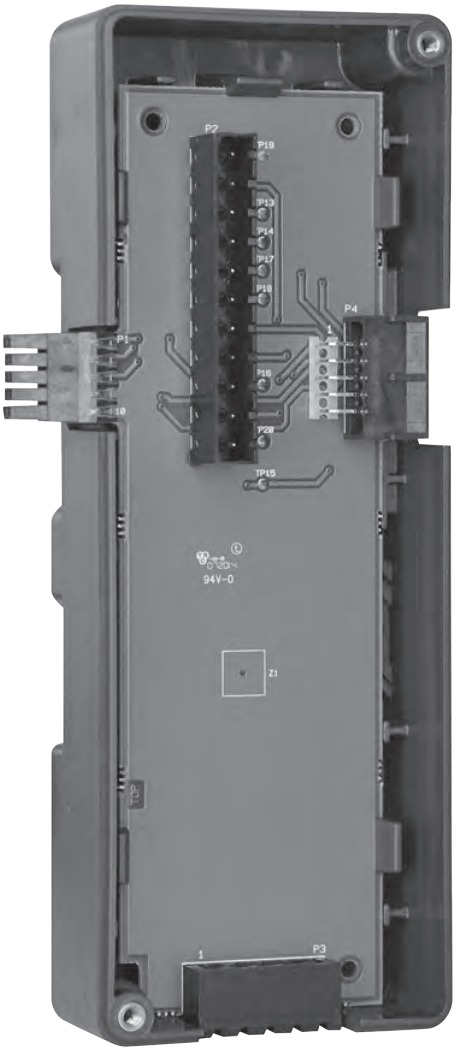
SLATE™

Sub-Base Module

R8001S9001

INSTALLATION INSTRUCTIONS





Scan for more information

Application

SLATE™ brings configurable safety and programmable logic together into one single platform. The platform can easily be customized for almost any requirement or application–offering virtually limitless development opportunities with far less complexity.

The R8001S9001 SLATE Sub-Base Module provides the ability for the SLATE system to be mounted via DIN Rail in a panel. All SLATE modules need this sub-base except for the SLATE Base Module.

Features

- Quick-mount to standard DIN-Rail
- Locking mechanism
- Provides bus connectivity to all modules
- Connections for remote mounted flame amplifiers (remote bus) and remote pushbutton reset

Specifications

Electrical Ratings:
Voltage and Frequency (from the Base): 18 VDC (± 1 VDC)
Maximum Total Connected Load: 2.5A
Terminal Ratings: See Table 1

Terminal	Description	Rating
1	18 V Power	2.5 A max including modules
2	18 V Ground	---
3	Remote Reset (Burner Control and Limit modules only)	Connect to Terminal 2 (18 V Ground) via external pushbutton

Terminal	Description	Rating
4	B (Remote Bus RS485)	Used for Remote mounted flame amplifiers
5	A (Remote Bus RS485)	Used for Remote mounted flame amplifiers

Table 1. Terminal Ratings.

Environmental Ratings
Ambient Temperature:
Operating: -20°F to +150°F (-29°C to +66°C).
Shipping: -40°F to +150°F (-40°C to +66°C)

Humidity: 95% continuous, noncondensing.
Vibration: 0.5G environment

Dimensions: See Fig. 1.

Weight: 5 oz (136 g)

Approvals
Underwriters Laboratories Inc. Listed, File: MP286
IRI acceptable.
Federal Communications Commission: Part 15, Class A Emissions.

Mounting
DIN Rail (See Fig. 3)

Required Components
R8001A1001 SLATE Base Module
Any other SLATE modules
Optional 5-position terminal block for remote flame amplifier or remote reset button connections (Phoenix Contact p/n 1754504 or equivalent). See Fig. 2.

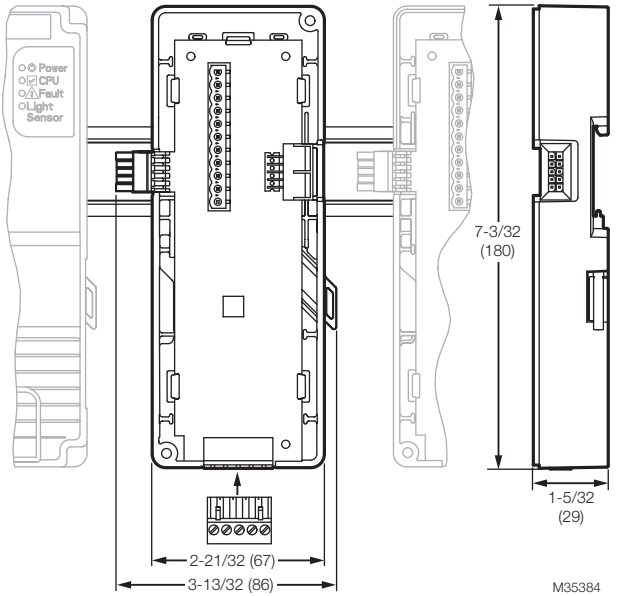
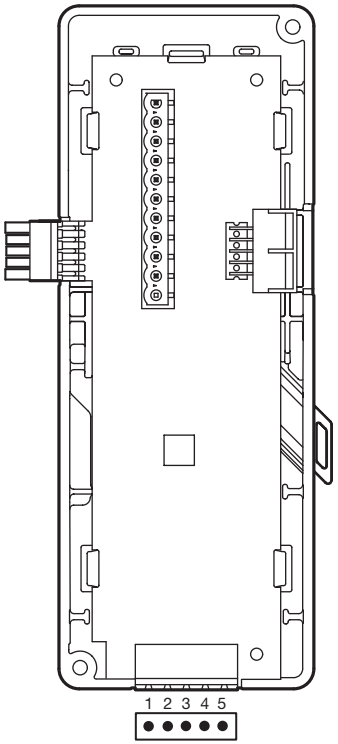


Fig. 1. Dimensions in in. (mm).



TERMINAL	DESCRIPTION
1	18V POWER
2	18V GROUND
3	REMOTE RESET (BURNER CONTROL AND LIMIT MODULES ONLY)
4	B (REMOTE BUS RS485)
5	A (REMOTE BUS RS485)

M35430

Fig. 2. Sub-base module wiring terminals.

Installation

⚠ WARNING

Fire or Explosion Hazard Can cause severe injury, death, or property damage.

Verification of safety requirements must be performed each time a control is installed on a burner to prevent possible hazardous burner operation.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.

Mounting

1. The sub-base module can be mounted on type C 20 DIN rail.
2. Mount the sub-base module first. The sub-base has locking mechanisms on both sides of the module. Pull to unlock position. See Fig. 3.

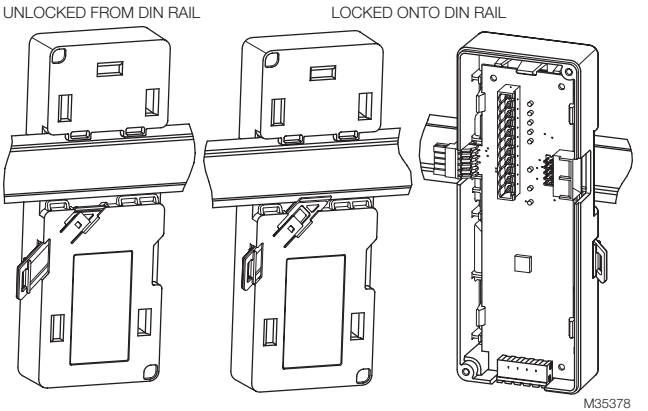


Fig. 3. Sub-base locking mechanisms.

3. Slide sub-base on the DIN rail and lock into place.

4. When securing subsequent sub-base modules make sure communication ports are aligned and locked into place. See Fig. 4.

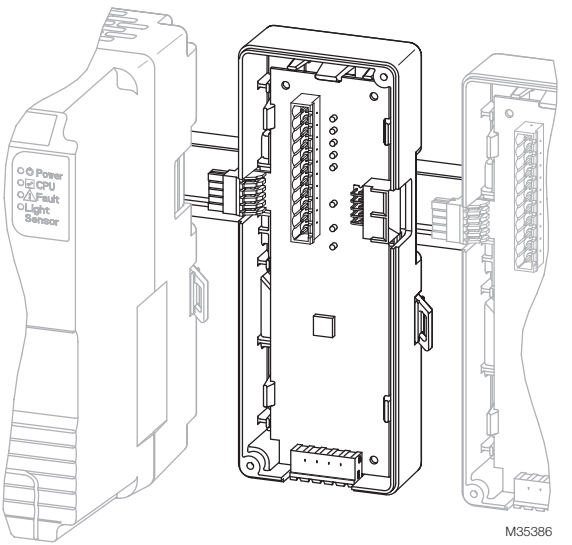


Fig. 4. Connecting additional sub-base modules.

5. After securing the sub-base module, snap the SLATE module into place and secure the module to the sub-base using screws (included with SLATE module).

Wiring

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or equipment damage.

1. Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power supply disconnect can be involved.
2. Wiring must comply with all applicable codes, ordinances and regulations. See Fig. 2.
3. Wiring must comply with NEC Class 1 (Line Voltage) wiring.

Application	Recommended Wire Size	Recommended Part Numbers
Communication Lines	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Other terminals	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C

Table 2. Recommended Wire Sizes and Part Numbers.

IMPORTANT

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference for radio communications. It has been tested and found to comply with the limits of a Class A computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference

when operated in a commercial environment. Operation of this equipment in a residential area may cause interference; in which case, the user, at their own expense, may be required to take whatever measures are required to correct this interference.

1. *This digital apparatus does not exceed the Class A limits for radio noise, set out in the Radio Interfeence Regulations of the Canadian Department of Communications.*
2. *Cable shield must be terminated to ground at both ends. If shielded cable is NOT used, use three-wire twisted cable.*

Recommended Grounding Practices

Use an Earth ground or a signal ground as described below.

Earth Ground (Base, Rectification Flame Amp Module, Other Modules Optional)

1. Use to provide a connection between the base and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the breaker in the event of an internal short circuit.
2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.
3. Verify that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Signal ground

Note the 18 V system ground is not electrically connected to earth ground. Follow local codes and appliance recommendations to determine if this should be connected to earth ground.

Recommended Routing of Leadwires

- Do not run high voltage ignition transformer wires in the same conduit with the flame detector or data lines.
- Do not route flame detector or data lines in conduit with line voltage circuits.

- Enclose flame detector leadwires without armor cable in metal cable or conduit.
- Follow directions in flame detector instructions.

Be sure loads do not exceed the terminal ratings. Refer to the labels or terminal ratings in Table 1.

The SLATE system must be mounted in an electrical enclosure. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation, and removal of SLATE modules.

Maximum Wire Length

- The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock)
- For remote reset leadwires, maximum length to remote pushbutton is 1000 feet.
- For remote bus data lines, maximum cable length depends on the number of modules connected, the noise conditions, and the cable used. The maximum of all interconnecting wires is 4000 feet.



32-00025-01

For more information and detailed instructions on the SLATE display please refer to the SLATE User Guide document located on our website at http://combustion.honeywell.com/SLATE

Honeywell

Automation and Control Solutions

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Honeywell SLATE ICM Platform
Submittal Specification

Note to specifiers: To specify Honeywell SLATE™ Integrated Combustion Management System with specified packaged boiler manufactures, "Copy and Paste" both Items 1.2 and 2.3 in project MasterSpec specification.

23 52 00 HEATING BOILER
23 52 23 CAST-IRON BOILERS
23 52 33 WATER-TUBE BOILERS
23 52 39 FIRE-TUBE BOILERS

PART 1 GENERAL

1.1 SUMMARY

1.2 RELATED SECTIONS

A. SECTION 23 09 13.33 – Control Valves

B. SECTION 23 09 13.43 – Control Dampers

C. SECTION 23 09 23 – Direct-Digital Control Systems for HVAC

D. SECTION 23 09 33 – Electric and Electronic Control Systems for HVAC

E. SECTION 23 09 93 – Sequence of Operations for HVAC Controls

F. SECTION 25 55 00 – Integrated Automation Control of HVAC

G. SECTION 25 95 00 - Integrated Automation Control Sequences for HVAC

PART 2 PRODUCTS

2.1 MANUFACTURES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MFR_1
2. MFR_2
3. MFR_3

Note to specifiers: Depending on the project configuration and requirements, and fuel options, a wide range of manufactures and models of packaged boilers can be specified. Cast-Iron boilers in commercial applications are employed. Firetube boilers in commercial, institutional, and industrial applications; both watertube and firetube units are employed.

2.2 CONSTRUCTION

A. Description: The boiler shall be factory-fabricated, factory-assembled and factory-tested, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return connections, and an integrated combustion management system. The combustion management system shall combine configurable safety and programmable logic ancillary control into a singular control platform in a modular format. Power burner shall have full modulation. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Unit to be ready for automatic operation except for connection of piping, fuel, electrical, chemical, and vent.

B. Pressure Vessel Design:

C. Heat Exchanger:

D. Modulating Fuel Valve:

E. Blower:

1. Motors:

a. Motor Sizes:

F. Ignition:

Note to specifiers: To specify Honeywell SLATE™ Integrated Combustion Management System with specified packaged boiler manufactures, "Copy and Paste" both Items 1.2 and 2.3 in project specification.

2.3 BOILER /BURNER CONTROLS

A. Description: The boiler /burner integrated combustion management system shall provide automatic boiler sequencing, circulation pump control, fan control, electronic ignition, flame supervision, system status indication, firing rate control, load control, central heating /domestic hot water control, limit control, system or self-diagnostics, and communications interface for a display, other network devices, Building Automation System, industrial control system, or to all simultaneously.

B. The control panel shall be factory pre-wired supplied with each boiler /burner unit. . The panel shall consist of an array of modules implementing a singular controller; **Honeywell SLATE™ Integrated Combustion Management System**, programmed at the OEM production facility. The control panel shall be mounted on the boiler, Base Module with light sensor backlit LCD screen local Operator Interface for monitoring and setpoint adjustments of the individual boiler.

C. The integrated combustion management system shall provide options and advanced system functions, configurable safety and programmable logic using NiagaraAX wire sheet editor Framework™, that allow standard and customizable control solutions.

D. Singular control platform modules:

1. Base module shall provide:
    a. Storage of data for device configuration and control program initialization.
    b. Backlit LCD screen with light sensor, local Operator Interface for monitoring and setpoint adjustments of the individual boiler.
    c. Power supply for all modules with multiple voltage options.
    d. Real time clock.
    e. Event log storage for lock-outs, fault history, and OEM requested events.
    f. Trend logging for OEM specified data.
    g. Network identification of the system as singular device.
    h. External communication 10BASE-T for Ethernet IP and /or RS485.
    i. Web services for direct browser access to the system, both Honeywell provided and designer customized pages, based on JavaScript, such as implemented Google Chrome™ and supports HTML5.

2. Burner Control module shall provide:
    a. Configurable safety.
    b. Flame safeguard control, 24 VDC or 24 to 240 VAC, primary or programmer, semi-automatic or fully automatic.
    c. Valve proving.
    d. Dual fuels capability.

3. Flame Amplifier modules shall provide:
    a. Signal from flame detector to indicate CE[e1] presents presence[MB(2] of flame, operated by Burner Control "parent" safety module.
    b. Display for flame signal strength.
    c. DIN rail or remote mounting.

4. Fuel Air Ratio Control module provides:

a. Relational control between fuel, airflow, and flue gas recirculation for the power burner.

b. Parallel-positioning control of up to four SLATE™ actuators and /or two variable frequency drives, up to (24) point curve with no slope constrains that would limit the steepness of the curve.

c. Control of RS-485 ModBus communications to communicate to the SLATE™ actuators and receive feedback (torque sizes: 50, 150, 300, 900 in/lb in-lb) with component anti-swap protection.

d. Curve verification and off curve checking algorithms.

e. Dual fuels capability.

f. O2 Trim control, or other flue gas constituents or temperatures.

5. Limit module shall provide:

a. The capability to directly receive any type of analog signal to create limits on either pressure or temperature or other, without requiring a UDC controller.

b. Four analog sensor cells, single input or two sets of redundant inputs.

c. Twelve limit blocks, with each block monitoring any sensor or pair of sensors.

d. Redundant relay output.

6. Analog I/O module shall provide:

a. Analog input and output capability for all combustion and ancillary control applications.

b. Multiple combination of analog functionality for each cell.

c. Four analog cells, with up to (12) signal inputs and outputs.

d. The capability to support voltage, resistance, current, PWM, Tachometer, Type J and K Thermocouples, RTD, Bridge and 3-wire NTC sensors.

e. The capability to configure inputs and outputs as 0-10 VDC and /or 4-20mA voltage, current, or PWM signals.

7. Digital I/O module shall provide:

a. Digital input and output capability for all combustion and ancillary control applications.

b. Universal I/O inputs configurable in multiple combination up to (14) optical inputs or (6) relay outputs.

c. Automatic adaptation to 24VDC or 24VAC to 240VAC.

8. Annunciator module shall provide:

a. Status monitoring of a series string of limit, control, and /or interlock contacts for diagnostic of a commercial or industrial burmer.

b. One relay output.

c. Automatic adaptation to 24VDC or 24VAC to 240VAC.

E. The platform shall be identified as a single network device, supporting communications protocols:

1.	BACnet /IP	-via 802.3i 10BASE-T.
2.	BACnet /MSTP	-via RS-485.
3.	Modbus RTU /TCP IP	-via 802.3i 10BASE-T.
4.	Modbus RTU /485	-via RS-485.
5.	Web Browser access (httpd)	-via 802.3i 10BASE-T

F. The platform shall provide a web-based user interface. The color touch screen display shall be Honeywell R8001K5001. ***(Where Shown on Drawings)*** provide a web-based user interface for viewing system status, and viewing, creating, or modifying configurations. ***(Where Shown on Drawings)*** The color touch screen display shall be:

1. Honeywell R8001K5001.
2. Third-party panel PC[e3][MB(4)].
3. Tablet or SmartPhone

G. Multiple Boiler Management: The OEM shall factory configure the Honeywell SLATE™ Integrated Combustion Management System for Lead /Lag Master Operation of a multiple boiler heating plant. The system shall be configured with all components of the system listed as products of a single manufacturer under the appropriate category by the Underwriter's Laboratories, Inc. and in accordance with the appropriate CSD-1 sections. System shall be commissioned by a factory authorized representative or supplier/installer with factory trained personnel.

H. Operational Sequence:

1. Shall comply with requirements specified in Section 23 09 93 Sequence of Operations for HVAC Controls.
2. Shall comply with requirements specified in Section 25 95 00 Integrated Automation Control Sequences for HVAC.

I. SLATE™ Building Automation System Integration: EachThe system shall function as a single network device respondingdevice responding to a single address, or be comprised of multiple SLATE™ systems may controllers, communicatecommunicating "peer to peer" via Modbus™ BACnet™/-MSTP and/or BACnet/t™ IP communication protocols.:

1. Shall comply with requirements specified in Section 23 09 23 Direct Digital Control System for HVAC.

2. Shall comply with requirements specified in Section 25 55 00 Integrated Automation Control of HVAC.

J. Building Automation System Interface: The system shall function as a single network device responding to a single address or be comprised of multiple SLATE™ controllers, communicating via Modbus/RS485 or BACnet/MSTPs™ and/or Modbus/TCP, BACnet/IP and/or HTTP™ communication protocols:

1. Shall comply with requirements specified in Section 23 09 23 Direct-Digital Control System for HVAC.
2. Shall comply with requirements specified in Section 25 55 00 Integrated Automation Control of HVAC.

2.4 ELECTRICAL POWER

A. .

B. .

2.5 VENTING

A. .

B. .

2.6 SOURCE QUALITY CONTROL

A. .

B. .

PART 3 EXECUTION

3.1 EXAMINATION

A. .

B. .

3.2 BOILER INSTALLATION

A. .

B. .

3.3 CONNECTIONS

A. .

B. .

3.4 FIELD QUALITY CONTROL

A. .

B. .



YANMAR

35 kW mCHP

FROM YANMAR ENERGY SYSTEMS

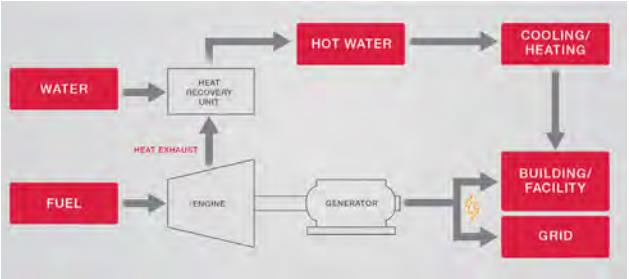
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770.877.9894
esmarketing@yanmar.com
www.yanmar-es.com

CP35D1



Using natural gas, the CP35D1's high-efficiency generator provides 35 kW of electrical power. The engine heat is captured and heats water at a rated temperature of 176°F for immediate use or storage in your facility. Excess electricity production may be sold back onto the grid in certain states, creating a credit on your electric bill.

CHP Basic Flow



Standard Model			CP35D1-TNUG
Blackout Start Model			CP35D1Z-TNUG
Power	Output	Rated Output	35 kW
		Voltage	208V, 60Hz
		Phases/Wires	Three phase, 3 wire
Fuel	Gas type		Natural gas
	Pressure	Standard	9 in WC (2.25 kPa)
		Range	8 -10 in WC (2 - 2.5 kPa)
	Consumption (LHV)		367,487 BTU (107.7 kW)
			3.67 therms/hr
	Consumption (HHV) (*1)		407,114 BTU (119.3 kW)
			4.07 therms/hr
Heat output	Rated recovered heat		204,040 BTU/h (59.8 kW)
	Rated hot water temp.	Inlet	167°F (75°C)
		Outlet	176°F (80°C)
	Rated hot water flow rate		43 GPM (164 L/min)
	Maximum hot water temp. (Outlet)		190°F (88°C)
Input power	Voltage, Frequency		208V, 60Hz
	Starting current		46 A
	Power consumption	Radiator fan stop	0.72 kW (standard) 0.75 kW (blackout start)
		Radiator fan run	0.97 kW (standard) 1.00 kW (blackout start)
Gross Efficiency (LHV)	Overall efficiency		88%
	Electrical generation efficiency		32%
	Exhaust heat recovery ratio		55%
Sound level	Radiator fan stopped		62 dB (A)
	Radiator fan operating		64 dB (A)
Dimensions	Width		78.7 in (2,000 mm)
	Depth		31.5 in (800 mm)
	Height		76.9 in (1,995 mm)
	Net weight		3,153 lb (1,430 kg) (standard) 3,196 lb (1,450 kg) (blackout start)
Maintenance Interval			7,500 hrs
Standard Warranty			2 Years; Unlimited Hours
YES Product Protection	10 Years / 30,000 hrs		Optional
	10 Years / 60,000 hrs		Optional
Emissions & Certifications			EPA Certified UL2200 Certified CSAC22.2 No 14-13 Certified CSAC22.2 No 100-04 Certified UL1741/IEEE1547 Certified

*1: Natural gas calculations for fuel consumption are based on converting LHV to HHV: LHV= 983 BTU/scf, HHV = 1,089 BTU/scf

CHP EPA COMBINED HEAT AND POWER PARTNERSHIP

Intertek

NOTE: Due to YANMAR's ongoing commitment to quality, specifications, ratings and dimensions subject to change without notice. Improper installation, adjustment, alteration, service or maintenance can cause property damage or personal injury. Installation and service must be in accordance with current specifications, ratings and dimensions and be performed by a qualified installer and servicing agency.

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E16YMESPC05

commercial economizers

A smart way to save on your commercial refrigeration costs.

ENERGY STAR PARTNER

IntelliCon®-RU

Commercial Refrigeration Unit Electrical Consumption Economizer



The IntelliCon®-RU will reduce electric consumption—typically 10% to 20%—when installed on commercial refrigeration/freezer (refrigeration) systems. IntelliCon-RU using intelligent Dynamic Cycle Management (DCM) Technology represents a major advancement in refrigeration system energy-saving technology, unsurpassed in today's commercial refrigeration marketplace. IntelliCon-RU is easily installed by a qualified installer, maintenance free and guaranteed to save energy.

Features

- Dynamic Cycle Management (DCM) Technology reduces air conditioning electric consumption—typically 10% to 20%
- UL listed, "Energy Management Equipment"
- Increased savings without replacing or upgrading costly system components
- "State-of-the-art" microprocessor-based control—LED indicators show operating modes
- Compatible with Intellidyne System 12
- Protects compressor against momentary power outages and short cycling
- Simple installation by a qualified HVAC/R installer
- No programming or follow-up visits required
- Maximum year-round efficiency
- Reduces maintenance and extends compressor life
- Fail-safe operation
- Guaranteed to save energy
- 15-year replacement warranty for breakdowns or defects

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www.intellidynellc.com

Intellidyne®

FEATURING DCM TECHNOLOGY

IntelliCon®-RU

Commercial Refrigeration Unit Electrical Consumption Economizer

Specifications

Mounting:
Any position via molded-on 1/2" Electrical Fitting

Size:
4"H x 4" W x 2 1/2"D

Operating Humidity:
5% - 95% Non-Condensing

Operating Temperature Range:
-10°F - +120°F

Power Input:
24/115/220 VAC @ 5W

Control Circuit:
24 VAC/DC, 115/220 VAC

Relay Contact:
10A @ 220VAC General Purpose

UL Listed,
"Energy Management Equipment"

Made in U.S.A.

The *IntelliCon®-RU* is a microprocessor-based, UL listed, electronic control that automatically adjusts the compressor cycles to achieve the greatest efficiency and reduced electrical usage. The sizing of refrigeration systems is based upon a number of factors. When any of the design considerations are not met, the refrigeration system can become oversized for the load and thus less efficient.

Intellidyne's intelligent Dynamic Cycle Management (DCM) Technology analyzes the demands and thermal characteristics of the entire refrigeration system, and dynamically modifies the compressor cycle pattern. These new patterns result in less frequent and more efficient compressor cycles. Just as computer control has increased the gas mileage of automobiles, *IntelliCon-RU* improves the electrical efficiency of refrigeration systems, by supplementing the antiquated on/off action of the thermostat or pressuretrol with the analysis and control capabilities of a computer.

The *IntelliCon* DCM Technology "intelligent modification of compressor cycling" will result in significant electrical energy savings. *IntelliCon's* innovative and intelligent algorithms have field proven electrical savings not only on properly sized and operating systems, but also on units that were undersized or those that had not been properly maintained.

The *IntelliCon-RU* works in conjunction with the existing temperature controls and will not void the compressor manufacturer's warranty. An additional feature of the *IntelliCon-RU* is the accepted industry practice of compressor anti-short-cycling control.

Installation by a qualified HVAC/R service technician is recommended. The *IntelliCon-RU* does not require any programming, adjustments or maintenance.

commercial economizers

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Verdiem®
by Aptean

The Leader In IT Energy Managment and Efficiency

TAKE CONTROL OF YOUR PC & PRINTER FLEETS

Verdiem uniquely monitors end user computing and print devices and provides IT with actionable data to increase efficiency and reduce costs, 30% or more. Verdiem also delivers a 90%+ success rate in waking up PCs for patches and other software updates.

GUARANTEED SOFTWARE UPDATE SUCCESS

- Enhanced Wake-on-LAN that requires no router or security changes
- Automatically elects proxies across all subnets
- Integrates with SCCM, automatically monitoring for advertisements
- Overcome Windows sleep disorders, ensuring PCs will properly wake-up, sleep, or shutdown
- Run system maintenance applications and reboot systems from a central console
- Automate custom processes when systems wake or before being put to sleep
- Report system health information

END USER PRINT OPTIMIZATION

- Inventory of printer makes and models
- Print volumes by department, location, users, and printer model
- Prescriptive guidance & cost savings on printers via elimination /shift to lower cost printers

"…if you're a Microsoft shop and you use Active Directory and Configuration Manager for deployments, Verdiem integrates both components seamlessly and we were extremely impressed with how we could leverage our existing implementations of both Active Directory and System Center Configuration Manager to deploy and then manage Verdiem."

"…because Verdiem allows us to remotely wake PCs with a simple website, we've actually solved a major help desk and support problem that we've had. People are actually able to turn their PCs on from home remotely and then able to do work off-line off-hours. So that was a very unforeseen benefit."

- Ryan Harvey,
Manager Design & IT,
University of Pittsburgh Medical Center

Verdiem®
by Aptean

The Leader In IT Energy Managment and Efficiency

BASIC PC POWER MANAGEMENT CAPABILITIES	SCCM '12	VERDIEM
Centralized Control and Administration	✓	✓
Collection-based Policies	✓	✓
Support for Simple Power Policies	✓	✓
Basic Usage and Savings Reporting	✓	✓
Support for Windows (XP, Vista, Windows 7 & 8)	✓	✓
Sleep, Hibernate, Shutdown	✓	✓
Display Standby	✓	✓
Active Directory Integration	✓	✓

REQUIRED ENTERPRISE CAPABILITIES	SCCM '12	VERDIEM
Proven Network Proxy Driven Wake-On-WAN		✓
Supports Wake-on-Web for Remote User Access		✓
Print Resource Analytics		✓
Auto Synchronization of Wake and Updating		✓
One-Click PC Sleep Disorder Resolution		✓
Real-time Control of PC Power States		✓
Executive-Level Sustainability Dashboard		✓
Multiple Intraday Power Policies		✓
Graceful Shutdown of Open Applications/Data		✓
Historical Data Retention and Advanced Reporting		✓
Support for Mac OS		✓
API Driven Tools for Enterprise Automation		✓
Location-based Utility Rate Driven Reporting		✓
Support wake-up for 802.1X networks		✓
Identifies wasted/unused systems with analytics		✓

Verdiem®
by Aptean

EFFICIENCY, SAVINGS AND CONTROL

The clear and practical choice for enterprise wake and PC power management.

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Verdiem is a registered trademark of Aptean Systems, LLC.



Aptean Verdiem Surveyor

Power Management for Microsoft and Mac

As a power management solution for PCs, Macs, and Windows tablets, Aptean Verdiem Surveyor provides a unified approach for IT device data collection, policy management, administration, and analytics. Surveyor offers the most accurate approach to energy management and measurement and can reduce your IT energy costs up to 60%.

Optimize Savings and Improve Energy Efficiency

Surveyor helps accurately measure computer and tablet energy consumption, allowing you to enforce policies for greater energy efficiency and optimize savings.

Surveyor delivers three IT efficiency solutions in a single integrated product:

- **PC Power Management** – Reducing PC energy usage starts with establishing a baseline of current energy usage data. Surveyor automatically detects and groups devices to capture accurate energy usage data and leverages the data to reduce power consumption.
- **Enterprise PC Wake** – Surveyor reliably wakes the PC fleet for security updates and patch management.
- **End User Print Analytics** – Uniquely monitor end user print activity and compile actionable data for devices and the people who use them.

Learn More

To learn more, contact your Account Manager or email us at **info@aptean.com**.

Benefits

- Improve security and compliance by achieving 95%+ wake success for patching
- Increase energy savings by an additional 30-60%
- Reduce IT labor and costs
- Streamline the administration of endpoint devices
- Enhance analytics capabilities with exhaustive reports that use the very detailed data collected on energy usage, savings opportunities and underutilized devices

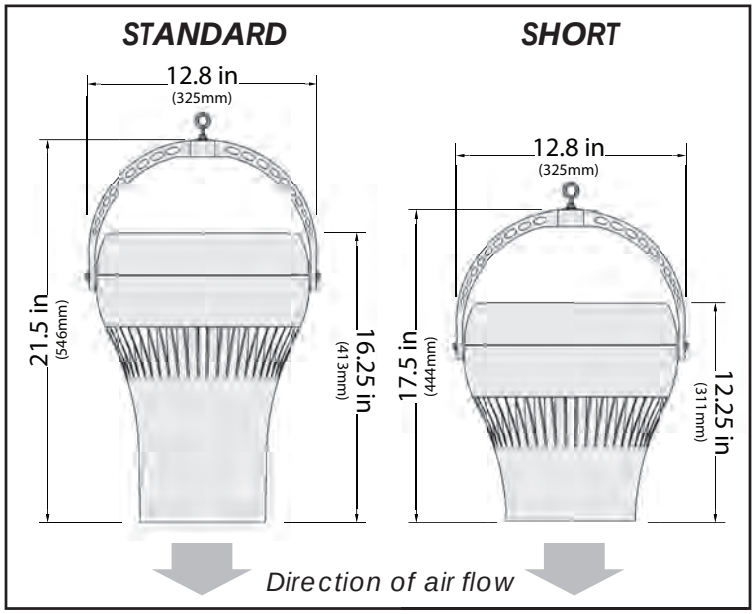
AIR PEAR 25-SP DESTRATIFICATION FAN SUBMITTAL

SPECIFICATION SECTION: 23 34 00 - HVAC FANS

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	**dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
A-25-SP	120	50/60	0.30/0.32	30/35	1500/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-SP	230	50/60	0.14/0.13	31/33	1450/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-SP	277	50/60	0.13/0.17	35/45	1500/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²

*0-static motor data supplied by fan manufacturer. Subject to change at any time.

**Sound pressure level at 3 feet. Sound Power Level 58 dB(A), designed to meet ISO 3744 – engineering grade precision for determining sound power.



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
A (Air Pear)	25	SP (Shaded Pole)	(Short) SH (Standard) STD	120 230 277	(Off White) W (Gray) G (Black) B

EXAMPLE: A - 25 - SP - **STD - 120 - W**

- **Color**
- **Voltage (AC)**
- **Nozzle Length**
- Motor Type
- Model
- Style

DESTRATIFICATION FAN DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season.

CERTIFICATION: *Conforms to UL-507, CAN/CSA C22.2#60335-1, UL 94 5VA and is ETL listed in USA and Canada.*

HOUSING: *PC/ABS resin, 5VA flame resistance rating*

MOTOR: *Single phase, shaded pole, single speed (variable with optional speed control), axial motor. Motor is thermally protected. Operating temperature: -4˚ F (-20˚ C) to 158˚ F (70˚ C). No lubrication required. Bearings are sealed. 6' cord and plug provided for 120V, no plug for 230V.*

STATOR: *Patented multi-vane stator significantly increases air throw for maximizing performance. PC/ABS.*

SAFETY CABLE: *6' length steel cable (fastened to body)*

WARRANTY*: Warranty - 3-years parts and workmanship. Money back guarantee - 30 days. Refurbish program after 3-year warranty period.*

FACTORY INSTALLED OPTIONS:

Item #	Description	Qty
PHI-9-C	Factory installed 9 in. PHI cell	
PHI-5-C	Factory installed 5 in. PHI cell	
GUARD25	Silver intake grille	

ACCESSORIES *(additional costs apply)*

Speed Control *(coordinate w/ electrical requirement)*

Item #	Description	Qty
TRIAC-120-1.5	120VAC, 1.5A wall mounted speed control	
TRIAC-120-5	120VAC, 5A wall mounted speed control	
TRIAC-120-15	120VAC, 15A wall mounted speed control	
TRIAC-230-8	230VAC, 8A wall mounted speed control	
TRIAC-277-5	277VAC, 5A wall mounted speed control	
TRIAC-SMART-7.5	95-250VAC, 7.5A, electrical box speed control	

COLOR OPTIONS:

"Off White" Cool Gray 2C *"Gray" Gray 432C* *Black*

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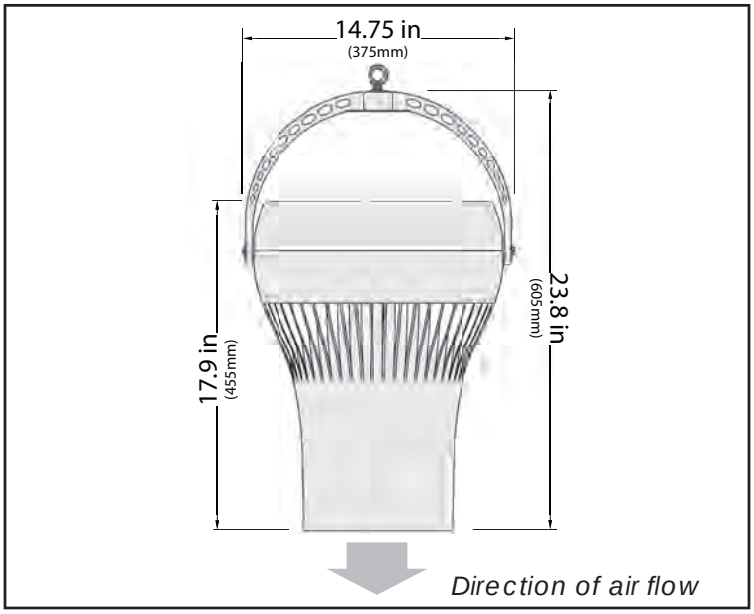
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AIR PEAR 45-P4 DESTRATIFICATION FAN SUBMITTAL

SPECIFICATION SECTION: 23 34 00 - HVAC FANS

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	**dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
A-45-P4	120	50/60	0.40/0.41	44/46	1400/1650	595/715	54	14 lb	Up to 38 ft.	Up to 1200 ft²
A-45-P4	230	50/60	0.19/0.2	42/45	1450/1630	595/707	54	14 lb	Up to 38 ft.	Up to 1200 ft²
A-45-P4	277	50/60	0.19/0.2	42/45	1450/1630	595/707	54	14 lb	Up to 38 ft.	Up to 1200 ft²

*0-static motor data supplied by fan manufacturer. Subject to change at any time.
**Sound pressure level at 3 feet. Sound Power Level 66 dB(A), designed to meet ISO 3744 – engineering grade precision for determining sound power.



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
A (Air Pear)	45	P4 (permanent split capacitor)	(Standard) STD	120 230 277	(Off White) W (Gray) G (Black) B

EXAMPLE: A - 45 - P4 - STD - **120 - W**

- **Color**
- **Voltage (AC)**
- Nozzle Length
- Motor Type
- Model
- Style

DESTRATIFICATION FAN DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season.

CERTIFICATION: Conforms to UL-507, CAN/CSA C22.2#60335-1, UL 94 5VA and is ETL listed in USA and Canada.

HOUSING: PC/ABS resin, 5VA flame resistance rating

MOTOR: Permanent Split Capacitor, single speed (variable with optional speed control), axial motor. Motor is thermally protected. Operating temperature: -13˚ F (-25˚ C) to 158˚ F (70˚ C). No lubrication required. Bearings are sealed. 6' cord and plug provided for 120V, no plug for 230/277V

GUARD GRILLE: Steel, phosphated and coated in black plastic

STATOR: Patented multi-vane stator significantly increases air throw for maximizing performance. PC/ABS.

SAFETY CABLE: 6' length steel cable (fastened to body)

WARRANTY: Warranty - 3-years parts and workmanship. Money back guarantee - 30 days. Refurbish program after 3-year warranty period.

FACTORY INSTALLED OPTIONS:

Item #	Description	Qty
PHI-9-C	Factory installed 9 in. PHI cell	

ACCESSORIES (additional costs apply)

Speed Control (coordinate w/ electrical requirement)

Item #	Description	Qty
TRIAC-120-1.5	120VAC, 1.5A wall mounted speed control	
TRIAC-120-5	120VAC, 5A wall mounted speed control	
TRIAC-120-15	120VAC, 15A wall mounted speed control	
TRIAC-230-8	230VAC, 8A wall mounted speed control	
TRIAC-277-5	277VAC, 5A wall mounted speed control	
TRIAC-SMART-7.5	95-250VAC, 7.5A, electrical box speed control	

COLOR OPTIONS:

"Off White" Cool Gray 2C

"Gray" Gray 432C

Black

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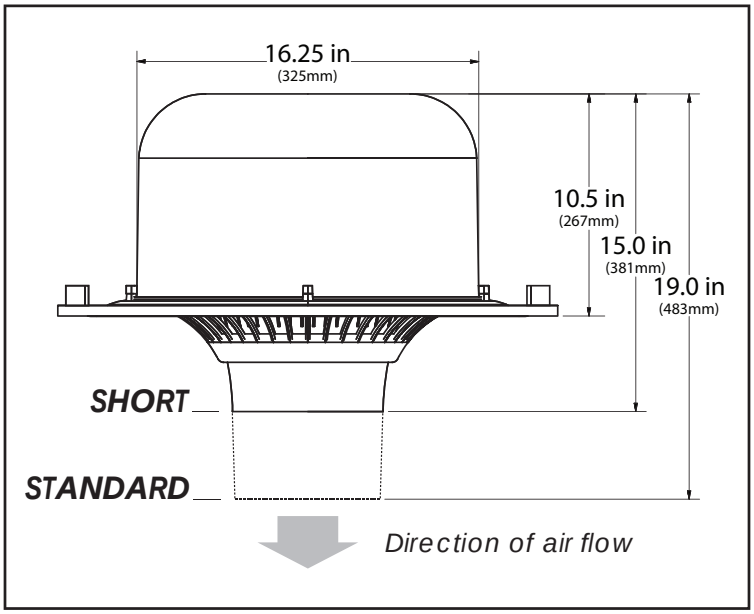
AIR PEAR SUSPENDED 25-SP DESTRATIFICATION FAN SUBMITTAL

SPECIFICATION SECTION: 23 34 00 - HVAC FANS

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	**dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
S-25-SP	120	50/60	0.30/0.32	30/35	1500/1650	459/547	45	16 lb	Up to 25 ft.	Up to 1200 ft²
S-25-SP	230	50/60	0.14/0.13	31/33	1450/1650	459/547	45	16 lb	Up to 25 ft.	Up to 1200 ft²
S-25-SP	277	50/60	0.13/0.17	35/45	1500/1650	459/547	45	16 lb	Up to 25 ft.	Up to 1200 ft²

*0-static motor data supplied by fan manufacturer. Subject to change at any time.

**Sound pressure level at 3 feet. Sound Power Level 58 dB(A), designed to meet ISO 3744 – engineering grade precision for determining sound power.



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
CONFIGURATION	
QUANTITY	

ORDERING LOGIC

Enter part number into the configuration field above

Style	Model	Motor Type	Nozzle Length	Voltage	Color
S (Suspended)	25	SP (Shaded Pole)	(Short) SH (Standard) STD	120 230 277	(Off White) W (Black) B

EXAMPLE: S - 25 - SP - **STD - 120 - W**

- **Color**
- **Voltage (AC)**
- **Nozzle Length**
- Motor Type
- Model
- Style

DESTRATIFICATION FAN DESCRIPTION

The patented Air Pear Thermal Equalizer creates uniform air temperatures from floor to ceiling for maximum thermal comfort and energy savings up to 35% in the heating season and up to 25% in the cooling season.

CERTIFICATION: *Conforms to UL-507, CAN/CSA C22.2#60335-1, UL 94 5VA and is ETL listed in USA and Canada.*

HOUSING: *PC/ABS resin, 5VA flame resistance rating*

MOTOR: *Single phase, shaded pole, single speed (variable with optional speed control), axial motor. Motor is thermally protected. Operating temperature: -4˚ F (-20˚ C) to 158˚ F (70˚ C). No lubrication required. Bearings are sealed. A junction box and receptacle are supplied. Electrical contractor will need to provide MC cable and wire directly to j-box/receptacle mounted to side of dome.*

STATOR: *Patented multi-vane stator significantly increases air throw for maximizing performance. PC/ABS.*

WARRANTY*: Warranty - 3-years parts and workmanship. Money back guarantee - 30 days. Refurbish program after 3-year warranty period.*

FACTORY INSTALLED OPTIONS:

Item #	Description	Qty
PHI-9-C	Factory installed 9 in. PHI cell	
PHI-5-C	Factory installed 5 in. PHI cell	
GUARD25	Silver intake grille	

ACCESSORIES *(additional costs apply)*

Speed Control *(coordinate w/ electrical requirement)*

Item #	Description	Qty
TRIAC-120-1.5	120VAC, 1.5A wall mounted speed control	
TRIAC-120-5	120VAC, 5A wall mounted speed control	
TRIAC-120-15	120VAC, 15A wall mounted speed control	
TRIAC-230-8	230VAC, 8A wall mounted speed control	
TRIAC-277-5	277VAC, 5A wall mounted speed control	
TRIAC-SMART-7.5	95-250VAC, 7.5A, electrical box speed control	

COLOR OPTIONS:

"Off White" Cool Gray 2C

Black

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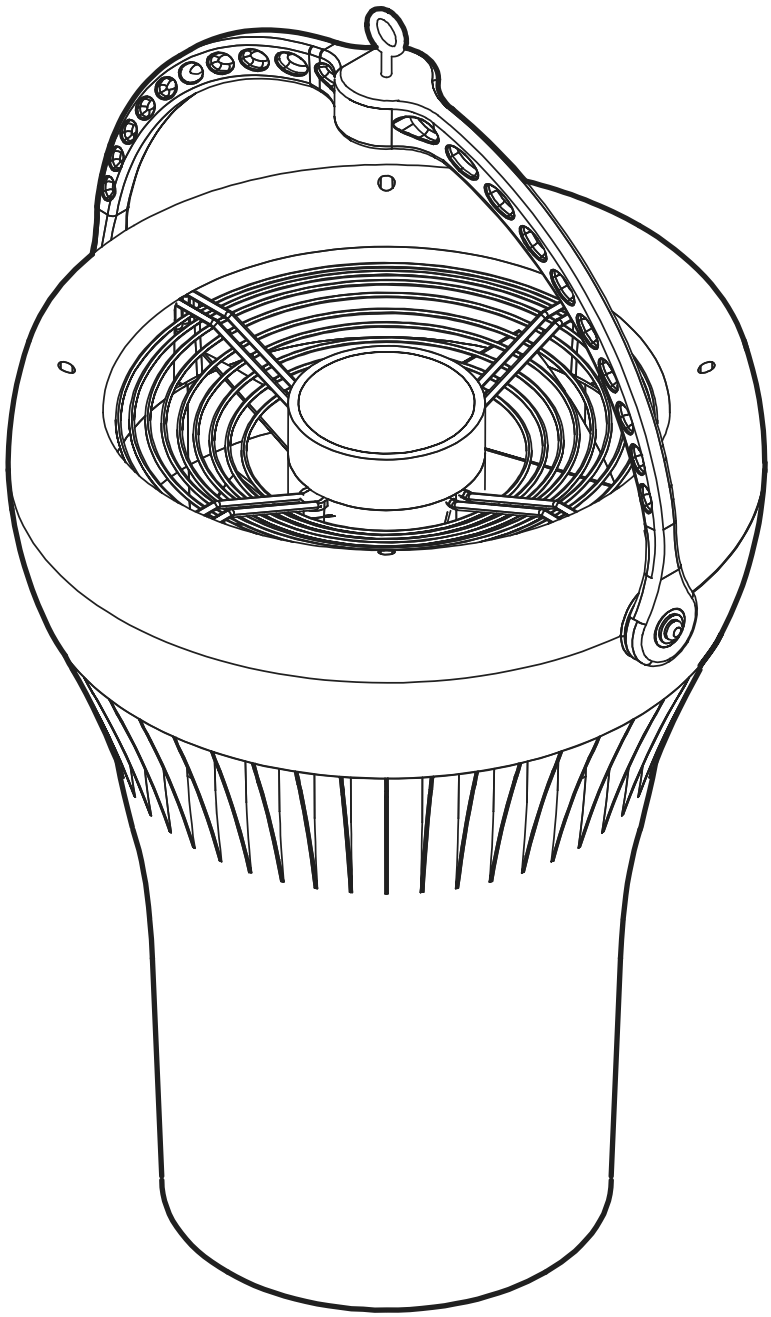
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May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

AIRIUS®

The World Standard
For Destratification

AIR PEAR
INSTALLATION, OPERATION & MAINTENANCE



Air Pear®
THE THERMAL EQUALIZER
BY AIRIUS

Installation Guide: V1.2

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NOTE: Carefully check fans/controls for shipping damage. Report any damage to the carrier immediately. Do not attempt to operate if visible damage is evident to either the circuit or to the electronic components. All information contained in this manual is intended to be correct, however information and data in this manual are subject to change without notice. Airius makes no warranty of any kind with regard to this information or data. Further, Airius is not responsible for any omissions or errors or consequential damage caused by the user of the product. Airius reserves the right to make manufacturing changes that may not be included in this manual.

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PC/ABS

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INTRODUCTION

Thank You!

Congratulations on the purchase of Airius' Thermal Equalizer system (Air Pear). Our patented, American-made, air-mixing system will ensure better thermal comfort in both the summer and winter while driving down expensive energy bills. We are here to support you and if you have any questions or comments, we can be contacted through our website, www.airiusfans.com, or give us a call: 1-888-247-7327.

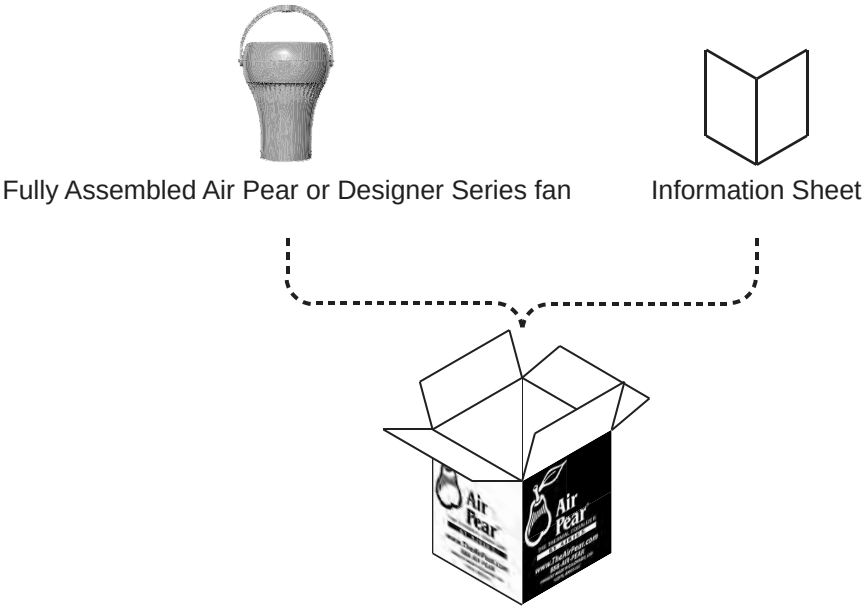
About Air Pear Models 10, 15, 25, 45, 60 & 100

The Air Pear unit is an energy-efficient air turbine, designed to continuously move a column of air to the floor for destratification and air circulation purposes. A typical system installation includes a series of units mounted just below the ceiling, evenly spaced throughout a facility, working in concert to improve comfort and reduce HVAC energy consumption up to 35% or more*. Airius fans are available in several sizes to accommodate a wide range of ceiling heights.

* THE PERFORMANCE AND RESULTS OF THE AIR PEAR SYSTEM ARE SUBJECT TO MANY VARIABLES SUCH AS, BUT NOT LIMITED TO, AIRFLOW OBSTRUCTIONS, THE INTERIOR ENVIRONMENT, EXTERIOR ENVIRONMENT, CONDITION OF BUILDING STRUCTURE, HVAC SYSTEM PERFORMANCE AND/OR ELECTRICAL SERVICE AND THUS, ACTUAL RESULTS MAY VARY.

What's in the Box

Each unit will arrive in its own box, fully assembled. NOTE: 120VAC versions come with a three-prong plug, and other voltages have no plug supplied. You will need to have a qualified electrician either wire the desired plug on to the power cord or hard wire directly to the power circuit. We recommend using a plug for easy removal during maintenance.



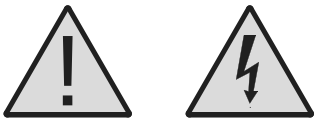
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Motor Information for Air Pear Models 10, 15, 25, 45, 60 & 100

MODEL	VOLTS 1Ø	HZ	*AMPS	*WATTS	*MAX RPM	*MAX CFM	*dB(A)	WEIGHT	MOUNTING HEIGHT	COVERAGE AREA
A-10-SP	120	50/60	0.11/0.13	13/15	1000/1050	318	24	7 lb/9 lb	Up to 12 ft.	Up to 500 ft²
A-10-SP	230	50/60	0.06/0.06	12/13	980/1000	318	24	7 lb/9 lb	Up to 12 ft.	Up to 500 ft²
A-10-EC	100-130	50/60	0.12	7	1000	318	24	7 lb/9 lb	Up to 12 ft.	Up to 500 ft²
A-10-EC	200-250	50/60	0.06	7	1000	318	24	7 lb/9 lb	Up to 12 ft.	Up to 500 ft²
A-15-SP	120	50/60	0.11/0.14	13.5/17	1230/1260	406	29	7 lb/9 lb	Up to 18 ft.	Up to 800 ft²
A-15-SP	230	50/60	0.06/0.07	15/17	1230/1260	406	29	7 lb/9 lb	Up to 18 ft.	Up to 800 ft²
A-15-EC	100-130	50/60	0.17	11	1260	406	29	7 lb/9 lb	Up to 18 ft.	Up to 800 ft²
A-15-EC	200-250	50/60	0.08	11	1260	406	29	7 lb/9 lb	Up to 18 ft.	Up to 800 ft²
A-25-SP	120	50/60	0.30/0.32	30/35	1500/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-SP	230	50/60	0.14/0.13	31/33	1450/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-SP	277	50/60	0.13/0.17	35/45	1500/1650	459/547	45	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-EC	100-130	50/60	0.4	30	1700	620	51	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-25-EC	200-250	50/60	0.26	30	1700	620	51	7 lb/9 lb	Up to 25 ft.	Up to 1200 ft²
A-45-P4	120	50/60	0.40/0.41	44/46	1400/1650	595/715	54	14 lb	Up to 38 ft.	Up to 1200 ft²
A-45-P4	230	50/60	0.19/0.2	42/45	1450/1630	595/707	54	14 lb	Up to 38 ft.	Up to 1200 ft²
A-45-P4	277	50/60	0.19/0.2	42/45	1450/1630	595/707	54	14 lb	Up to 38 ft.	Up to 1200 ft²
A-45-P2	120	50/60	1.05/1.48	120/175	2550/2700	1057/1128	64	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-P2	230	50/60	0.54/0.7	125/165	2450/2600	1072/1160	64	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-P2	277	NA/60	NA/0.7	NA/190	NA/2900	NA/1301	64	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-EC	100-130	50/60	0 - 2.2	0 - 170	0 - 2850	0 - 1180	71	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-EC	200-277	50/60	0 - 1.4	0 - 175	0 - 3050	0 - 1290	71	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-EL	100-130	50/60	0 - 2.2	0 - 170	0 - 2850	0 - 1180	71	14 lb	Up to 45 ft.	Up to 1500 ft²
A-45-EL	200-277	50/60	0 - 1.4	0 - 175	0 - 3050	0 - 1290	71	14 lb	Up to 45 ft.	Up to 1500 ft²
A-60-P4	120	50/60	0.91/0.92	88/108	1400/1620	1443/1665	60	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-P4	230	50/60	0.57/0.66	120/150	1390/1600	1667/1902	60	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-P4	277	50/60	NA/0.68	NA/170	NA/1660	NA/2002	60	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-EC	100-130	50/60	0 - 2.2	0 - 170	0 - 1660	0 - 1825	63	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-EC	200-277	50/60	0 - 1.3	0 - 170	0 - 1630	0 - 1770	63	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-EL	100-130	50/60	0 - 2.2	0 - 170	0 - 1660	0 - 1825	63	22 lb	Up to 60 ft.	Up to 2000 ft²
A-60-EL	200-277	50/60	0 - 1.3	0 - 170	0 - 1630	0 - 1770	63	22 lb	Up to 60 ft.	Up to 2000 ft²
A-100-EC	100-130V	50/60	0 - 4.2	0 - 350	0 - 1620	0 - 3210	66	45 lb	Up to 100 ft.	Up to 2500 ft²
A-100-EC	200-277V	50/60	0 - 2.5	0 - 390	0 - 1690	0 - 3358	66	45 lb	Up to 100 ft.	Up to 2500 ft²
A-100-EL	200-277V	50/60	0 - 2.5	0 - 390	0 - 1690	0 - 3358	66	45 lb	Up to 100 ft.	Up to 2500 ft²

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Safety Precautions - Read & Save



Warning! - To prevent fire, electrical shock or injury, please observe the following:

Electrical work must be performed by a qualified person(s) in accordance with all national and local codes/standards.

Air Pear® Thermal Equalizer® fans
Models 10, 15, 25, 45, 60, &100: all voltages

120V Models:
Supplied with a polarized/grounded plug molded to a 6 ft. (1.8 m) cord. To reduce the risk of electrical shock, this plug is intended to fit in a polarized/grounded outlet only one way. If the plug does not fit fully in the outlet, contact a qualified electrician. Do not attempt to defeat this safety feature.

230V & 277V Models:
Supplied with a 6 ft (1.8 m) cord with a 3-wire pigtail for attachment to a single phase plug rated for the correct voltage; NEMA type: L6-20P or similar, wire color code: UL/CSA: black-live/white-neutral/green-yellow-earth.

Warning! To prevent electrical shock and/or injury, unplug/disconnect unit from power source before you move unit, service unit or remove any part of housing.

Warning! To reduce the risk of fire or electrical shock, do not use models 10, 15 and 25 equipped with shaded pole motors or models 45, 60 and 100 with permanent split capacitor (P.S.C.) motors with any unapproved solid-state speed control device. Models 45, 60, 100 and 125 with electrically commutated motors (labeled as EC or EL) are capable of variable speeds with the proper controls. Contact Airius for additional information regarding variable speed controls and options.

Do not carry the Air Pear/Designer Series unit by the cord. Do not use the cord as a handle. Do not use the cord to attach or hang the product. Be sure to grasp the plug, not the cord, when disconnecting this unit from an electrical outlet.

Do not use this product if it has a damaged cord, faulty plug or any broken housing or motor component. If the supply cord, plug, motor or housing is damaged, it must be serviced or replaced by Airius, its service agents or similarly qualified persons to avoid a hazard.

To prevent damage, which may result in fire or shock hazard, do not expose this product to rain or direct moisture. Do not immerse product into water or allow water to drip into the motor housing. Do not install outdoors or in an area open to the weather. Shut off power to a wet motor at source before servicing.

Spinning blades may inflict eye or other physical injury. Always replace a damaged blade. Disconnect unit from power source first. Contact Airius for replacement blades. Plastic blades are rated 5VA, the highest fire-resistant rating for plastics, and they will not maintain a flame.

Caution! Some Air Pear products have an unguarded impeller/fan blade. Do not use in locations readily accessible to people or animals. Blades may inflict injury when moving or stationary.

To reduce the risk of injury to persons, install product so that bottom of moving fan blade or the lowest moving part is at least 8.2 ft. (2.5 m) above the floor or grade level.

The motor is thermally protected; overheating will cause the motor to stop operating. The motor may restart once normal operating temperatures are achieved. If motor fails to restart, disconnect motor from electric source and contact Airius. Do not disable this safety device or override this safety feature; doing so will void the warranty.

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Safety Precautions - Read & Save (cont.)

Do not use any PVC product (electrical tape) with the fans. If installing a fan in an environment with cutting oils in the air (production machine shop) contact the factory for assistance at 303-772-2633.

Do not position product near furnaces, fireplaces, stoves or other high temperature heat sources. Do not position Air Pear unit such that the downward air column created by the Air Pear will be directly bisected by another source of air flow, such as from another fan or from an open supply register. Do not position the unit close to other objects that will interfere with fan operation. Do not allow fan blades to come into contact with objects that can lock or inhibit the rotor operation.

Service and installation: No lubrication is required. Bearings are sealed. Bail adjustment can be made with a T-30 Torx driver/wrench, or a 5/32" Hex wrench may be used. Other tools for service: T-20 Torx (7/64" Hex) & T-25 Torx (1/8" Hex) and a #2 Phillips screwdriver.

The Air Pear unit is designed to be used with only the electrical voltage identified on the label located in the nozzle and on the bottom of the motor. Connecting to any other voltage could damage the motor and create an electrical hazard and will void warranty. If you have a question, please contact the factory.

Assembling Suspended Ceiling units: See additional instructions for kit included with this pamphlet or located in box containing kit.

Important: Install with hanging device or fastener rated for a minimum of 5x the weight of the unit. **Never use zip ties to hang the fan.** Use care when positioning the unit. To maximize performance, make sure the airflow is unobstructed into the top of the unit and the downward airflow is unobstructed and allowed to reach the floor.

Cleaning: Unplug unit from power source first to prevent electrical shock and to avoid injuries from spinning blades. Caution: Stationary blades can cause injury! You may clean the plastic housing with a warm cloth, using mild detergent only. Do not use petroleum products, thinners, solvents, ammonia, alcohols or other chemicals to clean any part of the Air Pear unit.

USA & Canada – ETL file #3164849 EU - CE

For additional information about
Air Pear® or Designer Series Thermal Equalizer® fans
and other products/accessories visit:

www.airiusfans.com

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PRE-INSTALLATION

Preparing the Work Site - Electrical Installation

ELECTRICAL WORK MUST BE PERFORMED BY A QUALIFIED PERSON(S) IN ACCORDANCE WITH ALL NATIONAL AND LOCAL CODES/STANDARDS.

Airius recommends installing a dedicated circuit only to be used with the Air Pear units. DO NOT wire the units into the lighting circuit, as the system will cycle on and off with the lights, greatly reducing the system's effectiveness.

Outlets are available in many configurations, check with the local electrical contractor to determine the preferred type for the facility. Outlets should generally be mounted vertically unless a "twist/locking" type is being used.

Refer to page 13 for plug wiring directions.
Refer to page 12 for specific model amperage.

To confirm electrical continuity, if possible, plug the Air Pear system into an energized outlet at floor level, similar to the outlet installed in the ceiling, before permanently mounting the Air Pear in the ceiling. Only energize the fan after hands/fingers or loose clothing are removed from/around the fan intake.

CAUTION − Make sure the fan voltage matches the intended power supply before installing. Connecting the fan to the wrong voltage will void warranty.

Preparing the Work Site - Mechanical Installation

A ladder, scissor lift or other suitable means of reaching the installation point will be required.

The Air Pear system is designed to hang vertically 12-to-18 inches below the ceiling of the facility with the discharge pointing to the floor for maximum thermal equalization. NOTE: The bail may be angled, as it is ratcheted for special situations where a vertical air column is undesirable and an angled column would be more effective.

Make sure the air column will have an unimpeded path from the discharge to the floor. **If using the fans in a grocery aisle application, mount the fan a minimum of 3 ft. from the edge of any open reach in case to minimize the possibility of introducing air into the case.**

The free-hanging units are designed to hang vertically and freely from the ceiling on hardware capable of supporting a minimum of five times the weight of the unit. Example - 1/4" (7 mm) diameter steel bolt is rated at a 60 lb. (27 kg.) load.

Hardware that may be used to hang the unit includes, but is not restricted to: hooks, chains, cables, carabiners, bridle rings, beam clamps and bolts. Roof structure, building construction, electrical outlets/service and accessibility will define the appropriate hardware for each installation.

If installing within a suspended ceiling, make sure there are no objects (ducts, sprinklers, conduit, etc.), for clearance purposes, directly above the proposed location of installation and relocate if necessary.

Refer to installation directions on page 16 for further information.

Refer to Suspended Ceiling Kit Assembly and Installation on page 20.

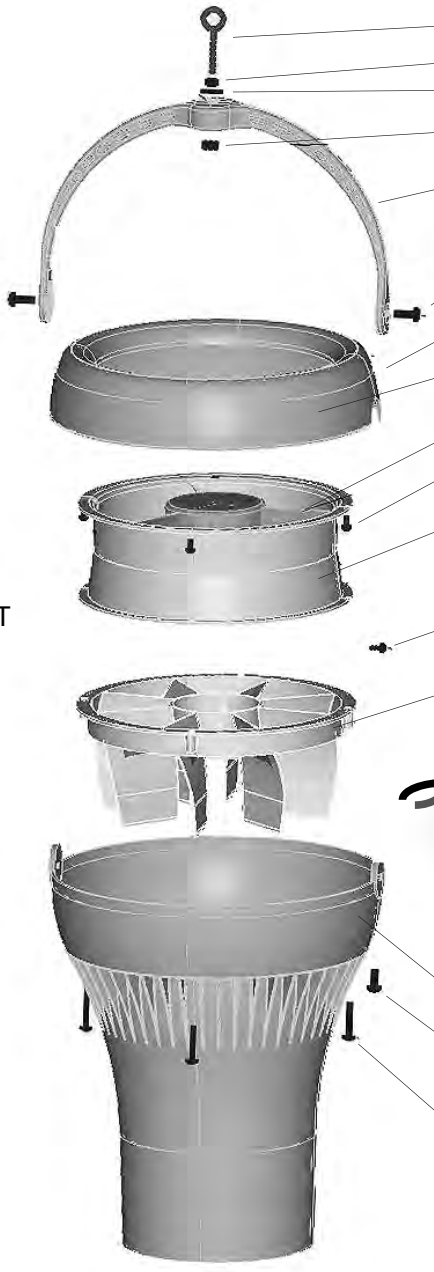
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Tools Needed

T-30 Torx Driver (5/32" Hex); other tools include T-20 Torx (7/64" Hex); T-25 Torx (1/8" Hex); #2 Phillips Driver.
All necessary tools to install mounting hardware (varies from installation to installation)

Fan Diagram 10-SP, 15-SP, 25-SP

AIR PEAR 10-SP, 15-SP, 25-SP



POWER LEADS:

"N" = NEUTRAL

UNMARKED = HOT

1) 1/4 - 20 x 1 1/2 EYE BOLT
2) 1/4 - 20 NUT
3) 1/4 x 5/8 WASHER
4) 1/4 - 20 NYLOCK NUT
5) BAIL/CROSSPIECE
6) 1/4 - 20 x 1 T-30 TORX (5/32 HEX) PAN HEAD MACHINE SCREW x 2 EA.
7) HOLE FOR STRAIN RELIEF SUPPORTING POWER CORD
8) COWL (PC/ABS)
9) FAN BLADES RATED 5VA 1 EA.
10) 8 - 32 x 3/8 T-20 TORX (7/64 HEX) PAN HEAD MACHINE SCREW x 4 EA.
11) ROTOR HOUSING - FAN MOTOR 120 OR 230 VAC THERMALLY PROTECTED (277 VAC AVAILABLE)
12) 8 - 32 x 1/4 T-20 TORX (7/64 HEX) PAN HEAD GROUNDING MACHINE SCREW x 1 EA.
13) STATOR (PC/ABS)
14) STRAIN RELIEF

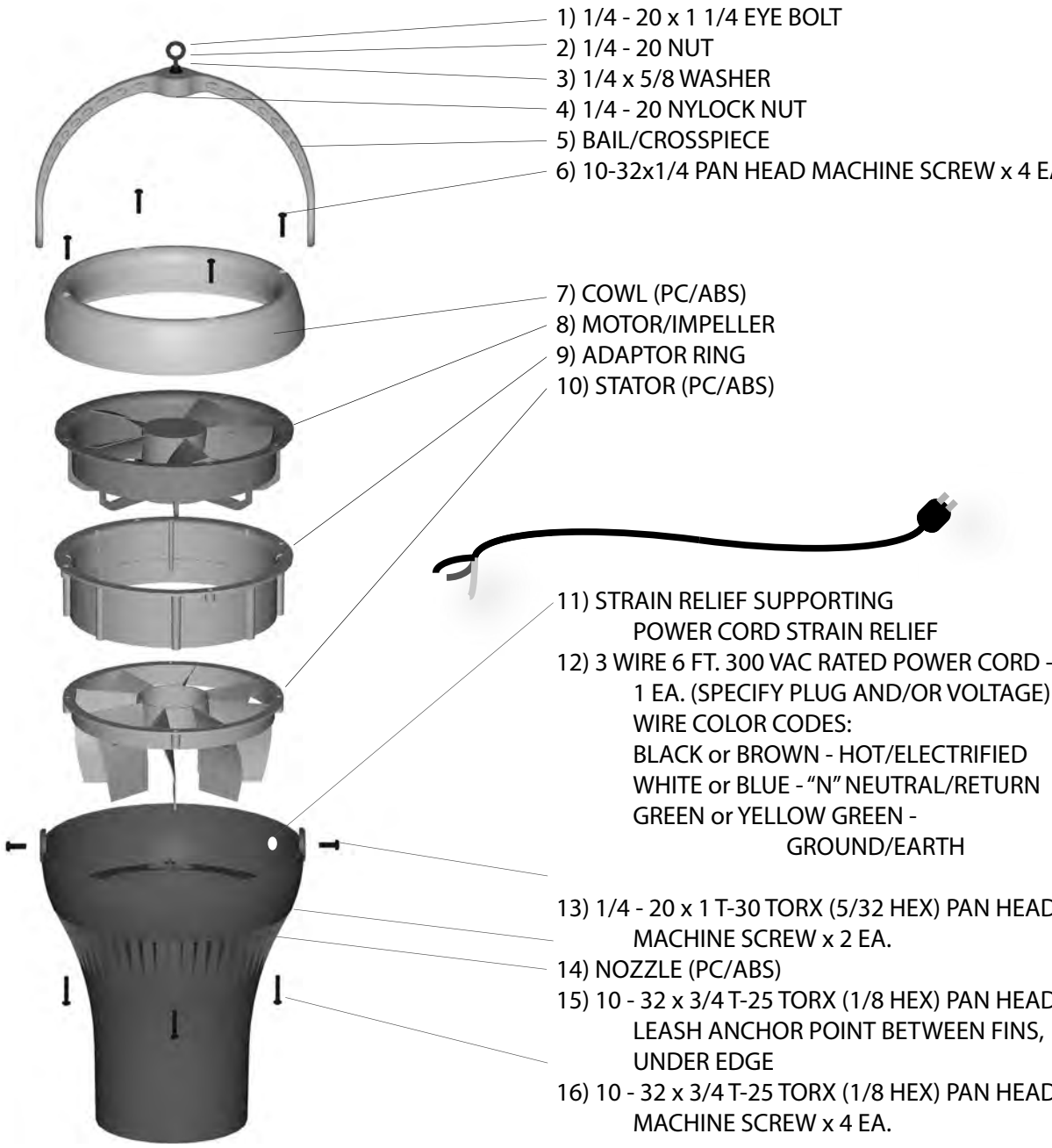


15) 3 WIRE 6 FT. 300 VAC RATED POWER CORD - 1 EA. (SPECIFY PLUG AND/OR VOLTAGE)
WIRE COLOR CODES:
BLACK or BROWN - HOT/ELECTRIFIED
WHITE or BLUE - "N" NEUTRAL/RETURN
GREEN or YELLOW GREEN - GROUND/EARTH

16) NOZZLE (PC/ABS)
17) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) PAN HEAD LEASH ANCHOR POINT BETWEEN FINS, UNDER EDGE
18) 10 - 32 x 1 1/4 T-25 TORX (1/8 HEX) PAN HEAD MACHINE SCREW x 4 EA.

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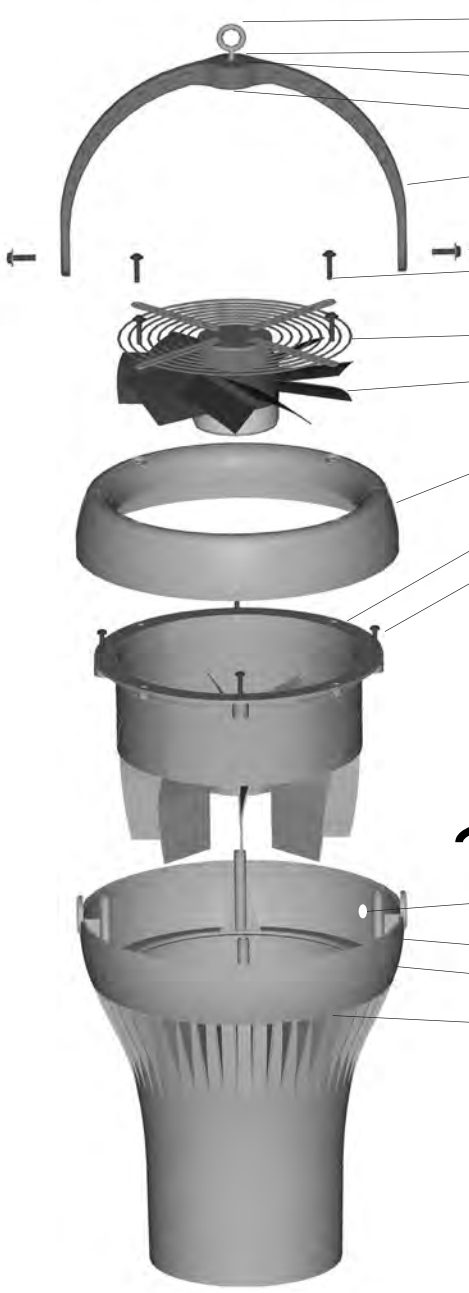
Fan Diagram 10-EC, 15-EC, 25-EC



1) 1/4 - 20 x 1 1/4 EYE BOLT
2) 1/4 - 20 NUT
3) 1/4 x 5/8 WASHER
4) 1/4 - 20 NYLOCK NUT
5) BAIL/CROSSPIECE
6) 10-32x1/4 PAN HEAD MACHINE SCREW x 4 EA.
7) COWL (PC/ABS)
8) MOTOR/IMPELLER
9) ADAPTOR RING
10) STATOR (PC/ABS)
11) STRAIN RELIEF SUPPORTING POWER CORD STRAIN RELIEF
12) 3 WIRE 6 FT. 300 VAC RATED POWER CORD - 1 EA. (SPECIFY PLUG AND/OR VOLTAGE)
WIRE COLOR CODES:
BLACK or BROWN - HOT/ELECTRIFIED
WHITE or BLUE - "N" NEUTRAL/RETURN
GREEN or YELLOW GREEN - GROUND/EARTH
13) 1/4 - 20 x 1 T-30 TORX (5/32 HEX) PAN HEAD MACHINE SCREW x 2 EA.
14) NOZZLE (PC/ABS)
15) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) PAN HEAD LEASH ANCHOR POINT BETWEEN FINS, UNDER EDGE
16) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) PAN HEAD MACHINE SCREW x 4 EA.

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Fan Diagram 45-P4, 45-P2, 45-EC, 45-EL



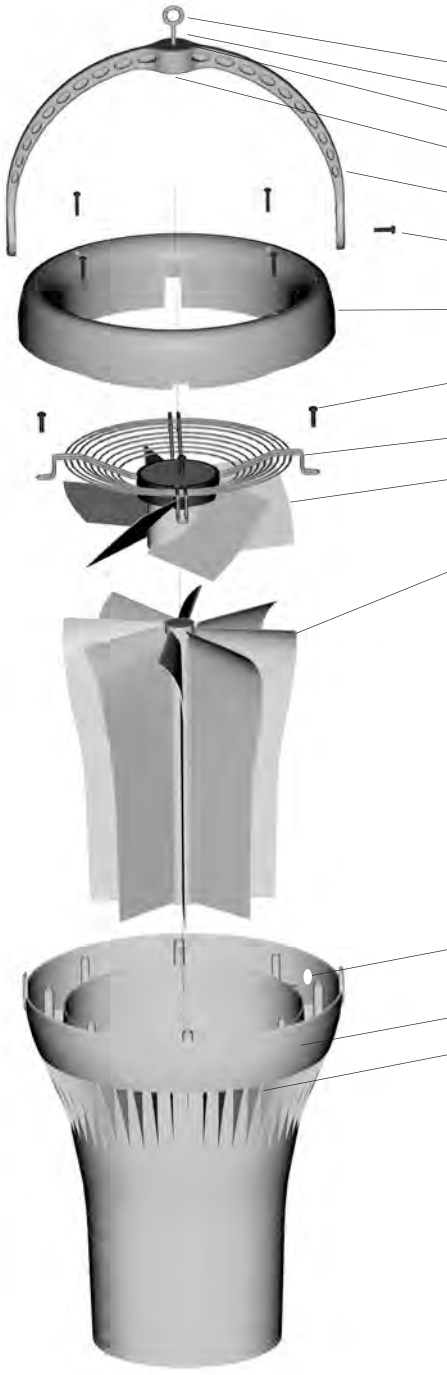
1) 1/4 - 20 x 1 1/4 EYE BOLT
2) 1/4 - 20 NUT
3) 1/4 x 5/8 WASHER
4) 1/4 - 20 NYLOCK NUT
5) BAIL/CROSSPIECE
6) 1/4 - 20 x 1 T-30 TORX PAN HEAD (x2)
   #10 SAE FLAT WASHER (x2)
7) 10-32 x 2 TORX (x4)
   #10 SAE FLAT WASHER (x4)
8) STEEL GRILLE, PHOSPHATED, BLACK
9) MOTOR/IMPELLER
10) COWL (PC/ABS)
11) STATOR (PC/ABS)
12) 10-32 x 1 1/4" TORX (x4)
13) 3 WIRE 6 FT. 300 VAC RATED POWER CORD - 1 EA. (SPECIFY PLUG AND/OR VOLTAGE)
    WIRE COLOR CODES:
    BLACK or BROWN - HOT/ELECTRIFIED
    WHITE or BLUE - "N" NEUTRAL/RETURN
    GREEN or YELLOW GREEN - GROUND/EARTH



14) HOLE FOR STRAIN RELIEF SUPPORTING POWER CORD
15) HOLE FOR CONTROL WIRES w/ GROMMET
16) NOZZLE (PC/ABS)
17) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) PAN HEAD LEASH ANCHOR POINT BETWEEN FINS, UNDER EDGE

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Fan Diagram 60-P4, 60-EC, 60-EL



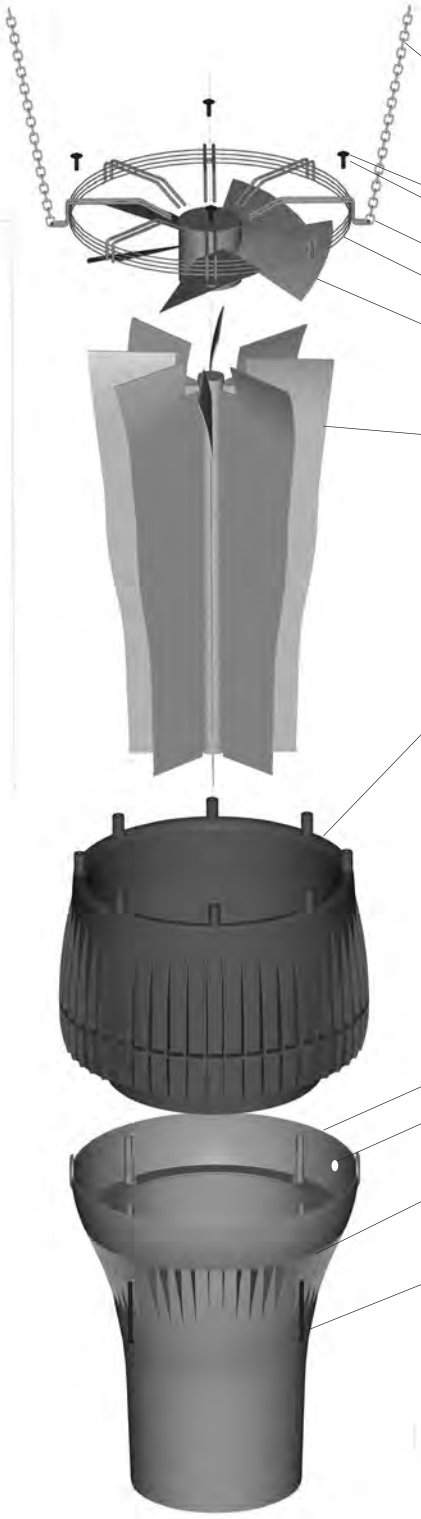
1) 1/4 - 20 x 1 1/4 EYE BOLT
2) 1/4 - 20 NUT
3) 1/4 x 5/8 WASHER
4) 1/4 - 20 NYLOCK NUT
5) BAIL/CROSSPIECE
6) 1/4 - 20 x 1 T-30 TORX PAN HEAD (x2)
7) FAN HOUSING (PC/ABS)
7) 1/4 - 20 x 1 (x4)
   #12 SAE FLAT WASHER (x4)
8) STEEL GRILLE, PHOSPHATED, BLACK
9) MOTOR/IMPELLER
10) STATOR (PC/ABS)
11) 3 WIRE 6 FT. 300 VAC RATED POWER CORD - 1 EA. (SPECIFY PLUG AND/OR VOLTAGE)
    WIRE COLOR CODES:
    BLACK or BROWN - HOT/ELECTRIFIED
    WHITE or BLUE - "N" NEUTRAL/RETURN
    GREEN or YELLOW GREEN - GROUND/EARTH



12) HOLE FOR STRAIN RELIEF SUPPORTING POWER CORD
13) NOZZLE (PC/ABS)
14) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) SLOT HEAD LEASH ANCHOR POINT BETWEEN FINS, UNDER EDGE

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Fan Diagram 100-EC, 100-EL



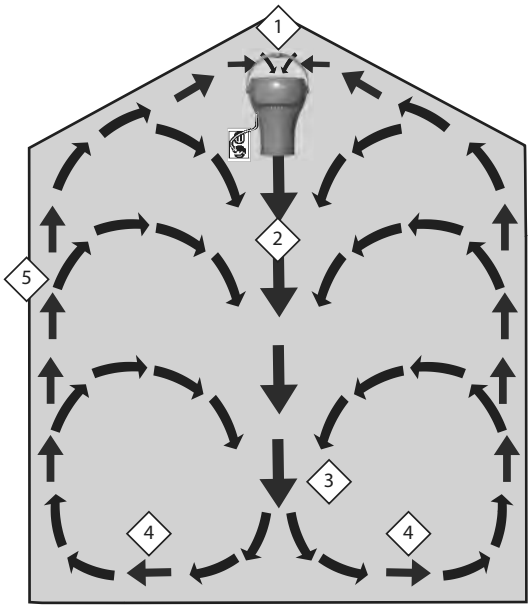
1) SUSPENSION CHAIN
2) 1/4 - 20 x 1
3) 1/4 x 7/8 WASHER
4) 3/16 x 1 7/8 QUICKLINK
5) STEEL GRILLE, PHOSPHATED, BLACK
6) MOTOR/IMPELLER
7) STATOR (ABS)
8) COWL (PC/ABS)
9) 3 WIRE 6 FT. 300 VAC RATED POWER CORD - 1 EA. (SPECIFY PLUG AND/OR VOLTAGE)
   WIRE COLOR CODES:
   BLACK or BROWN - HOT/ELECTRIFIED
   WHITE or BLUE - "N" NEUTRAL/RETURN
   GREEN or YELLOW GREEN - GROUND/EARTH



10) NOZZLE (PC/ABS)
11) HOLE FOR STRAIN RELIEF SUPPORTING POWER CORD
12) 10 - 32 x 3/4 T-25 TORX (1/8 HEX) PAN HEAD LEASH ANCHOR POINT BETWEEN FINS, UNDER EDGE
13) 1/4 - 20 x 4 T-30 TORX PAN HEAD (x4)
    #12 SAE FLAT WASHER (x4)

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Understanding Air Pear's Unique Air Flow



1. Low Velocity Intake - Low intake speed does not disturb air boundary layer under roof deck.
2. Columnar Laminar Flow - Removing the rotational component induced by the axial fan allows for the air to move in a straight, ductless column from the ceiling to the floor.
3. Entrainment - The column acts on the surrounding dead pool of air to induce entrainment and effectively multiply the air delivered to the floor.
4. Radial Spread - Once the column hits the floor, the air spreads radially until it loses velocity and migrates toward the ceiling.
5. Torus - The combination of these effects creates a torus-type air circulation and mixing pattern that effectively and efficiently achieves thermal equalization and general air movement.

Determine the number of fans, model and amperage to facilitate in the branch circuit design. Only qualified person(s) may determine the proper branch sizing and facilitate installation. If you have questions, contact your local electrical contractor.



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INSTALLATION

Power Requirements

Model Amperage 120VAC, single phase, 50/60 Hz:

Air Pear 10-SP: 0.11 / 0.13 A
Air Pear 15-SP: 0.11 / 0.14 A
Air Pear 25-SP: 0.30 / 0.32 A
Air Pear 45-P4: 0.40 / 0.41 A
Air Pear 45-P2: 1.05 / 1.48 A
Air Pear 60-P4: 0.91 / 0.92 A

Model Amperage 100-130VAC, single phase, 50/60 Hz:

Air Pear 10-EC: 0.12 A
Air Pear 15-EC: 0.17 A
Air Pear 25-EC: 0.4 A
Air Pear 45-EC: 2.2 A
Air Pear 45-EL: 2.2 A
Air Pear 60-EC: 2.2 A
Air Pear 60-EL: 2.2 A
Air Pear 100-EC: 4.2 A

Model Amperage 230VAC, single phase, 50/60 Hz:

Air Pear 10-SP: 0.06 / 0.06 A
Air Pear 15-SP: 0.06 / 0.07 A
Air Pear 25-SP: 0.14 / 0.13 A
Air Pear 45-P4: 0.19 / 0.2 A
Air Pear 45-P2: 0.54 / 0.7 A
Air Pear 60-P4: 0.57 / 0.66 A

Model Amperage 200-250VAC, single phase, 50/60 Hz:

Air Pear 10-EC: 0.06 A
Air Pear 15-EC: 0.08 A
Air Pear 25-EC: 0.26 A

Model Amperage 277VAC, single phase, 60 Hz:

Air Pear 25-SP: 0.14 A
Air Pear 45-P4: 0.2 A
Air Pear 45-P2: 0.7 A
Air Pear 60-P4: 0.68 A

Model Amperage 200-277VAC, single phase, 50/60 Hz:

Air Pear 45-EC: 1.4 A
Air Pear 45-EL: 1.4 A
Air Pear 60-EC: 1.3 A
Air Pear 60-EL: 1.3 A
Air Pear 100-EC: 2.5 A
Air Pear 100-EL: 2.5 A

Branch Circuit Protection

The Air Pear fans do not include fuses for branch circuit protection. The branch circuit must have a dedicated circuit breaker or similar device. National and local safety standards and electrical codes may determine additional requirements for installation.

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Plug Wiring (230/277VAC Models)

120VAC cord is supplied with a molded three-prong polarized/grounded plug. DO NOT DEFEAT this SAFETY DEVICE or modify the plug in any way.

230/277VAC no plug supplied. When fitting a plug always ensure that all relevant local regulations/electrical codes are understood and followed with care - if in any doubt seek expert guidance.

The power cord is a three-wire 18 AWG (or 16 AWG) 300VAC rated electrical cord UL rated in North America (NA) as SJT or for CE/EU compliance rated as HO5VV.

The three wires in the power cord are color-coded to ensure proper wiring as follows:

BLACK or BROWN = HOT/ELECTRIFIED/LIVE
WHITE or BLUE = “N” NEUTRAL/RETURN PATH
GREEN or YELLOW-GREEN = GROUND/EARTH

The cord is attached to the fan motor via two power leads with insulated 1/4” quick connects.

The cord is secured in the housing by a strain relief and knotted inside the housing for additional security.

Procedure for wiring the plug in a single-phase electrical system:

Use CAUTION when wiring/attaching the plug (Male Connector) to the Air Pear/Designer Series system or when using any electrical device.

1. Plug should be rated for 230VAC or 277VAC and fit properly into outlet (female connector) being used for power.

2. To avoid electrical shock, DO NOT plug device into energized outlet until all exposed wires and connecting terminals are enclosed by plug housing. See plug manufacturer’s instructions.

3. Locate the three stripped wires on the 300VAC rated power cord attached to the unit where the outer cord insulation jacket has been removed. Wires are coded as follows: black or brown is HOT/Live (the energized conductor), white or blue is neutral “N” (the conductor used for a return current path) and green or yellow/green is ground/earth (the conductor to connect to the earth).

4. Using the plug manufacturer’s instructions, locate the proper positions to attach the color-coded wire to the color-coded or otherwise appropriately labeled terminals on the plug.

5. Tighten all connections. Reassemble plug in accordance with plug manufacturer’s instructions.

To confirm electrical continuity, if possible, plug the Air Pear system into an energized outlet on the ground, similar to the outlet installed in the ceiling, before permanently mounting.

NOTE: The Air Pear System can be wired directly to a junction box but only by a qualified electrician or similarly qualified person. Always ensure that all relevant local regulations/electrical codes are understood and followed with care - if in any doubt seek expert guidance. Check local electrical codes. The preferred system is designed with a plug for easy service and cleaning. An on-off switch must be installed in the circuit to be able to disable the power to prevent electrical hazard when servicing the appliance.

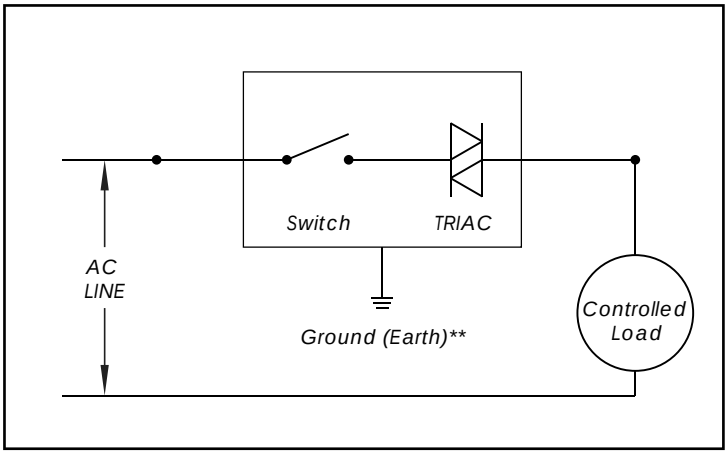
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Speed Control Wiring (Model 10-SP, 15-SP, 25-SP, 45-P2, 45-P4 & 60-P4)

SAFETY WARNING!

Unit should be installed by a qualified electrician in accordance with the National Electrical Code and other local codes that may apply. This control must be grounded when installed. Failure to follow these instructions may result in electrical shock or a fire hazard. This control is suitable for mounting in a metal or approved enclosure. These controls must not be used for loads exceeding those ratings clearly marked on the device.

CONNECTION DIAGRAM FOR 2-WIRE CONTROLS



APPLICATION

- Motor Type - Shaded Pole, PSC and Universal.
- Required Load - Fans and speed dependant loads.

WIRING

- Warning! - Power must be turned off before wiring. Connect control in series with motor and line voltage - never connect control across line.

MOUNTING

- Use 2” deep standard electrical box.
- Secure control with outer bracket tabs.

MINIMUM SPEED ADJUSTMENT

- Motor must be in actual operating conditions to achieve proper speed adjustment. (Motor will not slow down unless proper load is applied.)
- Turn main control knob clockwise to lowest speed position.
- Locate and adjust minimum speed setting on front plate with screw driver (rotate clockwise to decrease minimum speed; counter-clockwise to increase minimum speed.)
- Note: For all high-current models, 8 amps or greater, the opposite minimum speed rotation adjustment must be made so that motor runs with sufficient torque to prevent stalling.
- Motor will now operate from this preset minimum speed to full speed.

FINAL MOUNTING

- Install front dial plate - remove protective plastic.
- Turn main control until switch snaps off.
- Push on knob so that pointer is off position.

NOTE: For no switch models install front dial plate and push on knob.

TRIAC SIZING CONSIDERATIONS

- ** Some models do not require grounding. Therefore, a ground wire is not provided.
- Make sure the total circuit amperage load does not exceed the TRIAC’s rated amperage.
- Make sure TRIAC’s voltage rating matches line voltage.

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2-Speed Control Wiring (Model 10-EC, 15-EC and 25-EC only)

SAFETY WARNING!

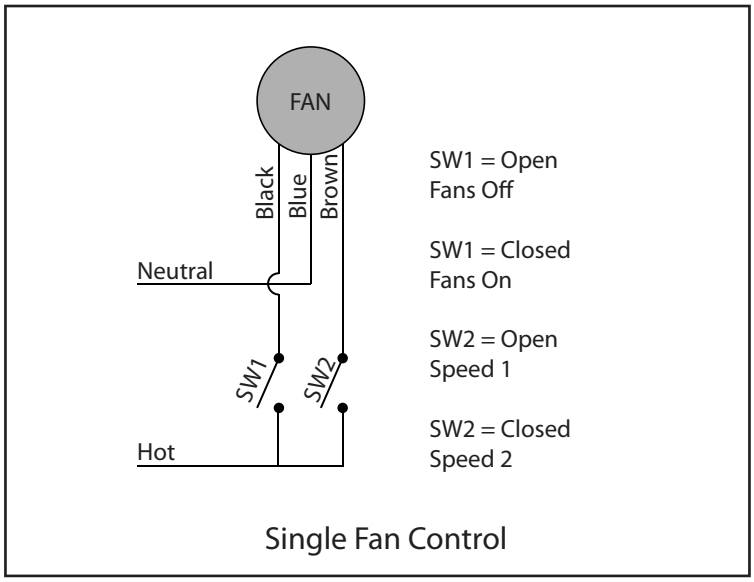
Unit should be installed by a qualified electrician in accordance with the National Electrical Code and other local codes that may apply.

APPLICATION

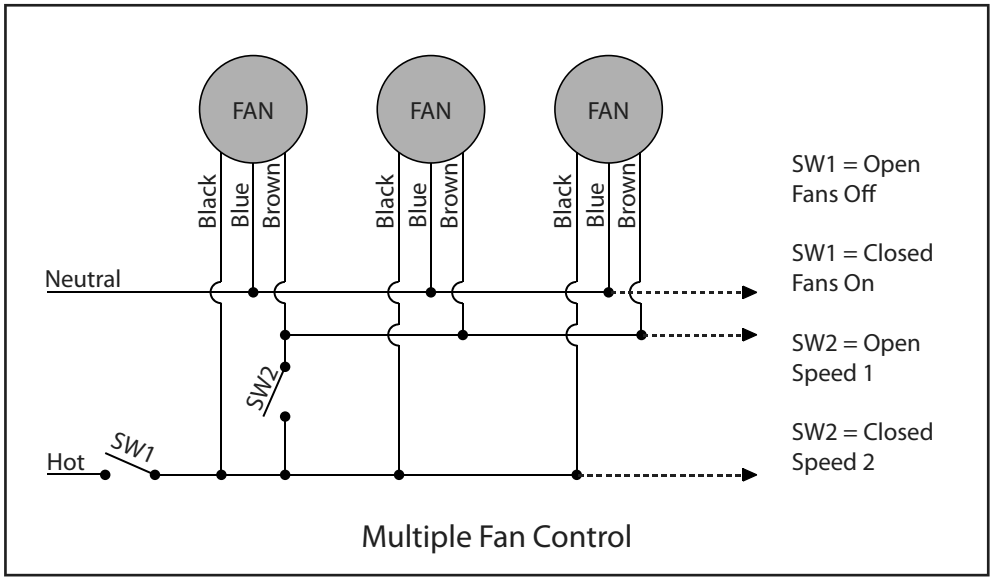
• Motor Type - Electronically Commutated, 2-speed control. The 2 speeds are factory set. Do not use this wiring method if you have the optional 0-10VDC control module or a shaded pole motor.

WIRING

• Warning! - Power must be turned off before wiring.



Single Fan Control



Multiple Fan Control

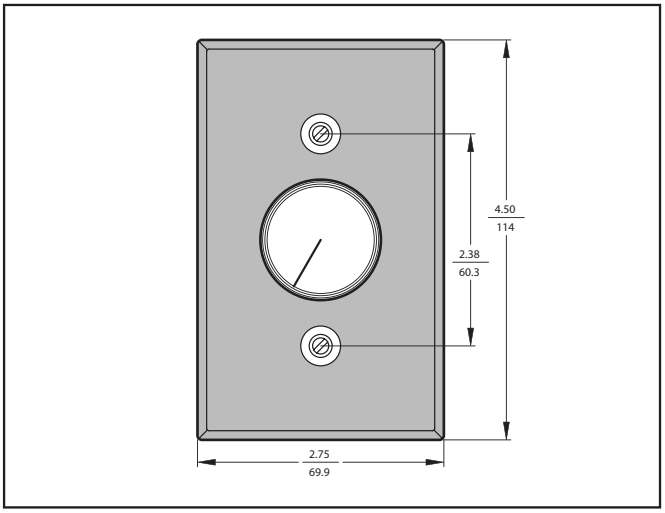
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Speed Control Wiring (10-EC, 15-EC & 25-EC with optional 0-10VDC module. Model 45-EC, 60-EC & 100-EC)

POTENTIOMETER SPEED CONTROL DESCRIPTION

Multi-turn wirewound potentiometer used to vary the speed of electrically commutated (EC) motors. Speed controls for shaded pole or PSC motors: refer to page 14. Speed control for EL fans: refer to seperate FanCenter installation & operation guide.

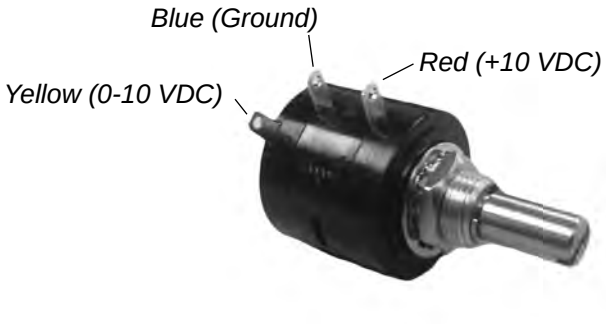
MODEL	VALUE (Ω)	LINEARITY	TOLERANCE
POT-1	10K	±0.25%	±5%

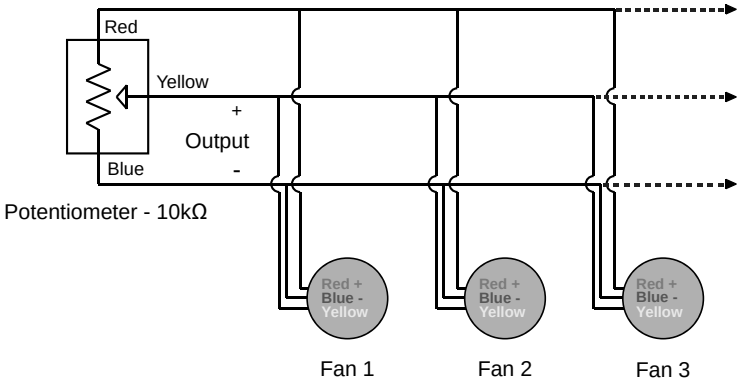


GENERAL NOTES

- The fan is supplied with current via the DC output and supplies a 0-10VDC signal that allows infinitely variable open loop speed control.
- If control wire exceeds 1300 ft. refer to Potentiometer wiring (external power source).
- A single controller can be used to control multiple fans with the same speed setting.
- Connecting the red and yellow leads will allow EC fans to operate at full speed.
- Wire runs up to 1000 feet (305 m) can be made using 20 - 24 AWG control wire. Wire runs longer than 1000 ft. will require the addition of a 10 - 12VDC power supply (not included).

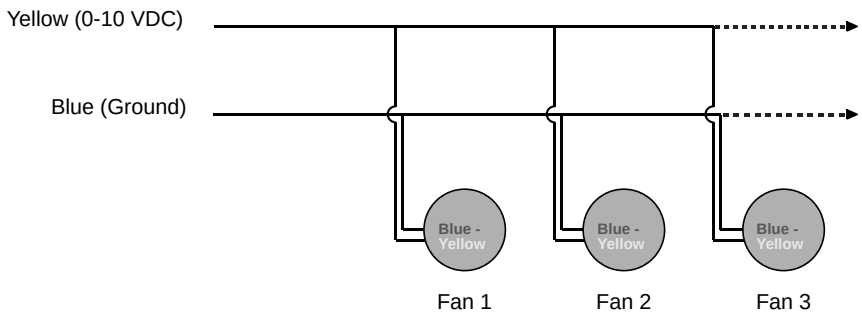
Potentiometer Control Wiring





BAS Control Wiring

The BAS should be capable of generating a 0-10VDC signal to modulate the fan speed. Use the following wiring diagram if this is the preffered connection type.



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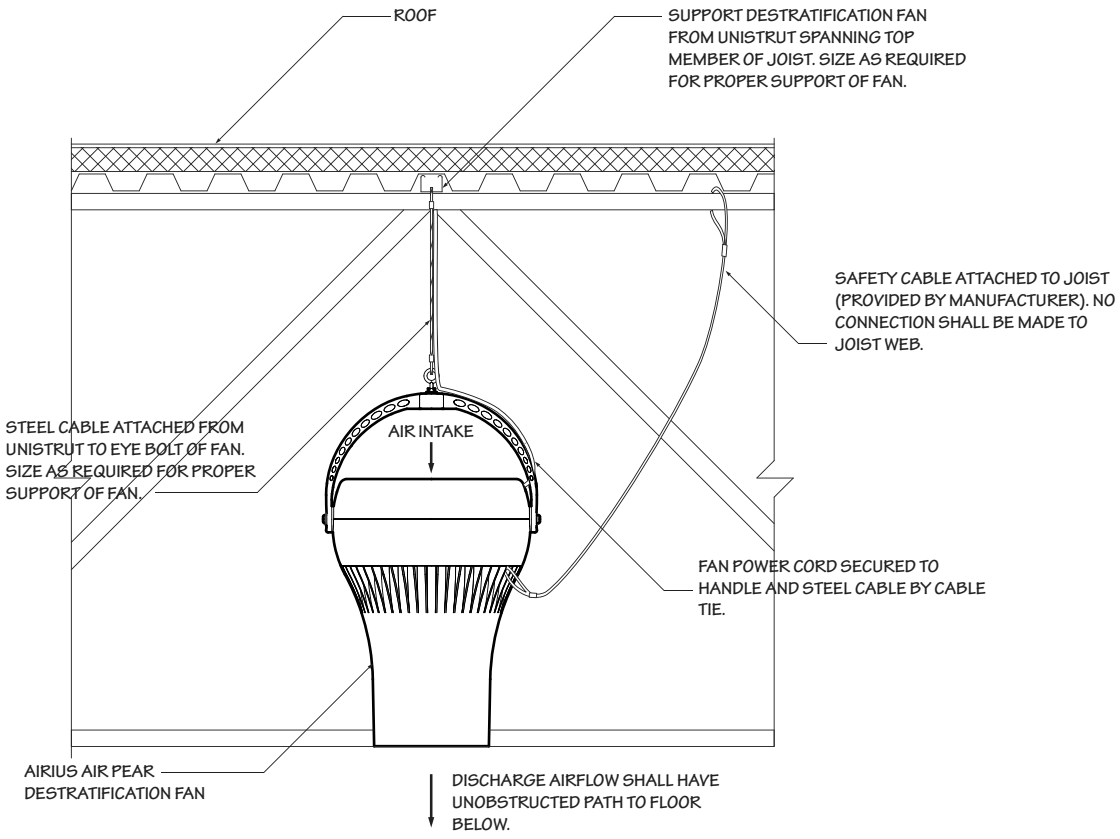
Free-Hanging Air Pear Suggested Installation Methods

Hardware that may be used to hang the unit includes, but is not restricted to: Hooks, chains, cables, carabiners, bridle rings, beam clamps and bolts. Roof structure, building construction and accessibility will define the appropriate hardware for each installation. Mount the fan as high in the ceiling as possible and do not restrict airflow into the intake.

After ensuring the Air Pear system is firmly attached and after REMOVING YOUR HANDS FROM THE UNIT, ONLY THEN is it safe to plug the unit into the power source using the approved plug to confirm function and electrical continuity.

NOTE: Secure the power cord to the ceiling structure as added security. The cord will act as a safety leash and by securing it the possibility of the plug accidentally coming out of the outlet is greatly reduced. A 50 lb. (20 kg.) rated Zip Tie or several wraps of mechanics wire are examples of methods of securing the power cord.

The following graphic is an example of hanging the typical Air Pear unit:



DESTRATIFICATION FAN DETAIL

SCALE: NONE

NOTES:

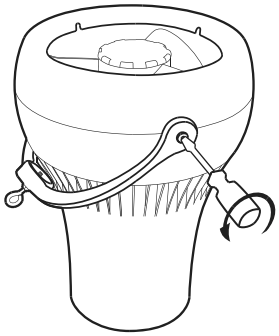
1. INSTALL FAN AS CLOSE AS POSSIBLE TO CEILING. (TYP 0'-6" TO 2'-0")
2. OPTIONAL HANGING METHODS INCLUDE: BEAM CLAMP/BRIDLE RING, CHAIN LINK/CARABINER, THREADED ROD/LOCK NUTS, ETC...
3. CONTRACTOR TO PROVIDE POWER FEED IN CONDUIT. THE ELECTRICAL CONNECTION CAN BE MADE IN A J-BOX (HARD WIRED) OR PLUG CONNECTION (J-BOX/RECEPTACLE).

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Suggested Installation Methods

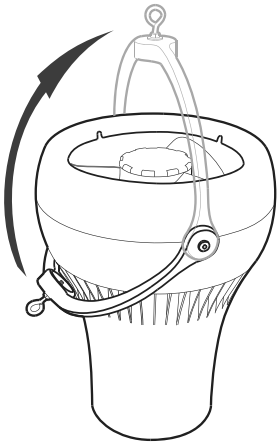
1

Remove the Air Pear from its box, then remove the plastic protective bag. The bail (handle) is attached via two Torx screws. Using T-30 Torx driver, loosen these screws enough so the bail may swing.



2

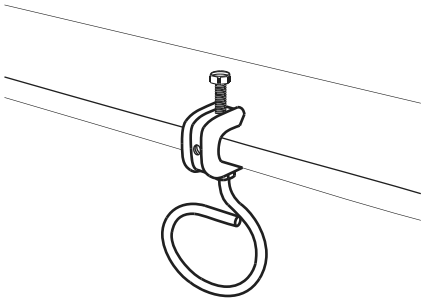
Swing the bail to the vertical position and re-tighten the two Torx screws.



3

The Air Pear system is designed to hang vertically and freely 12-to-18 inches, or as close as possible, from the ceiling on professionally installed hardware, for models 10/15/25, capable of supporting a minimum of five times the weight of the Air Pear unit, 60 lb. (27 kg.). Example - 1/4” (7 mm) diameter steel bolt is rated at 60 lb. (27 kg.) load.

A feature of the Air Pear system is its flexibility. Hardware that may be used to hang the unit includes, but is not restricted to: Hooks, chains, cables, carabiners, bridle rings, beam clamps and bolts. Roof structure, building construction and accessibility will define the appropriate hardware for each installation.

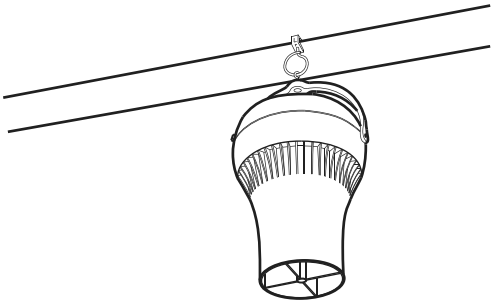


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Suggested Installation Methods

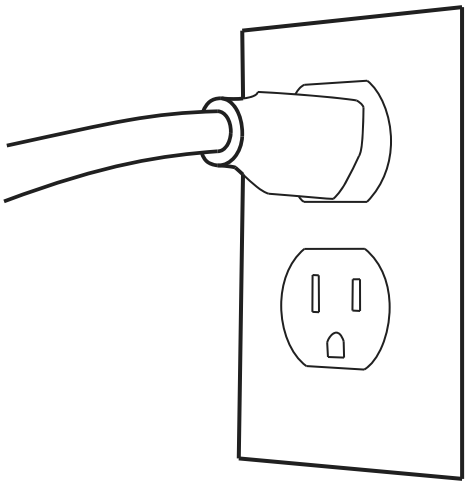
4

After ensuring the Air Pear system is firmly attached, remove your hands from the unit.



5

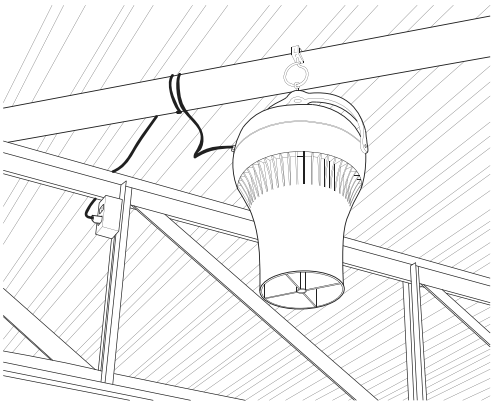
It is then safe to plug the unit into the power source using the approved plug to confirm function and electrical continuity.



6

NOTE: SECURE the power cord to the ceiling structure as added security. The cord will act as a safety leash and by securing it the possibility of the plug accidentally coming out of the outlet in the future is greatly reduced. A 50 lb. (20 kg.) rated Zip-Tie or mechanics wire are examples of methods of securing the power cord.

The graphic to the right is an example of hanging the Air Pear unit:



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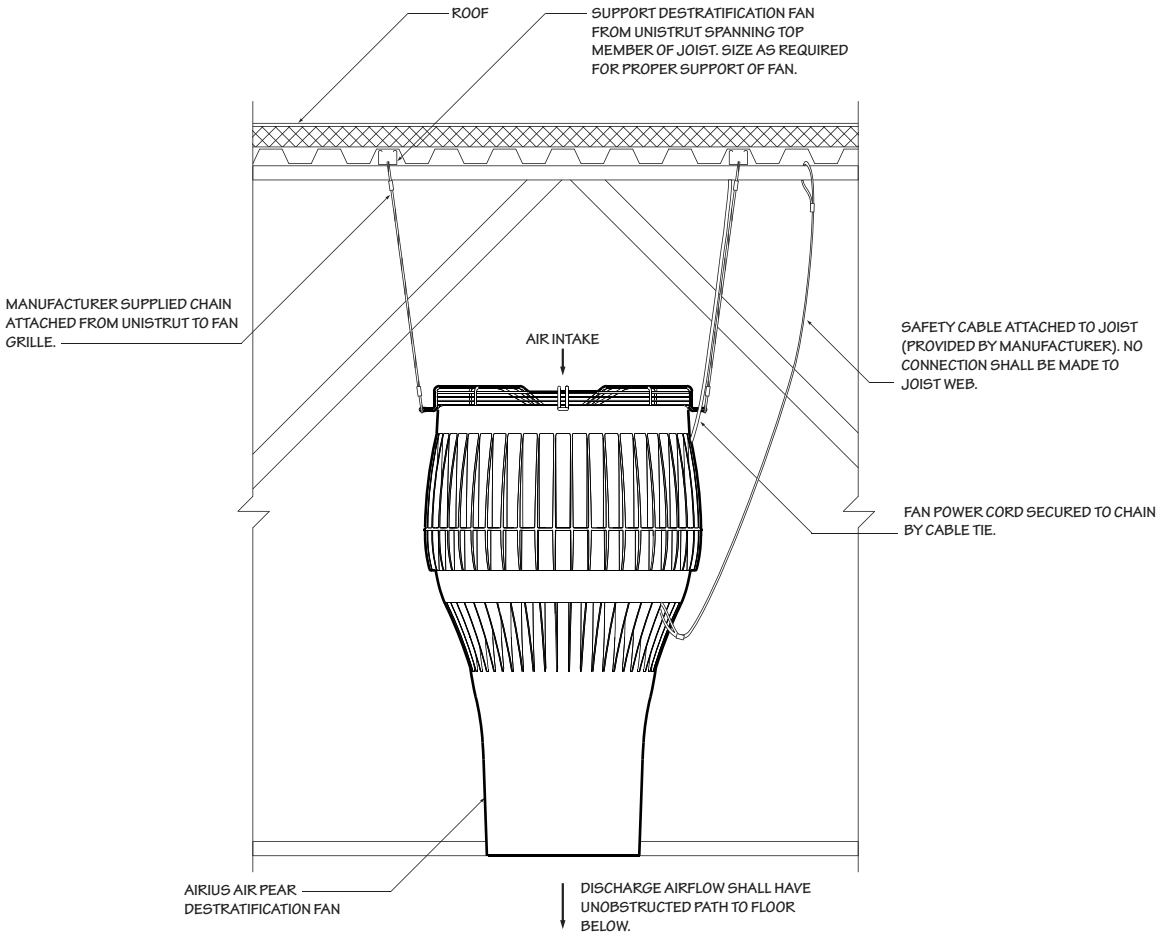
Free-Hanging Air Pear 100 Suggested Installation Method

200 lbs rated chains are supplied with the Model 100 fans that attach to the unit and the structure above. Roof structure, building construction and accessibility will define the appropriate connection hardware for each installation. Do not fasten units to joist web members or joist bridging.

After ensuring the Air Pear system is firmly attached and after REMOVING YOUR HANDS FROM THE UNIT, ONLY THEN is it safe to plug the unit into the power source using the approved plug to confirm function and electrical continuity.

NOTE: Secure the power cord to the ceiling structure as added security. The cord will act as a safety leash and by securing it the possibility of the plug accidentally coming out of the outlet is greatly reduced. A 50 lb. (20 kg.) rated Zip Tie or several wraps of mechanics wire are examples of methods of securing the power cord.

The following graphic is an example of hanging the Air Pear Model 100:



DESTRATIFICATION FAN DETAIL

SCALE: NONE

NOTES:
1. INSTALL FAN CLOSE TO CEILING. (TYP 1'-6" TO 3'-0")
2. CONTRACTOR TO PROVIDE POWER FEED IN CONDUIT. THE ELECTRICAL CONNECTION CAN BE MADE IN A J-BOX (HARD WIRED) OR PLUG CONNECTION (J-BOX/RECEPTACLE).
3. THE THIRD MANUFACTURER SUPPLIED CHAIN CAN BE USED TO TILT THE FAN AT AN ANGLE.

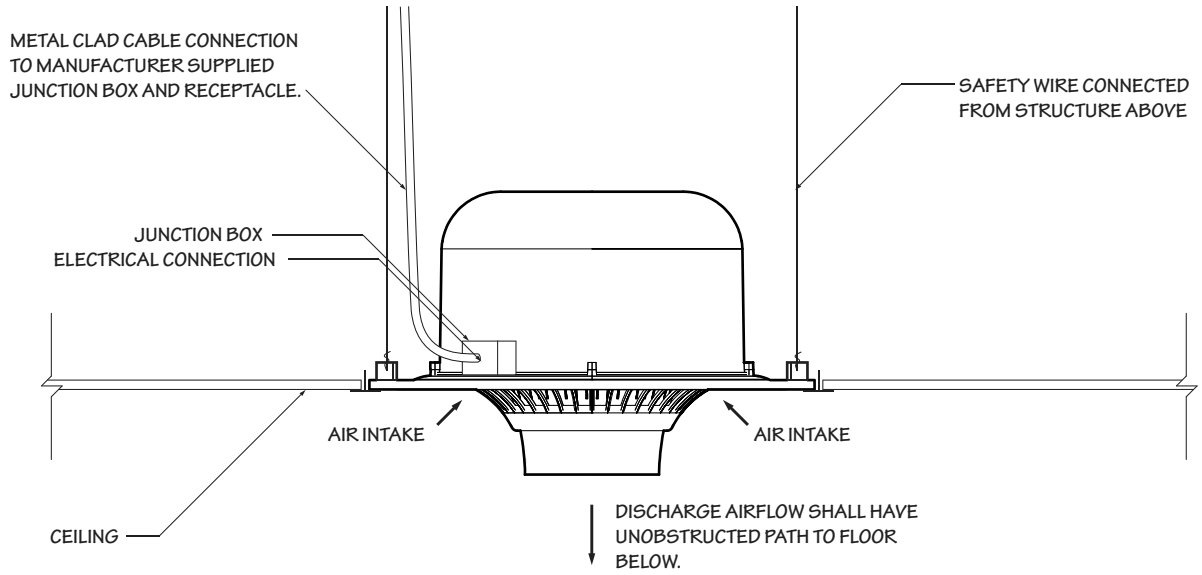
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Suspended Ceiling Air Pear Suggested Installation Methods

After ensuring the Air Pear system is firmly attached and after REMOVING YOUR HANDS FROM THE UNIT, ONLY THEN is it safe to plug the unit into the power source using the approved plug to confirm function and electrical continuity.

NOTE: Drill each of the four right angle corner tabs and secure the faceplate to the structure above with mechanics wire.

The following graphic is an example of hanging the typical Suspended Ceiling Air Pear unit:



DESTRATIFICATION FAN DETAIL

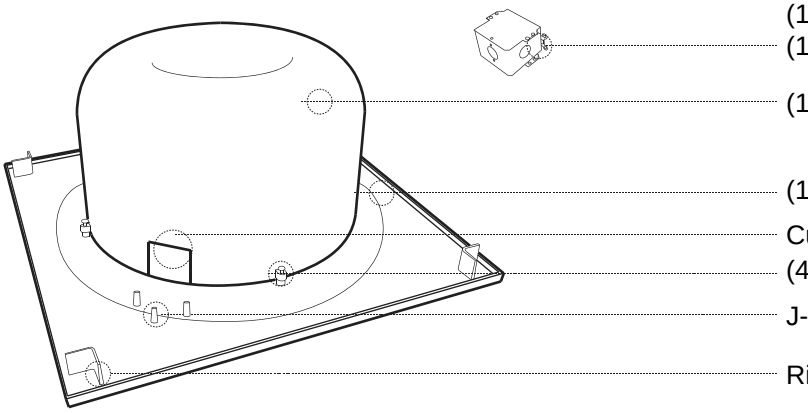
SCALE: NONE

NOTES:

1. CONTRACTOR SHALL INSTALL METAL CLAD CABLE TO MANUFACTURER SUPPLIED JUNCTION BOX AND RECEPTACLE.

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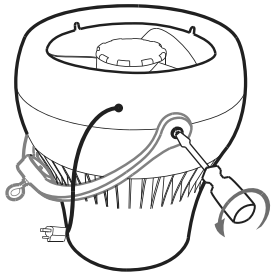
Suspended Ceiling Air Pear Assembly & Installation



*Included in hardware bag

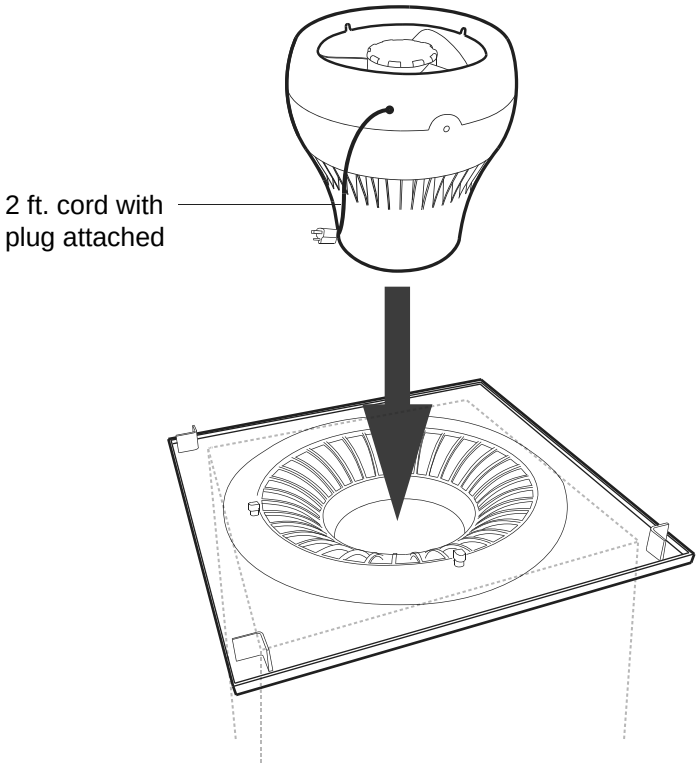
1

Remove the Air Pear from its box and plastic protective bag. The bail (handle) is attached via two Torx screws. Loosen these screws and remove the bail (discard at your discretion).



2

Remove all components from packing materials. Using the box that the suspended ceiling kit unit arrived in, open end up, place the 2’ x 2’ flat air intake grille over the open end of the box, face down. The right angle corner tabs should be facing up. Insert the Air Pear unit (with bail removed) into the center hole so that the nozzle extends below the air intake grille and the cord is hanging over the edge.



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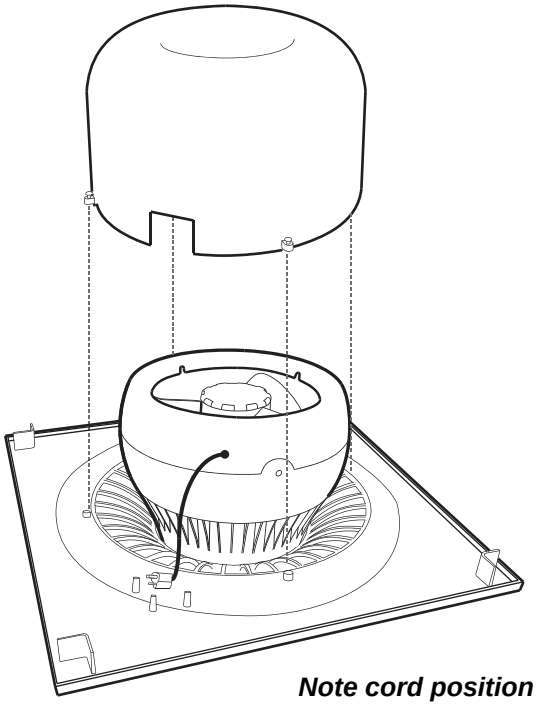
Suspended Ceiling Kit Assembly & Installation (cont.)

3

Place dome over Air Pear unit and align it with screw holes. Note that cutout should face the j-box mounting location. Dome should seat into the rim designed for it on the base, if necessary gently push the dome edge in until it seats inboard of the rim.

Insert the four Phillips screws (10-32 x 5/8” provided) through ears in dome and into threaded brass inserts. Screws will go in easily when aligned properly. Do not overtighten, as galling or stripping could occur.

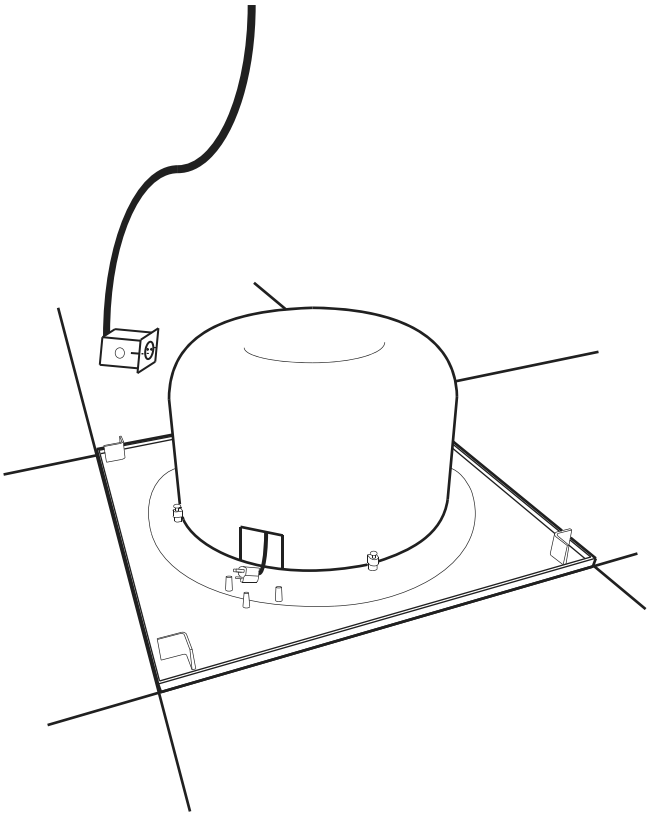
When dome is installed, the power cord needs to be fed through the cutout in the dome.



Note cord position

4

Have an electrician or similarly qualified person wire, with MC-type cable, the supplied receptacle into the j-box in close proximity to the intended installation location. Fasten the supplied metal faceplate to the j-box. Follow all local and national electric codes. MC cable should have enough length to ensure easy installation.



5

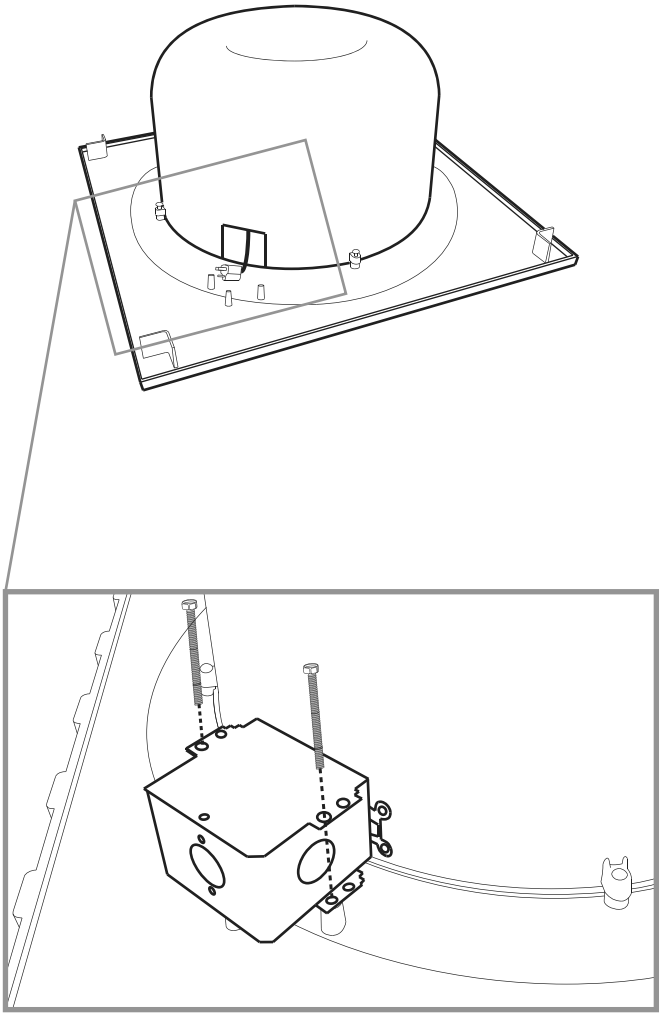
Place the assembled suspended ceiling kit into the T-bar grid. The air intake grille is designed to replace a 2’ x 2’ ceiling tile. If replacing a 2’ x 4’ tile, please use an additional piece of 2 ft. T-bar suspension material to finish the edge and provide additional strength and rigidity to the existing suspension system.

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Suspended Ceiling Air Pear Assembly & Installation (cont.)

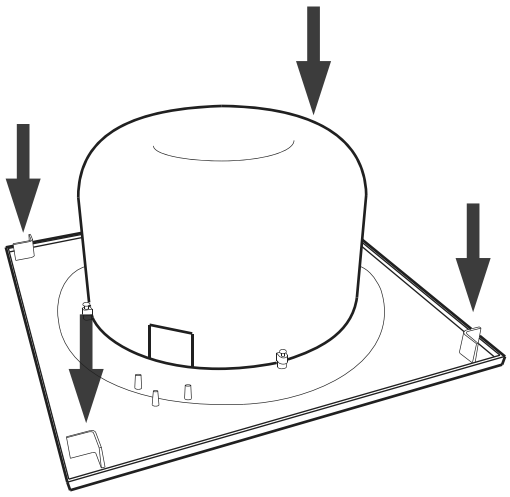
6

Plug the Air Pear power cord into the receptacle. Using the supplied thumbscrews, fasten the j-box to the air intake grill through the indicated holes as shown (wiring to j-box omitted for clarity).



7

The base has four right angle tabs located at each corner that can be drilled for additional ceiling/support wires to be added if desired.



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OPERATING THE FAN

Heating Season

Within an enclosed building space, with minimal air movement, hot lighter air rises to the ceiling while cold heavier air falls to the floor creating a temperature gradient. This condition will cause excess energy use as the HVAC system fights to maintain the thermostat set point typically at 5 ft. above floor level. This inefficient condition can also cause great thermal discomfort for the building occupants.

The Air Pear is an energy-efficient air turbine, designed to continuously move a column of air to the floor. A typical Air Pear installation includes a series of units mounted just below the ceiling, evenly spaced throughout a facility, working in concert to balance the air temperature ceiling to floor and wall to wall.

As air circulation improves and air temperatures balance, your HVAC system will require less and less energy to comfortably heat the work area, reducing the energy consumption of HVAC systems up to 35% or more. Once started, the entire process of “thermal equalization” will take, on average, less than 24 hours.

All Air Pear fans are designed to run continuously, year-round, to maintain thermal equalization and general air movement.

Cooling Season

We tend to think stratification occurs only in the heating season, but actually the condition exists year round. As you mechanically condition the air to combat rising outdoor temperatures, combined with minimal air movement, a large temperature gradient can exist.

The HVAC system will consume more energy as it fights the temperature gradient, hot and cold spots and short cycling compared to a properly mixed space. Using the Air Pear system will help alleviate the problem through thermal equalization. Keeping the thermostats satisfied longer and creating air movement that produces a cooling effect on the skin will result in the ability to raise the thermostat set points as much as 6° F, yielding up to an 18% energy savings during cooling seasons.

In non-air conditioned spaces, the Air Pear system can be used for spot cooling and general air circulation. If a large temperature differential exists between day and night, a strategy of drawing cool night air into the space and closing openings during the day can help maintain a cooler temperature internally as outdoor air temperatures rise.

A person’s head is most sensitive to comfort perception. Hot air trapped in the ceiling warms all the surrounding duct work, decking and other ceiling-mounted equipment to act as a radiant heat source and can cause the occupants to perceive discomfort. Reducing this radiant heat source through thermal equalization will help alleviate this condition.

All Air Pear fans are designed to run continuously, year-round, to maintain thermal equalization and general air movement. The fan speed can be maintained the same throughout the year or increased for the summer months to enhance the evaporative cooling effect if people in the space find this to be desirable.

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MAINTENANCE

Preventive Maintenance

Follow these easy steps to prevent any excess dirt buildup and preserve the life of the product:

No lubrication is required as bearings are sealed.

Cleaning:

- **Unplug unit from power source** first to prevent possible electrical shock and prevent injuries from spinning blades.
- Caution: Stationary blades can cause injury!
- You may clean the plastic housing with a damp cloth, using mild household detergent only.
- DO NOT use petroleum products, thinners, solvents, ammonia, alcohols or other chemicals to clean any part of the Air Pear unit.

Note: If fan is not operating or any parts are broken, contact manufacturer for replacement information.

TROUBLESHOOTING

General Troubleshooting

The Air Pear/Designer Series units are tested before they leave the factory, resulting in an extremely low rate of returns. However, mechanical devices do fail, and we recommend that you identify the problem and try the simple suggestions below.

Fan will not start:

a) Check fuses and circuit breakers.
b) Check voltage at fan connection.
c) Adjust the trim set screw in fan wall speed control (if using optional speed control). If minimum setting is too low the fan may shut off with voltage fluctuations. Increase minimum. See page 14 for more information.
d) Contact manufacturer for additional help: 1-888-AIR-PEAR (888-247-7327).

Fan airflow is too fast/slow:

a) Adjust speed control dial to produce desired flow. Adjust the trim set screw in fan wall speed control (if using optional speed control). If minimum setting is too low the fan may shut off with voltage fluctuations. Increase minimum. See page 14 for more information.

Fan has excess vibration (noise or wobbles):

a) Make certain the hanging hardware is secured tightly.
b) Contact manufacturer for additional help: 1-888-AIR-PEAR (888-247-7327).

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WARRANTY

Airius Warranty Policy

This warranty is limited to products purchased directly from Airius, LLC ("Airius") or one of its authorized resellers. To determine whether a reseller is authorized, please contact Airius at the contact information below.

Airius warrants products listed below will operate properly and be free of defects in materials and workmanship according to the following terms:

Products	Warranty Period
Air Pear Fans	3 Years (All Parts/Components)
Designer Series Fans	3 Years (All Parts/Components)
Retail Series Fans	3 Years (All Parts/Components)
Speed Controllers	1 Year (All Parts/Components)
Photohydroionization Cell	2 Years (All Parts/Components)

These include new units or units rebuilt under Airius' factory refurbish program. Airius will repair or replace such units, at Airius' sole discretion, if there is any defect in their materials or workmanship caused by Airius during the warranty period. With respect to replacement or repair rendered, Airius warrants that the parts replaced or repaired will operate properly and be free from defects in materials and workmanship for the remainder of the original warranty period.

Definitions:

1. The "warranty period" shall begin on the shipping date from the Airius factory to the customer (end user)
2. "Operate properly" applies to mechanical, electrical and structural functions only. No guarantee is made regarding the quantity of air movement or the appropriateness or the effectiveness or merchantability of any product for its intended purpose or for the customer's particular application.

Exclusions

Any of the following actions will constitute a breach of and will void all warranties:

1. Improper delivery, installation, or maintenance, including, but not limited to:
   a. Failure to follow the required installation procedures specified in the Airius "Installation Guide" and in all other documentation supplied with the fans and related equipment, including documentation provided by the manufacturers of the individual fan and control components;
   b. Failure to follow all applicable codes and ordinances, including, but not limited to the National Electric Code and state and local building codes;
   c. Failure to follow electrical engineering industry standards regarding the approved method of installing electrical equipment having the characteristics of the fans, the fan controls, and their related components, even if such standards are not explicitly referenced in any literature supplied by Airius or provided by the manufacturers of the fan and control components.
2. Any modification or alteration of, or adjustment to the fans, fan controls, and/or any disassembly of the components of the fans and fan controls for any purpose whatsoever, including any attempt to diagnose and/or repair any problem, without prior written authorization from Airius. Such disassembly includes, but is not limited to, separation of the motor from the housing assembly and/or removal of any electrical component from the fan controller unit.
3. Installation of fans into a detrimental environment with airborne oils / cutting fluids / solvents that may attack the base resin or motor, unless:
   a. Airius has provided written authorization prior to installation.
4. Misuse, abuse, accidents, unreasonable use or Acts of God.
5. Incorrect electric current, voltage or supply.
6. Failure to use fan controls supplied by Airius, unless:
   a. Airius has provided written authorization prior to installation; and
   b. The fan controls are built, operated and maintained according to specifications provided to and approved by Airius.

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Airius Warranty Policy (Continued)

7. Failure to perform periodic maintenance as detailed in the Airius-supplied "Installation Guide."
8. Consequential or incidental damages sustained by any person or entity as a result of any breach of these warranties are also excluded, except where such damages may not be excluded by law.

Acquiring Warranty Service

Do not return any item without first being assigned a Return Material Authorization (RMA) tag number. Customer must obtain a RMA# from Airius (888-AIR-PEAR or info@theairpear.com) before returning the faulty unit. RMA number must appear on the return-shipping label and be associated with any correspondence. Customer is responsible for all return shipping costs to:

Airius Warranty - RMA# ____
811 South Sherman Street
Longmont, Colorado 80501

Airius will return the unit(s) freight prepaid. Airius may elect to repair the same unit at customer site or offer replacement parts to facilitate repair and reduce customer down time and expense. Airius is not responsible for misuse of their product. Freight claims are the responsibility of the customer and all products are shipped FOB Longmont, Colorado, USA.

Remedy and Limit of Liability

The exclusive remedy of the purchaser, and the limit of liability for Airius, for any and all losses in connection with this product shall be repair or replacement of the warranted product or the affected components, as provided above.

Airius reserves the right to make the final determination, based on its own assessment, as to (1) whether the problem in question is the result of a defect in design, workmanship or materials, and not the result of error, misuse or abuse on the part of the customer, as set forth under the exclusions detailed above; (2) whether the problem or defect is material and requires action under this warranty; and (3) whether the remedy of repair or replacement is appropriate.

With regard to electrical and electronic components provided by Airius that comprise part of the products, including motors, Airius relies on the determination by the original manufacturer as to whether the failure of such component was the result of a defect. If the manufacturer of such component determines that there was no defect and therefore refuses to cover it under warranty, Airius likewise will not warranty such item.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY, REPRESENTATION OR CONDITION OF MERCHANTABILITY OR THAT THE PRODUCTS ARE FIT FOR ANY PARTICULAR PURPOSE OR USE, AND SPECIFICALLY IN LIEU OF ALL SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. REPAIR OR REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF AIRIUS FOR ANY SPECIAL, INDIRECT, INCIDENTIAL, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED, TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORESEEABLE.

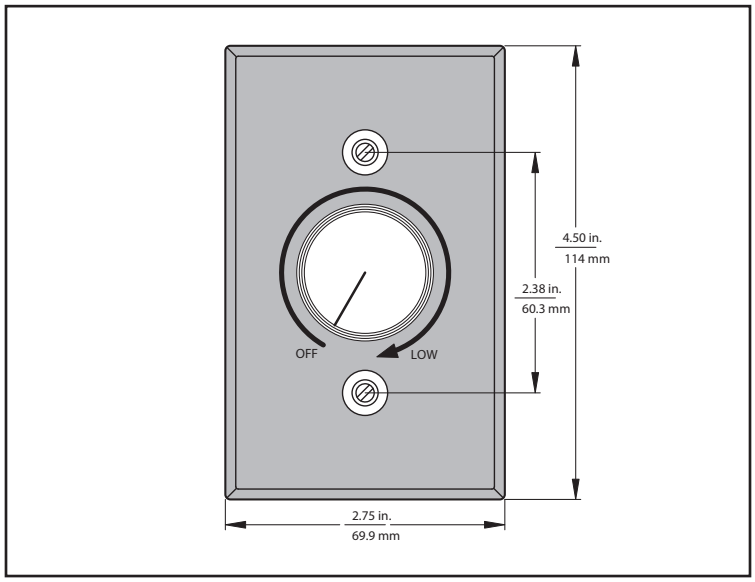
Any and all disputes related to this warranty or any other matter related to Airius must be submitted to binding arbitration within 45 radial miles of Longmont, Colorado. The arbitrator will follow the Colorado Uniform Arbitration Act and the Rules of the American Arbitration Association. Under Colorado law, punitive damages are not recoverable by any party subject to arbitration. Moreover, jury trials are not available in arbitration. The arbitration decision or award is legally binding and enforceable. To the extent that a court rules that this paragraph is not enforceable, the parties agree to resolve any and all disputes in the Boulder District Court in Boulder, Colorado.

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TRIAC-120-1.5 SPEED CONTROL SUBMITTAL

CONTROL OF SINGLE SHADED POLE/PSC MOTOR

MODEL	VOLTAGE	AMPS
TRIAC-120-1.5	120V	1.5



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
QUANTITY	

PART NUMBER & QUANTITY

☐ TRIAC-120-1.5 Qty. _____

TRIAC SPEED CONTROL DESCRIPTION

Airius speed controls are used to vary the speed of shaded pole (SP) or permanent split capacitor (PSC) motors. Speed controls for EC motors: refer to the potentiometer submittal. Speed control for EL fans: refer to the FanCenter submittal.

ATTRIBUTES AND CHARACTERISTICS

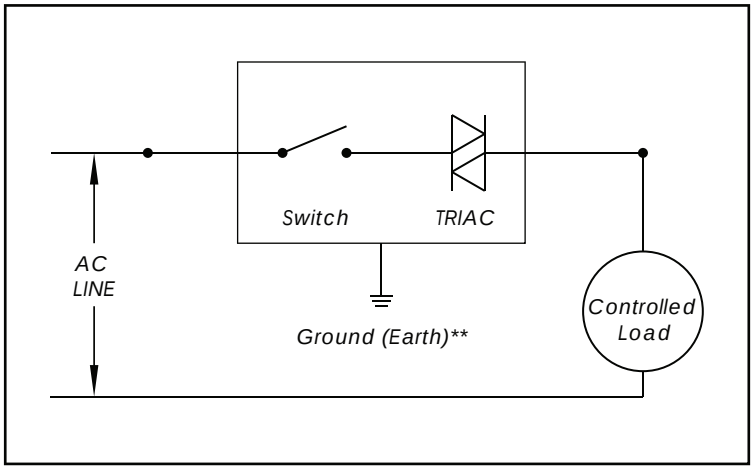
- Built-in On/Off AC line switch
- RFI filter (provides RFI and EMI suppression)
- All models mount in a standard 2" x 4" electrical wall box
- Faceplate (4.5" x 2.75"), knob, screws and wire nuts included
- Simple installation by a qualified electrician
- Off - Max - Hi - Med - Low speeds (4 step)
- Can control a single fan

CODE APPROVAL

- UL listing/recognition
- CSA certified

WARRANTY

- Warranty - 1 - years parts and workmanship



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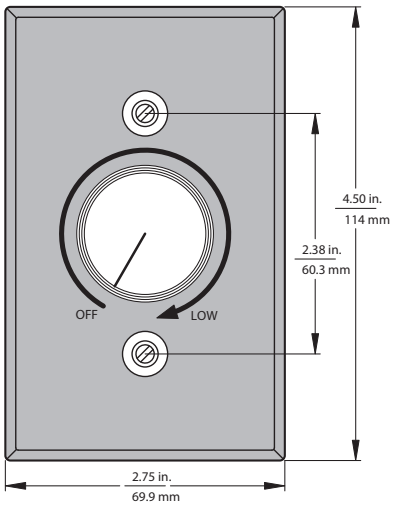
811 South Sherman Street, Longmont, Colorado 80501, Phone: 303.772.2633, Fax: 303.772.8276, info@airiusfans.com, www.airiusfans.com

May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

TRIAC-120-5 SPEED CONTROL SUBMITTAL

CONTROL OF SINGLE OR MULTIPLE SHADED POLE/PSC MOTOR

MODEL	VOLTAGE	AMPS
TRIAC-120-5	120V	5



PROJECT	
ENGINEER	
ARCHITECT	
CONTRACTOR	
SUBMITTED BY	
DATE	
QUANTITY	

PART NUMBER & QUANTITY

☐ TRIAC-120-5 Qty. _____

Note: Expect the fan to hum at the lower to middle speed where the sine-wave chopping is most severe. Fan control works best when fully loaded

TRIAC SPEED CONTROL DESCRIPTION

Airius speed controls are used to vary the speed of shaded pole (SP) or permanent split capacitor (PSC) motors. Speed controls for EC motors: refer to the potentiometer submittal. Speed control for EL fans: refer to the FanCenter submittal.

ATTRIBUTES AND CHARACTERISTICS

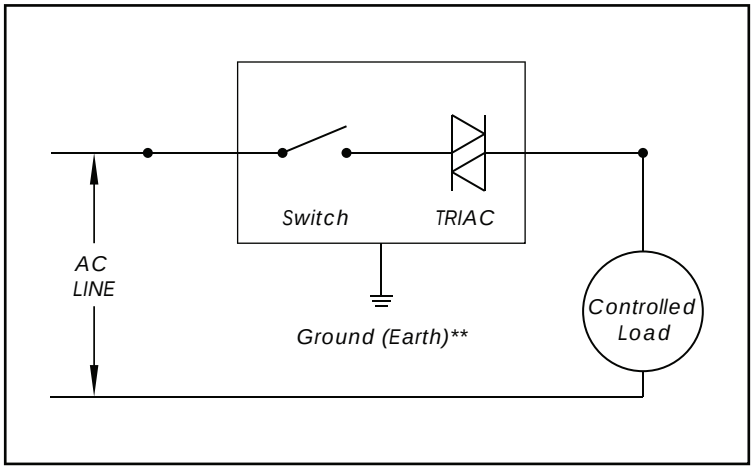
- *Built-in On/Off AC line switch*
- *Minimum speed trimpot*
- *RFI filter (provides RFI and EMI suppression)*
- *All models mount in a standard 2" x 4" electrical wall box*
- *Faceplate (4.5" x 2.75"), knob, screws and wire nuts included*
- *Simple installation by a qualified electrician*
- *Adjust top 50% RPM*
- *Can control multiple fans on a single dedicated circuit*

CODE APPROVAL

- *UL listing/recognition*
- *CSA certified*

WARRANTY

- *Warranty - 1 - years parts and workmanship*



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811 South Sherman Street, Longmont, Colorado 80501, Phone: 303.772.2633, Fax: 303.772.8276, info@airiusfans.com, www.airiusfans.com

May be covered by one or more of the following United States Patents: 7,381,129 B2; D514688 and other patents pending

Commercial Gas Water Heaters

CYCLONE® Mxi MODULATING

MODULATING BURNER ADVANCES THE CYCLONE TO HIGHER LEVELS OF EFFICIENCY

The full line of A. O. Smith Cyclone Mxi condensing water heaters has been designed to provide years of dependable service and feature industry leading technology. Models are available from 120,000 to 500,000 Btu/h and all deliver thermal efficiencies of 95% and higher. The unique helical coil heat exchanger limits weld joints for optimal service life while maximizing heat transfer.

Cyclone is the industry leader in high efficiency commercial water heating. The current Mxi modulating models adjust firing rate to the specific demand further increasing efficiency and money savings.

INTELLIGENT CONTROL SYSTEM WITH LCD DISPLAY AND iCOMM CONNECTIVITY

- Exclusive A. O. Smith designed touch display control system
- Provides detailed water heater status information
- Precise temperature control adjustable from 90 to 180 degrees
- Built-in diagnostics
- Run history information
- Cyclone® Mxi Modulating water heaters are compatible with the iCOMM™ remote monitoring system. Call 1.888.928.3702 for information.

COMING SPRING 2017

- Remote monitoring capability utilizing the iCOMM app. Wi-Fi connectivity kit requited for models 120-250, standard on models 300-500.

SUBMERGED COMBUSTION CHAMBER, WITH HELICAL HEAT EXCHANGER COIL

- Positioned in center of tank, surrounded by water to virtually eliminate radiant heat loss from chamber
- Direct spark ignition
- Spiral heat exchanger keeps hot burner gases swirling, uses centrifugal force to maximize efficiency of heat transfer to water in tank
- Spiral heat exchanger reduces lime scale from forming on water-side surfaces, which maintains energy efficiency over time

POWERED ANODES STANDARD ON ALL MODELS

- Provides long-lasting tank protection in varying water conditions
- Powered anodes are non-sacrificial
- Automatically adjusts output needed to properly protect the tank

PERMAGLAS® ULTRA COAT™ GLASS LINING

- Glass coating is applied using a liquid slush coating technique to ensure uniform coating
- Heat exchanger coil is glassed both externally and internally for optimum protection

MECHANICAL VENTING VERSATILITY

- Conventional power venting or direct venting
- Vents vertically or through a sidewall
- Front located exhaust and condensate connections allow for easy install and access
- Vents with low cost PVC Schedule 40 intake and exhaust pipe. Approved for optional CPVC Schedule 40, Polypropylene and AL29-4C stainless steel vent materials
- Direct-vent intake and exhaust pipe can terminate separately outside building or through single opening, using concentric vent assembly
- Canadian installations require ULC S636 PVC/ CPVC, ULC S636 Polypropylene and AL29-4C stainless steel pipe for intake and exhaust

HIGH EFFICIENCY MODULATING PRE-MIX POWERED BURNER

- Down-fired pre-mix burner provides optimum efficiency and quiet operation
- Top-mounted burner position prevents condensation from affecting burner operation

3-YEAR LIMITED TANK / 1-YEAR LIMITED PARTS WARRANTY

- For complete warranty information, consult written warranty or go to hotwater.com.



BTH-120(A) THROUGH BTH-500(A)
MODEL SHOWN:
BTH-199(A) SERIES 300/301

Low Lead Content
ENERGY STAR
CERTIFIED WATER QUALITY
ASME HLW
GAS-FIRED C UL US LISTED
iCOMM
AHRI CERTIFIED www.ahridirectory.org
ASME (Optional)

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www.hotwater.com | 800-527-1953 Toll-Free USA | A. O. Smith Corporation | 500 Tennessee Waltz Parkway | Ashland City, TN 37015

OTHER FEATURES:

SPACE-SAVING DESIGN FOR INSTALLATION FLEXIBILITY

- Easy-to-remove top cover for convenient access to serviceable parts
- 0″ installation clearances on sides and rear, 1-1/2″ installation clearance on top
- Handhole cleanout allows easy access to tank interior for cleaning
- 0″ clearance to combustibles, approved for installation on combustible floors

CODES AND STANDARDS

- CSA certified and ASME rated T&P relief valve
- Maximum hydrostatic working pressure: 160 psi
- All models are design certified by Underwriters Laboratories (UL), Inc., to ANSI Z21.10.3 - CSA 4.3 Standards
- Meets the thermal efficiency and standby loss requirements of the U.S. Department of Energy and current edition ASHRAE/IES 90.1
- Design Certified by Underwriters Laboratories to NSF standard 5 for 180°F (62°C) water
- Complies with SCAQMD Rule 1146.2 and other Air Quality Management Districts with similar requirements for ultra low-NOx emissions
- ASME tank construction optional on 120-500 model sizes

VENT REQUIREMENTS FOR BTH 120(A) - 250(A)

Number of 90° Elbows Installed	3 Inch Pipe	4 Inch Pipe
	Maximum Feet (Meters)	Maximum Feet (Meters)
One (1)	45 feet (13.7 meters)	115 feet (35 meters)
Two (2)	40 feet (12.2 meters)	110 feet (33.5 meters)
Three (3)	35 feet (10.7 meters)	105 feet (32 meters)
Four (4)	30 feet (9.1 meters)	100 feet (30.5 meters)
Five (5)	N/A	95 feet (29 meters)
Six (6)	N/A	90 feet (27.4 meters)

VENT REQUIREMENTS FOR BTH 300(A) - 500(A)

Number of 90° Elbows Installed	4 Inch Pipe	6 Inch Pipe
	Maximum Feet (Meters)	Maximum Feet (Meters)
One (1)	65 feet (19.8 meters)	115 feet (35 meters)
Two (2)	60 feet (18.2 meters)	110 feet (33.5 meters)
Three (3)	55 feet (16.8 meters)	105 feet (32 meters)
Four (4)	50 feet (15.2 meters)	100 feet (30.5 meters)
Five (5)	45 feet (13.7 meters)	95 feet (29 meters)
Six (6)	40 feet (12.2 meters)	90 feet (27.4 meters)

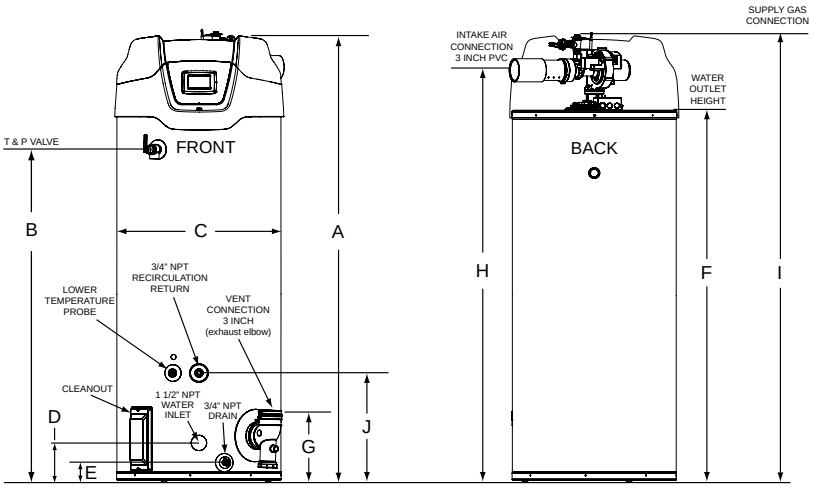
GAS PRESSURE REQUIREMENTS

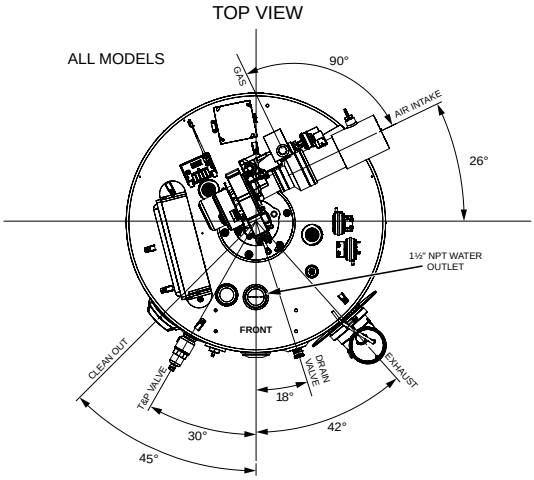
Model Number	Manifold Pressure		Minimum Supply Pressure		Maximum Supply Pressure	
	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas
BTH-120(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	3.5"W.C. (1.10 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-150(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	3.5"W.C. (1.10 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-199(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	3.5"W.C. (1.10 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-250(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	3.5"W.C. (1.10 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-300(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	4.8"W.C. (1.19 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-400(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	4.8"W.C. (1.19 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)
BTH-500(A)	0"W.C. (0 kPa)	0"W.C. (0 kPa)	4.8"W.C. (1.19 kPa)	8.5"W.C. (2.12 kPa)	14"W.C. (3.49 kPa)	14"W.C. (3.49 kPa)

Depending on the installed equivalent length, and/or the number of appliances connected, the supply gas line size may need to be increased beyond the minimum required size.

Commercial Gas Water Heaters

BTH 120-250





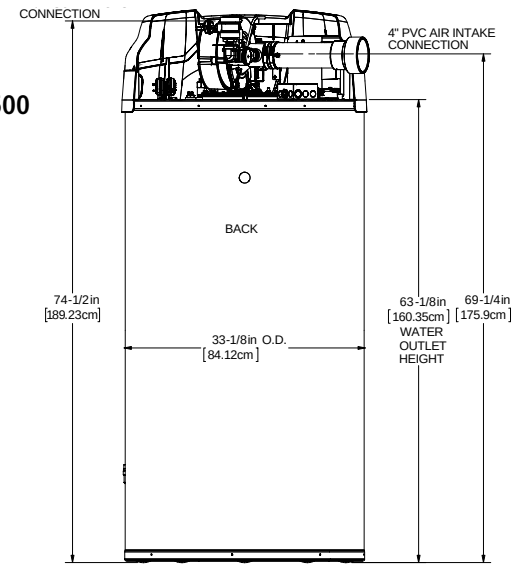
* Center line of water outlet on top of the water heaters is approximately 7 inches from the front edge of the water heater

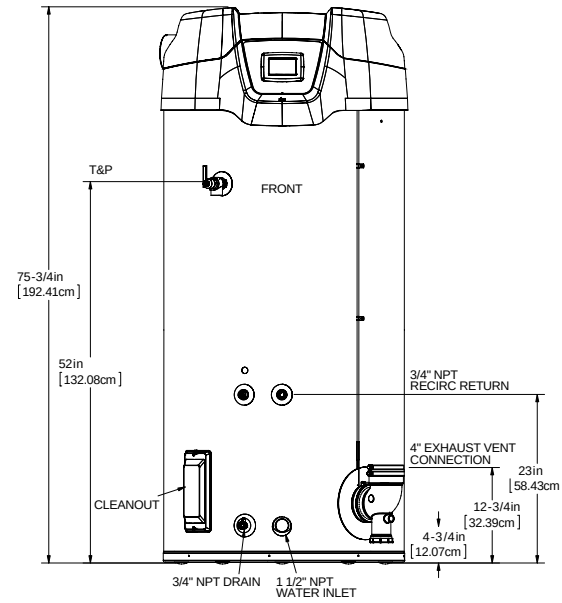
Model Number	Approx. Capacity		Dimensions										lb/kg	Approx. Shipping Weight Std	Approx. Shipping Weight ASME
			A	B	C	D	E	F	G	H	I	J			
BTH-120(A)	Gallons	60	55 1/2	35	27 3/4	6 5/16	3	42 1/4	11 1/4	48 1/2	53 1/2	18 1/4	lb	460	490
	Liters	227	141	88.9	70.5	16	7.62	107.32	28.6	123.2	135.9	46.36	kg	208	220
BTH-150(A)	Gallons	100	76 1/2	56 3/8	27 3/4	6 5/16	3	64	11 1/4	70	75 1/2	18 1/4	lb	523	553
	Liters	379	194.9	143.2	70.5	16	7.62	162.6	28.6	177.8	191.8	46.36	kg	237	251
BTH-199(A)	Gallons	100	76 1/2	56 3/8	27 3/4	6 5/16	3	64	11 1/4	70	75 1/2	18 1/4	lb	523	553
	Liters	379	194.9	143.2	70.5	16	7.62	162.6	28.6	177.8	191.8	46.36	kg	237	251
BTH-250(A)	Gallons	100	76 1/2	56 3/8	27 3/4	6 5/16	3	64	11 1/4	70	75 1/2	18 1/4	lb	523	553
	Liters	379	194.9	143.2	70.5	16	7.62	162.6	28.6	177.8	191.8	46.36	kg	237	251

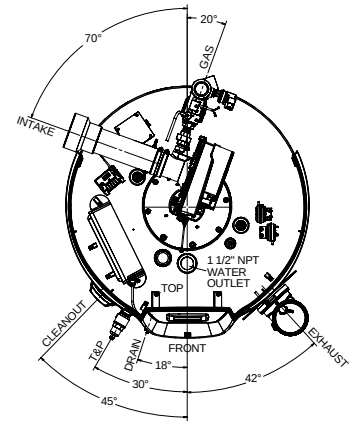
Electrical characteristics-120V-60Hz A.C., 5.0 A
"A" in model represents ASME construction
Propane gas models available
Dimensions and specifications subject to change without notice in accordance with our policy of continuous product improvement.

Commercial Gas Water Heaters

BTH 300-500







Model Number	Approx. Capacity		Dimensions										lb/kg	Approx. Shipping Weight Std	Approx. Shipping Weight ASME
			A	B	C	D	E	F	G	H	I	J			
BTH-300(A)	Gallons	119	75 3/4	52	33 1/8	4 3/4	4 3/4	63 1/8	12 3/4	69 1/4	74 1/2	23	lb	855	855
	Liters	450.96	192.41	132.08	84.12	12.07	12.07	160.35	32.39	175.9	189.23	58.43	kg	387	387
BTH-400(A)	Gallons	119	75 3/4	52	33 1/8	4 3/4	4 3/4	63 1/8	12 3/4	69 1/4	74 1/2	23	lb	855	855
	Liters	450.96	192.41	132.08	84.12	12.07	12.07	160.35	32.39	175.9	189.23	58.43	kg	387	387
BTH-500(A)	Gallons	119	75 3/4	52	33 1/8	4 3/4	4 3/4	63 1/8	12 3/4	69 1/4	74 1/2	23	lb	855	855
	Liters	450.96	192.41	132.08	84.12	12.07	12.07	160.35	32.39	175.9	189.23	58.43	kg	387	387

Electrical characteristics-120V-60Hz A.C., 5.0 A
"A" in model represents ASME construction
Propane gas models available
Dimensions and specifications subject to change without notice in accordance with our policy of continuous product improvement.

Commercial Gas Water Heaters

RECOVERY CAPACITY

Model Number	Type of Gas	Input		Thermal Efficiency
		BTU/HR	kW	
BTH-120(A)	Natural/Propane	120,000	35	95%
BTH-150(A)	Natural/Propane	150,000	44	98%
BTH-199(A)	Natural/Propane	199,900	58	97%
BTH-250(A)	Natural/Propane	250,000	73	96%
BTH-300(A)	Natural/Propane	300,000	88	96%
BTH-400(A)	Natural/Propane	399,900	117	95%
BTH-500(A)	Natural/Propane	499,900	146	95%

Model Number	U.S. GALLONS/HR AND LITRES/HR AT TEMPERATURE RISE INDICTATED													
	Approx. Capacity	°F	30°F	40°F	50°F	60°F	70°F	80°F	90°F	100°F	110°F	120°F	130°F	140°F
		°C	17°C	22°C	28°C	33°C	39°C	44°C	50°C	56°C	61°C	67°C	72°C	78°C
BTH-120(A)	60 U.S. Gals.	GPH	461	345	276	230	197	173	154	138	126	115	106	99
	227 Litres	LPH	1743	1308	1046	872	747	654	581	523	475	436	402	374
BTH-150(A)	100 U.S. Gals.	GPH	594	445	356	297	255	223	198	178	162	148	137	127
	379 Litres	LPH	2248	1686	1349	1124	963	843	749	674	613	562	519	482
BTH-199(A)	100 U.S. Gals.	GPH	783	588	470	392	336	294	261	235	214	196	181	168
	379 Litres	LPH	2965	2224	1779	1483	1271	1112	988	890	809	741	684	635
BTH-250(A)	100 U.S. Gals.	GPH	970	727	582	485	416	364	323	291	264	242	224	208
	379 Litres	LPH	3670	2753	2202	1835	1573	1376	1223	1101	1001	918	847	786
BTH-300(A)	119 U.S. Gals.	GPH	1164	873	698	582	499	436	388	349	317	291	269	249
	450.96 Litres	LPH	4405	3304	2643	2202	1888	1652	1468	1321	1201	1101	1017	944
BTH-400(A)	119 U.S. Gals.	GPH	1535	1151	921	767	658	576	512	460	419	384	354	329
	450.96 Litres	LPH	5810	4358	3486	2905	2490	2179	1937	1743	1585	1453	1341	1245
BTH-500(A)	119 U.S. Gals.	GPH	1919	1439	1151	959	822	720	640	576	523	480	443	411
	450.96 Litres	LPH	7263	5448	4358	3632	3113	2724	2421	2179	1981	1816	1676	1556

Recovery capacities are based on AHRI rated thermal efficiencies.
For ASME Construction add an "A" to the end of the model number ex: BTH-120A.

STORAGE CAPACITY

Model Number	U.S. Gallons	Liters
BTH 120	60	227
BTH 150	100	379
BTH 199	100	379
BTH 250	100	379
BTH 300	119	450.96
BTH 400	119	450.96
BTH 500	119	450.96

GAS LINE CONNECTION SIZE

Model	Series	Natural Gas	Propane Gas
BTH 120	300/301	3/4" NPT	3/4" NPT
BTH 150	300/301	3/4" NPT	3/4" NPT
BTH 199	300/301	3/4" NPT	3/4" NPT
BTH 250	300/301	3/4" NPT	3/4" NPT
BTH 300	300/301	1-1/2" NPT	1-1/2" NPT
BTH 400	300/301	1-1/2" NPT	1-1/2" NPT
BTH 500	300/301	1-1/2" NPT	1-1/2" NPT

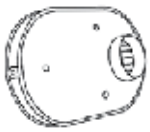
Commercial Gas Water Heaters

OPTIONAL KITS



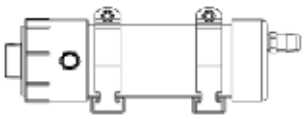
OPTIONAL CONCENTRIC VENT KITS

- BTH-120 - 250 vent kit p/n 100111100
- BTH-300 - 500 vent kit p/n 100113124



OPTIONAL LOW PROFILE TERMINATION VENT KITS

- 3˝ Flush Mount Vent Kit p/n 100187887
- 4˝ Flush Mount Vent Kit p/n 100187888
- 6˝ Flush Mount Vent Kit p/n 100187889



OPTIONAL CONDENSATE NEUTRALIZATION KITS

- BTH-120-199 kit p/n 100112380
- BTH-250-500 kit p/n 100112381

COMMON VENTING KITS FOR UP TO 3 WATER HEATERS (ONE KIT PER WATER HEATER REQUIRED)

Kit	Description
100227396	PVC Common Vent Kit, 120 – 250 Models
100223775	PVC Common Vent Kit, 300 – 500 Models
100227395	Polypropylene Common Vent Kit, 120 -250 Models
100223774	Polypropylene Common Vent Kit, 300 - 500 Models

Installations must comply with all national, state and local codes.
See kit instructions and corresponding water heater manual for detailed installation instructions and additional information.
50 Feet maximum equivalent length of straight pipe common vent and elbows
NOTE: Order 1 kit for each water heater.
See the Common Vent Kit manual or spec sheet for detailed information.

SPECIFICATION

(Natural or Propane) gas water heater(s) shall be A. O. Smith Cyclone Mxi model # _____ or equal, minimum 95% thermal efficiency, a storage capacity of _____ gallons, an input rating of _____ BTUs per hour, a recovery rating of _____ gallons per hour (gph) at 100°F rise and a maximum hydrostatic working pressure of 160 psi. Water heater(s) shall: 1. Modulating gas burner that automatically adjusts the input based on demand. 2. Powered anodes that are non sacrificial and maintenance free. 3. Have seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded; 4. Meets the thermal efficiency and/or standby loss requirements of the U. S. Department of Energy and current edition of ASHRAE/IES 90.1; 5. Have foam insulation and a CSA Certified and ASME rated T&P relief valve; 6. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up; 7. Be approved for 0˝ clearance to combustibles.

The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout. 1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 - CSA 4.3 standards governing storage type water heaters; 2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.

120K-250K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for power venting using a (3˝ or 4˝) _____ diameter PVC pipe for a total distance of (50 ft or 120 ft.) _____ equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a (3˝ or 4˝) _____ diameter PVC pipe for a total distance of (50 ft or 120 ft.) _____ equivalent feet of vent piping and (50 ft. or 120 ft.)_____ equivalent feet of intake air piping.

300K - 500K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for standard power venting using a (4˝ or 6˝)_____ diameter PVC pipe for a total distance of (70 ft. or 120 ft.)_____ equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a (4˝ or 6˝) _____ diameter PVC pipe for a total distance of (70 ft or 120 ft.) _____ equivalent feet of vent piping and (70 ft. or 120 ft.)_____ equivalent feet of intake air piping.

Operation of the water heater(s) in a closed system where thermal expansion has not been compensated for (with a properly sized thermal expansion tank) will void the warranty.

Water heater should incorporate the iCOMM™ system for remote monitoring, leak detection and fault alert.

For Technical Information, call 800-527-1953. A. O. Smith Corporation reserves the right to make product changes or improvements without prior notice.

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intelligent ICS control systems

RTU Solution

Dynamic Energy Management System for Roof Top Units

I-CON 3300

Forced-Air System Fuel Economizer



I-CON 2400

Commercial Air Conditioning Electricity Consumption Economizer



Features

- Dynamic Cycle Management (DCM) technology is guaranteed to reduce fuel and electricity consumption - typically 10% - 20% or more.
- Saves energy without replacing or upgrading costly system components and without violating manufacturers' warranties.
- Illuminated LCD display shows consumption savings, operating modes, system diagnostics and operating temperatures.
- Compatible on systems with undersized ducting.
- Compatible with packaged or split systems.
- Energy saving system is field tested and validated.
- Works with any thermostat including setback and multi-zone.
- Reduces maintenance and extends service.
- Simple installation by a qualified installer.
- Saves energy without sacrificing comfort.
- Maximum efficiency year round.
- 15 year limited manufacturer's warranty for breakdown or defects.

Honeywell Home

Thoughtfully designed. Expertly engineered.

THE HONEYWELL HOME T SERIES

Fits your business to a T.



BRILLIANT

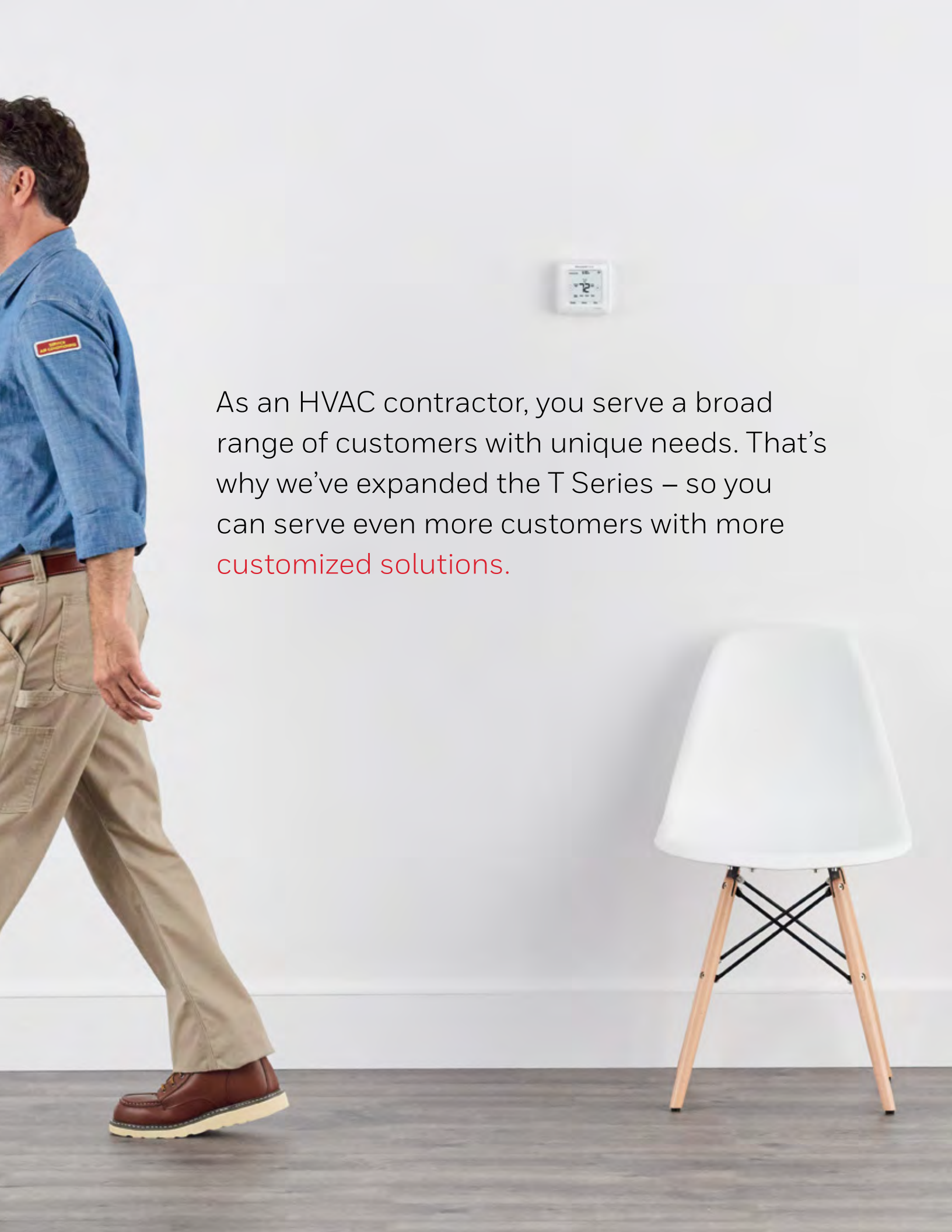
Meet the next generation of everyday comfort solutions.



T10 Pro Smart Thermostat with RedLINK™ Room Sensor

Get to know Honeywell Home T Series.

The T Series is a portfolio of non-connected and Wi-Fi connected thermostats that streamlines everything from product selection and installation to customer service and support. With a standard mount and simple interface, the T Series will enhance the entire thermostat experience for you and your customers alike.



As an HVAC contractor, you serve a broad range of customers with unique needs. That's why we've expanded the T Series – so you can serve even more customers with more customized solutions.



UWP mounting system

A thermostat series designed with

CONTRACTORS IN MIND

Intuitive setup

Fits your technicians to a T

Every T Series thermostat features on-screen menus with familiar installer setup (ISU) steps, helping to eliminate the learning curve that can come with a new product. Your techs will be T Series experts in no time.

Faster installs

Fits your install process to a T

With the UWP mounting system, you can standardize your training program, install process, and truck stock – helping your techs get in and out and on their way more quickly and efficiently.

Easy upsell

Fits your revenue model to a T

The T Series has a snap-together design that enables you to easily move customers from a non-connected to a connected thermostat without having to rip and replace the connector and cover plate.*

*C-wire required

Discover all the ways the Honeywell Home T Series fits your business to a T. Get product info, training materials and more at **ForwardThinking.HoneywellHome.com/TSeries.**

DELIVER CONNECTIVITY

without the complexity

Consumers want a connected experience that streamlines and simplifies home comfort. The T10 Pro Smart Thermostat with RedLINK™ Room Sensor and T6 Pro Smart Thermostat will fit their needs to a T. They're easy to use, easy to love, and best of all, easy for your techs to install and set up.



T10 Pro Smart Thermostat with RedLINK™ Room Sensor

T6 Pro Smart Thermostat

Smart Features

Flexible comfort control

The T10 Pro Smart with RedLINK™ Room Sensor allows homeowners to prioritize comfort in the rooms that matter most, using time-based scheduling, motion detection or geofencing. The T6 Pro Smart allows homeowners to customize comfort using geofencing or scheduling.

Seamless smart home integration

The T10 Pro Smart and T6 Pro Smart seamlessly integrate with smart home partners like Google Assistant and Amazon Alexa for customers who want to control all their smart home devices with voice commands or a single app.

Simple Functionality

Familiar installer setup

Technicians can configure the T10 Pro Smart and T6 Pro Smart and connect to Wi-Fi right on the device – making installation quick and easy.

Intuitive operation

Homeowners can choose to do scheduling on the thermostat, or they can use the highly rated Honeywell Home app.

Optional IAQ control

With the T10 Pro Smart, you can control one humidification, dehumidification or ventilation solution, and with the T6 Pro Smart, you can choose optional ventilation control and dual fuel.



T6 Pro Smart

Works with Apple HomeKit

WORKS WITH amazon alexa

T10 Pro Smart

works with the Google Assistant

WORKS WITH amazon alexa

T SERIES COMPARISON CHART

Thermostat	Thermostat name	Program options	Power method	Display size	Stages	Dual fuel	Ventilation with ERV/HRV or damper	Wired indoor/ outdoor sensors	Service reminders
	**T10 Pro Smart with RedLINK™ Room Sensor** THX321WFS2001W **RedLINK™ Room Sensor (2-pack)** C7189R2002-2	Geofencing, 7-day, 5-2, 5-1-1, 1 or non-programmable	C-wire only	7.27 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	Yes* *With humidifier, dehumidifier, or ventilator capabilities	Yes	Yes
	**T6 Pro Smart** TH6320WF2003	Geofencing, 7-day, 5-2, 5-1-1 or non-programmable	C-wire only	6.89 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	Yes	Yes	Yes
	**T6 Pro Smart** TH6220WF2006	Geofencing, 7-day, 5-2, 5-1-1 or non-programmable	C-wire only	6.89 sq. in.	2H/1C Heat Pump + 2H/2C Conventional	No	No	Yes	Yes
	**T6 Pro Z-Wave™** TH6320ZW2003	7-day, 5-2, 5-1-1, non-programmable or occupancy controlled	Battery or C-wire	6.89 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Yes
	**T6 Pro Hydronic** TH6100AF2004	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	1 Stage Hot Water Heat Only – No Fan	No	No	Yes	No
	**T6 Pro** TH6320U2008	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Limited
	**T6 Pro** TH6220U2000	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	2H/1C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Limited
	**T6 Pro** TH6210U2001	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	2H/1C Heat Pump + 1H/1C Conventional	No	No	No	Limited
	**T4 Pro** TH4110U2005	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	3.93 sq. in.	1H/1C Heat Pump + 1H/1C Conventional	No	No	No	Limited
	**T1 Pro** TH1110D2009	Non-programmable	Battery or C-wire	2.37 sq. in.	1H/1C Conventional or 1H/1C Heat Pump	No	No	No	No
	**T1 Pro** TH1010D2000	Non-programmable	Battery or C-wire	2.37 sq. in.	1 stage heat-only or cool-only	No	No	No	No

For more information

ForwardThinking.HoneywellHome.com/TSeries

resideo

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Golden Valley, MN 55422
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resideo.com

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Honeywell Home

intelligent ICS control systems

RTU Solution

Dynamic Energy Management System for Roof Top Units

I-CON 3300

Forced-Air System Fuel Economizer



I-CON 2400

Commercial Air Conditioning Electricity Consumption Economizer



Features

- Dynamic Cycle Management (DCM) technology is guaranteed to reduce fuel and electricity consumption - typically 10% - 20% or more.
- Saves energy without replacing or upgrading costly system components and without violating manufacturers' warranties.
- Illuminated LCD display shows consumption savings, operating modes, system diagnostics and operating temperatures.
- Compatible on systems with undersized ducting.
- Compatible with packaged or split systems.
- Energy saving system is field tested and validated.
- Works with any thermostat including setback and multi-zone.
- Reduces maintenance and extends service.
- Simple installation by a qualified installer.
- Saves energy without sacrificing comfort.
- Maximum efficiency year round.
- 15 year limited manufacturer's warranty for breakdown or defects.

AM CONSERVATION GROUP, INC.

DUAL SPRAY SWIVEL AERATOR



Product Highlights

Our Dual Spray Swivel Aerator allows for directing the water flow where it's needed most providing greater efficiencies. It offers two stream options: a full force multiple stream and a splash-free bubble stream and a contains a 360° swivel helping to reduce water use and boosts water pressure.

Product Details

- Dual threaded
- Fits most male and female threaded faucets
- Available in bulk, individually packaged or in contractor ten packs

Item Code	Flow Rate	Finish	Dual Stream		Dual Thread		Case Qty	Certifications	
			Compact	Extended	Male	Female		ASME A112.18.1/CSA B125.1	Low Lead
FA035-C-1.5	1.5 gpm	Chrome	Aerated	Multi-spray	15/16" -27	55/64" -27	250	Yes	Yes
FA035-C-2.0	2.0 gpm	Chrome	Aerated	Multi-spray	15/16" -27	55/64" -27	250	Yes	Yes

Certification and Performance Requirements

- Low lead compliant (AB-1953)
- ANSI specification A112.18.1, CSA, CEC, DOE
- Meets Performance Requirements for:
  California Energy Commission
  Department of Environmental Conservation
  Canadian Standards Association,
  Federal, State and Local plumbing standards

water efficiency

2301 Charleston Regional Parkway • Charleston, South Carolina 29492 • 800.GOOD.BUY • 800.777.5655
sales@amconservationgroup.com • www.amconservationgroup.com

Pressure Compensating Bubble Spray Faucet Aerator



Our Niagara Conservation branded Pressure Compensated Bubble Spray Aerators are an innovative water-saving solution designed to accommodate both male and female applications. These faucet aerators save water and energy by producing forceful streams at a reduced flow rate that minimizes the amount of energy needed to heat hot water.

Features

- All brass chrome plated dual threaded body
- Fits most male and female threaded faucets, Male: 15/16-27, Female: 55/64-27
- Pressure compensating technology guarantees a consistent flow rate across a wide range of pressure
- Bubble Spray
- 10 year warranty**

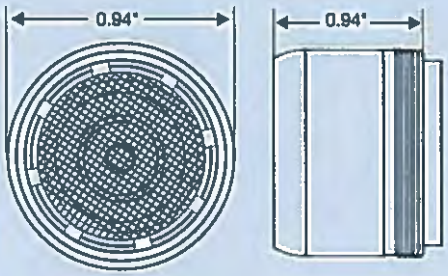
Certification and Performance Requirements

- ASME A112.18.1 / CSA B125.1; ANSI/NSF 61

Certified by CSA Group

Model #	Spray	Finish	Flow Rate	Watersense	Case Qty
N3210B-PC	Aerated Bubble	Chrome	1.0 GPM	Yes	500
N3104-PC	Aerated Bubble	Chrome	1.5 GPM	Yes	500

Dimensions



*Dimensions are subject to change

Potential Annual Savings[1]

	Flow Rate	Water	Electric Heating	Gas Heating
Dollar Savings	1.0 GPM	$104	$67	$37
Utility Savings	1.0 GPM	10,512 Gallons	594 kWh	33 Therms
Dollar Savings	1.5 GPM	$51	$39	$21
Utility Savings	1.5 GPM	6,132 Gallons	347 kWh	19 Therms

Factors in calculating savings potential

- 3 person households each person using a faucet 8 minutes per day 365 days per year (AWWARF Residential Study)
- Comparing water use with these aerator vs. a standard 2.2 GPM unit
- US city average water and sewer cost of $8.3 per 1,000 gallons (study done by AUS Consulting Group 2011)
- Average cost of electricity 0.113c per kWh (Energy Star Nov 2013 Lightbulb Calculator — http://www.energystar.gov/ia/products/prod_lists/lamps_savings)
- Average cost of gas $1.137 per therm (Bureau of Labor Statistics April 2014)
- Calculations done by http://www.fishnick.com/savewater/tools/watercalculator

**WARRANTY DETAILS

AM Conservation Group, Inc. guarantees to the original purchaser or recipient of an aerator that it is free from defects in material and workmanship for a period of 10 years. AM Conservation Group, Inc. will at our choice replace any part of the aerator which is in our opinion defective provided that the product has not been abused, misused, altered, or damaged after its purchase. This includes damage due to the use of tools or harsh chemicals. In the event a product has been discontinued, AM Conservation Group, Inc. will replace it with what we determine to be the closest product. AM Conservation Group, Inc. is not responsible for labor charges, installation, or other consequential cost. AM Conservation Group, Inc.'s responsibility shall not exceed the original cost of the product.

AM CONSERVATION GROUP, INC. | Offering NIAGARA CONSERVATION BRAND

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sales@amconservationgroup.com • www.amconservationgroup.com

Water Efficiency

Honeywell Home

Thoughtfully designed. Expertly engineered.

THE HONEYWELL HOME T SERIES

Fits your business to a T.



BRILLIANT

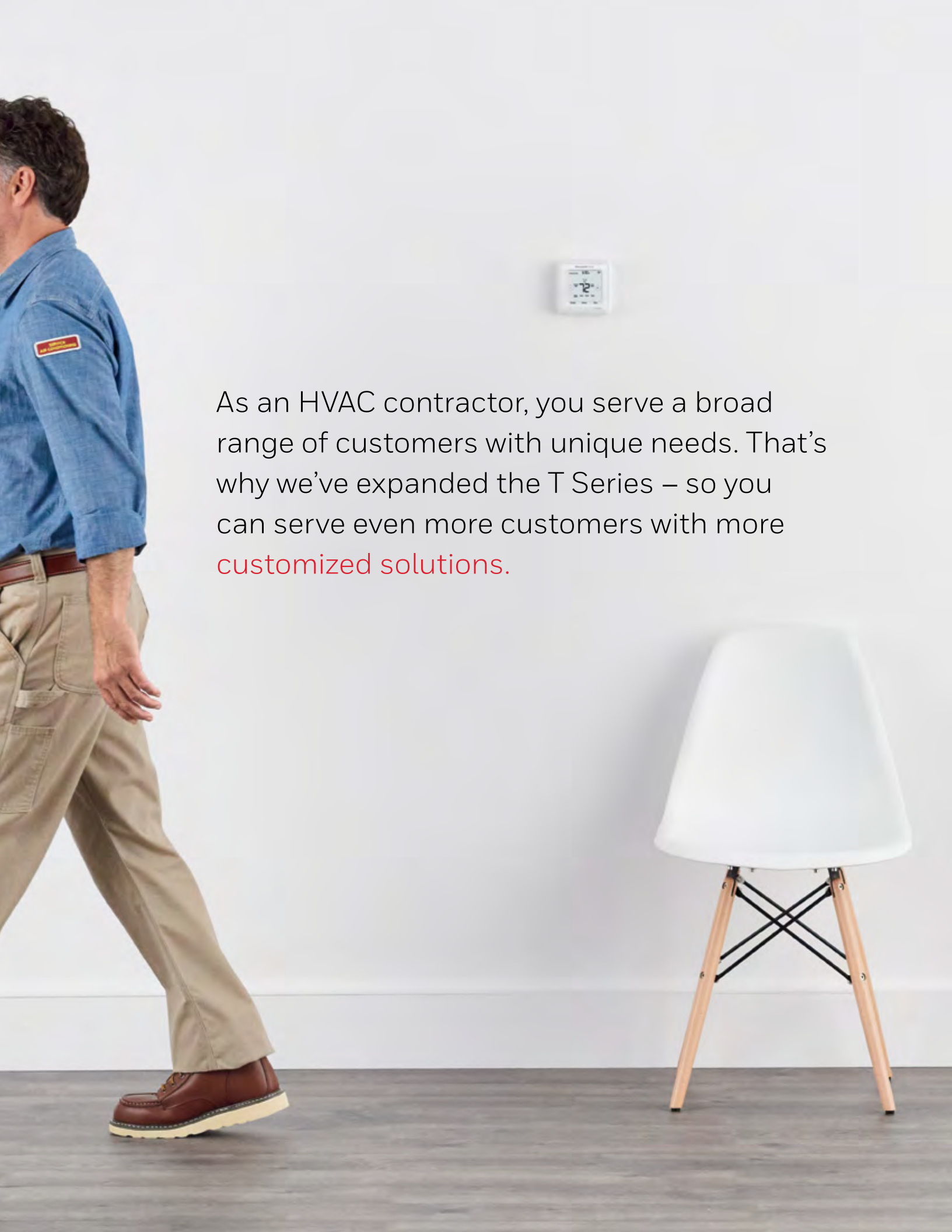
Meet the next generation of everyday comfort solutions.



T10 Pro Smart Thermostat with RedLINK™ Room Sensor

Get to know Honeywell Home T Series.

The T Series is a portfolio of non-connected and Wi-Fi connected thermostats that streamlines everything from product selection and installation to customer service and support. With a standard mount and simple interface, the T Series will enhance the entire thermostat experience for you and your customers alike.



As an HVAC contractor, you serve a broad range of customers with unique needs. That's why we've expanded the T Series – so you can serve even more customers with more customized solutions.



UWP mounting system

A thermostat series designed with

CONTRACTORS IN MIND

Intuitive setup

Fits your technicians to a T

Every T Series thermostat features on-screen menus with familiar installer setup (ISU) steps, helping to eliminate the learning curve that can come with a new product. Your techs will be T Series experts in no time.

Faster installs

Fits your install process to a T

With the UWP mounting system, you can standardize your training program, install process, and truck stock – helping your techs get in and out and on their way more quickly and efficiently.

Easy upsell

Fits your revenue model to a T

The T Series has a snap-together design that enables you to easily move customers from a non-connected to a connected thermostat without having to rip and replace the connector and cover plate.*

*C-wire required

Discover all the ways the Honeywell Home T Series fits your business to a T. Get product info, training materials and more at **ForwardThinking.HoneywellHome.com/TSeries.**

DELIVER CONNECTIVITY

without the complexity

Consumers want a connected experience that streamlines and simplifies home comfort. The T10 Pro Smart Thermostat with RedLINK™ Room Sensor and T6 Pro Smart Thermostat will fit their needs to a T. They're easy to use, easy to love, and best of all, easy for your techs to install and set up.



T10 Pro Smart Thermostat with RedLINK™ Room Sensor

T6 Pro Smart Thermostat

Smart Features

Flexible comfort control

The T10 Pro Smart with RedLINK™ Room Sensor allows homeowners to prioritize comfort in the rooms that matter most, using time-based scheduling, motion detection or geofencing. The T6 Pro Smart allows homeowners to customize comfort using geofencing or scheduling.

Seamless smart home integration

The T10 Pro Smart and T6 Pro Smart seamlessly integrate with smart home partners like Google Assistant and Amazon Alexa for customers who want to control all their smart home devices with voice commands or a single app.

Simple Functionality

Familiar installer setup

Technicians can configure the T10 Pro Smart and T6 Pro Smart and connect to Wi-Fi right on the device – making installation quick and easy.

Intuitive operation

Homeowners can choose to do scheduling on the thermostat, or they can use the highly rated Honeywell Home app.

Optional IAQ control

With the T10 Pro Smart, you can control one humidification, dehumidification or ventilation solution, and with the T6 Pro Smart, you can choose optional ventilation control and dual fuel.



T6 Pro Smart

Works with Apple HomeKit

WORKS WITH amazon alexa

T10 Pro Smart

works with the Google Assistant

WORKS WITH amazon alexa

T SERIES COMPARISON CHART

Thermostat	Thermostat name	Program options	Power method	Display size	Stages	Dual fuel	Ventilation with ERV/HRV or damper	Wired indoor/ outdoor sensors	Service reminders
	**T10 Pro Smart with RedLINK™ Room Sensor** THX321WFS2001W **RedLINK™ Room Sensor (2-pack)** C7189R2002-2	Geofencing, 7-day, 5-2, 5-1-1, 1 or non-programmable	C-wire only	7.27 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	Yes* *With humidifier, dehumidifier, or ventilator capabilities	Yes	Yes
	**T6 Pro Smart** TH6320WF2003	Geofencing, 7-day, 5-2, 5-1-1 or non-programmable	C-wire only	6.89 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	Yes	Yes	Yes
	**T6 Pro Smart** TH6220WF2006	Geofencing, 7-day, 5-2, 5-1-1 or non-programmable	C-wire only	6.89 sq. in.	2H/1C Heat Pump + 2H/2C Conventional	No	No	Yes	Yes
	**T6 Pro Z-Wave™** TH6320ZW2003	7-day, 5-2, 5-1-1, non-programmable or occupancy controlled	Battery or C-wire	6.89 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Yes
	**T6 Pro Hydronic** TH6100AF2004	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	1 Stage Hot Water Heat Only – No Fan	No	No	Yes	No
	**T6 Pro** TH6320U2008	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	3H/2C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Limited
	**T6 Pro** TH6220U2000	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	2H/1C Heat Pump + 2H/2C Conventional	Yes	No	Yes	Limited
	**T6 Pro** TH6210U2001	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	5.44 sq. in.	2H/1C Heat Pump + 1H/1C Conventional	No	No	No	Limited
	**T4 Pro** TH4110U2005	7-day, 5-2, 5-1-1 or non-programmable	Battery or C-wire	3.93 sq. in.	1H/1C Heat Pump + 1H/1C Conventional	No	No	No	Limited
	**T1 Pro** TH1110D2009	Non-programmable	Battery or C-wire	2.37 sq. in.	1H/1C Conventional or 1H/1C Heat Pump	No	No	No	No
	**T1 Pro** TH1010D2000	Non-programmable	Battery or C-wire	2.37 sq. in.	1 stage heat-only or cool-only	No	No	No	No

For more information

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Honeywell Home

armacell®

Tolerances for AP Armaflex® Black Lap Seal*

Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
3/8" Walls												
IPBST05838	1/2" Copper	0.625	0.710	0.750	0.790	0.300	0.363	0.425	1.310	1.475	1.640	2.6
IPBST03438	5/8" Copper	0.750	0.810	0.860	0.910	0.300	0.363	0.425	1.410	1.585	1.760	2.4
IPBST07838	3/4" Copper	0.875	0.940	0.995	1.050	0.300	0.363	0.425	1.540	1.720	1.900	2.4
IPBST11838	1" Copper	1.125	1.200	1.255	1.310	0.300	0.363	0.425	1.800	1.980	2.160	2.3
IPBST13838	1-1/4" Copper	1.375	1.450	1.510	1.570	0.300	0.363	0.425	2.050	2.235	2.420	2.2
IPBST15838	1-1/2" Copper	1.625	1.710	1.770	1.830	0.350	0.413	0.475	2.410	2.595	2.780	2.5
IPBST11038	1 1/2" IPS	1.900	1.970	2.030	2.090	0.350	0.413	0.475	2.670	2.855	3.040	2.4
IPBST21838	2" Copper	2.125	2.220	2.280	2.340	0.350	0.413	0.475	2.920	3.105	3.290	2.4
1/2" Walls												
IPBST03812	1/4" Copper	0.375	0.420	0.460	0.500	0.360	0.423	0.485	1.140	1.305	1.470	3.3
IPBST01212	3/8" Copper	0.500	0.560	0.600	0.640	0.380	0.443	0.505	1.320	1.485	1.650	3.3
IPBST05812	1/2" Copper	0.625	0.710	0.750	0.790	0.400	0.463	0.525	1.510	1.675	1.840	3.4
IPBST03412	5/8" Copper	0.750	0.810	0.860	0.910	0.420	0.483	0.545	1.650	1.825	2.000	3.3
IPBST07812	3/4" Copper	0.875	0.940	0.995	1.050	0.430	0.493	0.555	1.800	1.980	2.160	3.3
IPBST11812	1" Copper	1.125	1.200	1.255	1.310	0.450	0.513	0.575	2.100	2.280	2.460	3.3
IPBST13812	1-1/4" Copper	1.375	1.450	1.510	1.570	0.460	0.523	0.585	2.370	2.555	2.740	3.2
IPBST15812	1-1/2" Copper	1.625	1.710	1.770	1.830	0.470	0.533	0.595	2.650	2.835	3.020	3.2
IPBST11012	1 1/2" IPS	1.900	1.970	2.030	2.090	0.480	0.543	0.605	2.930	3.115	3.300	3.1
IPBST21812	2" Copper	2.125	2.220	2.280	2.340	0.490	0.553	0.615	3.200	3.385	3.570	3.2
IPBST20012	2" IPS	2.375	2.470	2.540	2.610	0.500	0.563	0.625	3.470	3.665	3.860	3.2
IPBST25812	2-1/2" Copper	2.625	2.720	2.800	2.880	0.500	0.563	0.625	3.720	3.925	4.130	3.2
IPBST21012	2-1/2" IPS	2.875	2.980	3.060	3.140	0.500	0.563	0.625	3.980	4.185	4.390	3.2
IPBST31812	3" Copper	3.125	3.230	3.310	3.390	0.500	0.563	0.625	4.230	4.435	4.640	3.2
IPBST30012	3" IPS	3.500	3.610	3.685	3.760	0.500	0.563	0.625	4.610	4.810	5.010	3.1
IPBST35812	3-1/2" Copper	3.625	3.740	3.810	3.880	0.500	0.563	0.625	4.740	4.935	5.130	3.1
IPBST41812	4" Copper	4.125	4.250	4.335	4.420	0.500	0.563	0.625	5.250	5.460	5.670	3.1
IPBST40012	4" IPS	4.500	4.600	4.690	4.780	0.500	0.563	0.625	5.600	5.815	6.030	3.0
3/4" Walls												
IPBST03834	1/4" Copper	0.375	0.420	0.460	0.500	0.620	0.683	0.745	1.660	1.825	1.990	5.9
IPBST01234	3/8" Copper	0.500	0.560	0.600	0.640	0.620	0.683	0.745	1.800	1.965	2.130	5.5
IPBST05834	1/2" Copper	0.625	0.710	0.750	0.790	0.660	0.723	0.785	2.030	2.195	2.360	5.6
IPBST03434	5/8" Copper	0.750	0.810	0.860	0.910	0.680	0.743	0.805	2.170	2.345	2.520	5.5
IPBST07834	3/4" Copper	0.875	0.940	0.995	1.050	0.700	0.763	0.825	2.340	2.520	2.700	5.4
IPBST11834	1" Copper	1.125	1.200	1.255	1.310	0.740	0.803	0.865	2.680	2.860	3.040	5.4
IPBST13834	1-1/4" Copper	1.375	1.450	1.510	1.570	0.750	0.813	0.875	2.950	3.135	3.320	5.3
IPBST15834	1-1/2" Copper	1.625	1.710	1.770	1.830	0.750	0.813	0.875	3.210	3.395	3.580	5.1
IPBST11034	1 1/2" IPS	1.900	1.970	2.030	2.090	0.750	0.813	0.875	3.470	3.655	3.840	4.9
IPBST21834	2" Copper	2.125	2.220	2.280	2.340	0.750	0.813	0.875	3.720	3.905	4.090	4.8
IPBST20034	2" IPS	2.375	2.580	2.680	2.780	0.750	0.813	0.875	4.080	4.305	4.530	5.2
IPBST25834	2-1/2" Copper	2.625	2.720	2.800	2.880	0.750	0.813	0.875	4.220	4.425	4.630	4.7
IPBST21034	2-1/2" IPS	2.875	3.080	3.180	3.280	0.750	0.813	0.875	4.580	4.805	5.030	5.0
IPBST31834	3" Copper	3.125	3.230	3.310	3.390	0.750	0.813	0.875	4.730	4.935	5.140	4.6
IPBST30034	3" IPS	3.500	3.700	3.800	3.900	0.750	0.813	0.875	5.200	5.425	5.650	4.9
IPBST35834	3-1/2" Copper	3.625	3.740	3.810	3.880	0.750	0.813	0.875	5.240	5.435	5.630	4.5
IPBST41834	4" Copper	4.125	4.250	4.335	4.420	0.750	0.813	0.875	5.750	5.960	6.170	4.5
IPBST40034	4" IPS	4.500	4.750	4.850	4.950	0.750	0.813	0.875	6.250	6.475	6.700	4.8

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

1" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03810	1/4" Copper	0.375	0.420	0.460	0.500	0.750	0.813	0.875	1.920	2.085	2.250	7.3
IPBST01210	3/8" Copper	0.500	0.560	0.600	0.640	0.790	0.853	0.915	2.140	2.305	2.470	7.2
IPBST05810	1/2" Copper	0.625	0.710	0.750	0.790	0.830	0.893	0.955	2.370	2.535	2.700	7.2
IPBST03410	5/8" Copper	0.750	0.810	0.860	0.910	0.850	0.913	0.975	2.510	2.685	2.860	7.0
IPBST07810	3/4" Copper	0.875	0.940	0.995	1.050	0.880	0.943	1.005	2.700	2.880	3.060	7.0
IPBST11810	1" Copper	1.125	1.200	1.255	1.310	0.920	1.013	1.105	3.040	3.280	3.520	7.2
IPBST13810	1-1/4" Copper	1.375	1.450	1.510	1.570	0.970	1.063	1.155	3.390	3.635	3.880	7.2
IPBST15810	1-1/2" Copper	1.625	1.710	1.770	1.830	1.000	1.093	1.185	3.710	3.955	4.200	7.2
IPBST11010	1 1/2" IPS	1.900	1.970	2.030	2.090	1.000	1.093	1.185	3.970	4.215	4.460	6.9
IPBST21810	2" Copper	2.125	2.220	2.280	2.340	1.000	1.093	1.185	4.220	4.465	4.710	6.8
IPBST20010	2" IPS	2.375	2.580	2.680	2.780	1.000	1.093	1.185	4.580	4.865	5.150	7.1
IPBST25810	2-1/2" Copper	2.625	2.720	2.800	2.880	1.000	1.093	1.185	4.720	4.985	5.250	6.5
IPBST21010	2-1/2" IPS	2.875	3.080	3.180	3.280	1.000	1.093	1.185	5.080	5.365	5.650	6.8
IPBST31810	3" Copper	3.125	3.230	3.310	3.390	1.000	1.093	1.185	5.230	5.495	5.760	6.3
IPBST30010	3" IPS	3.500	3.700	3.800	3.900	1.000	1.093	1.185	5.700	5.985	6.270	6.6
IPBST35810	3-1/2" Copper	3.625	3.740	3.810	3.880	1.000	1.093	1.185	5.740	5.995	6.250	6.2
IPBST41810	4" Copper	4.125	4.250	4.335	4.420	1.000	1.093	1.185	6.250	6.520	6.790	6.1
IPBST40010	4" IPS	4.500	4.750	4.850	4.950	1.000	1.093	1.185	6.750	7.035	7.320	6.4
IPBST50010	5" IPS	5.563	5.810	5.910	6.010	1.000	1.093	1.185	7.810	8.095	8.380	6.2
IPBST60010	6" IPS	6.625	6.880	6.980	7.080	1.000	1.093	1.185	8.880	9.165	9.450	6.1
1-1/2" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03815	1/4" Copper	0.375	0.420	0.460	0.500	1.408	1.500	1.592	3.236	3.460	3.684	13.7
IPBST01215	3/8" Copper	0.500	0.560	0.600	0.640	1.408	1.500	1.592	3.376	3.600	3.824	12.7
IPBST05815	1/2" Copper	0.625	0.710	0.750	0.790	1.408	1.500	1.592	3.526	3.750	3.974	12.0
IPBST03415	5/8" Copper	0.750	0.810	0.860	0.910	1.408	1.500	1.592	3.626	3.860	4.094	11.3
IPBST07815	3/4" Copper	0.875	0.940	0.995	1.050	1.408	1.500	1.592	3.756	3.995	4.234	10.8
IPBST11815	1" Copper	1.125	1.200	1.255	1.310	1.408	1.500	1.592	4.016	4.255	4.494	10.1
IPBST13815	1-1/4" Copper	1.375	1.450	1.510	1.570	1.408	1.500	1.592	4.266	4.510	4.754	9.6
IPBST15815	1-1/2" Copper	1.625	1.710	1.770	1.830	1.408	1.500	1.592	4.526	4.770	5.014	9.2
IPBST11015	1 1/2" IPS	1.900	1.970	2.030	2.090	1.408	1.500	1.592	4.786	5.030	5.274	8.7
IPBST21815	2" Copper	2.125	2.220	2.280	2.340	1.408	1.500	1.592	5.036	5.280	5.524	8.6
IPBST20015	2" IPS	2.375	2.580	2.680	2.780	1.408	1.500	1.592	5.396	5.680	5.964	8.8
IPBST25815	2-1/2" Copper	2.625	2.720	2.800	2.880	1.408	1.500	1.592	5.536	5.800	6.064	8.2
IPBST21015	2-1/2" IPS	2.875	3.080	3.180	3.280	1.408	1.500	1.592	5.896	6.180	6.464	8.4
IPBST31815	3" Copper	3.125	3.230	3.310	3.390	1.408	1.500	1.592	6.046	6.310	6.574	7.9
IPBST30015	3" IPS	3.500	3.700	3.800	3.900	1.408	1.500	1.592	6.516	6.800	7.084	8.1
IPBST35815	3-1/2" Copper	3.625	3.740	3.810	3.880	1.408	1.500	1.592	6.556	6.810	7.064	7.7
IPBST41815	4" Copper	4.125	4.250	4.335	4.420	1.408	1.500	1.592	7.066	7.335	7.604	7.5
IPBST40015	4" IPS	4.500	4.750	4.850	4.950	1.408	1.500	1.592	7.566	7.850	8.134	7.8
IPBST50015	5" IPS	5.563	5.810	5.910	6.010	1.408	1.500	1.592	8.626	8.910	9.194	7.5
IPBST60015	6" IPS	6.625	6.880	6.980	7.080	1.408	1.500	1.592	9.696	9.980	10.264	7.3
2" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03820	1/4" Copper	0.375	0.420	0.460	0.500	1.900	2.000	2.100	4.220	4.460	4.700	19.7
IPBST01220	3/8" Copper	0.500	0.560	0.600	0.640	1.900	2.000	2.100	4.360	4.600	4.840	18.2
IPBST05820	1/2" Copper	0.625	0.710	0.750	0.790	1.900	2.000	2.100	4.510	4.750	4.990	17.2
IPBST03420	5/8" Copper	0.750	0.810	0.860	0.910	1.900	2.000	2.100	4.610	4.860	5.110	16.2
IPBST07820	3/4" Copper	0.875	0.940	0.995	1.050	1.900	2.000	2.100	4.740	4.995	5.250	15.5
IPBST11820	1" Copper	1.125	1.200	1.255	1.310	1.900	2.000	2.100	5.000	5.255	5.510	14.5

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

IPBST13820	1-1/4" Copper	1.375	1.450	1.510	1.570	1.900	2.000	2.100	5.250	5.510	5.770	13.7
IPBST15820	1-1/2" Copper	1.625	1.710	1.770	1.830	1.900	2.000	2.100	5.510	5.770	6.030	13.1
IPBST11020	1 1/2" IPS	1.900	1.970	2.030	2.090	1.900	2.000	2.100	5.770	6.030	6.290	12.4
IPBST21820	2" Copper	2.125	2.220	2.280	2.340	1.900	2.000	2.100	6.020	6.280	6.540	12.2
IPBST20020	2" IPS	2.375	2.580	2.680	2.780	1.900	2.000	2.100	6.380	6.680	6.980	12.3
IPBST25820	2-1/2" Copper	2.625	2.720	2.800	2.880	1.900	2.000	2.100	6.520	6.800	7.080	11.6
IPBST21020	2-1/2" IPS	2.875	3.080	3.180	3.280	1.900	2.000	2.100	6.880	7.180	7.480	11.7
IPBST31820	3" Copper	3.125	3.230	3.310	3.390	1.900	2.000	2.100	7.030	7.310	7.590	11.1
IPBST30020	3" IPS	3.500	3.700	3.800	3.900	1.900	2.000	2.100	7.500	7.800	8.100	11.2
IPBST35820	3-1/2" Copper	3.625	3.740	3.810	3.880	1.900	2.000	2.100	7.540	7.810	8.080	10.7
IPBST41820	4" Copper	4.125	4.250	4.335	4.420	1.900	2.000	2.100	8.050	8.335	8.620	10.5
IPBST40020	4" IPS	4.500	4.750	4.850	4.950	1.900	2.000	2.100	8.550	8.850	9.150	10.7
IPBST50020	5" IPS	5.563	5.810	5.910	6.010	1.900	2.000	2.100	9.610	9.910	10.210	10.2
IPBST60020	6" IPS	6.625	6.880	6.980	7.080	1.900	2.000	2.100	10.680	10.980	11.280	9.9

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

T8 10.5W 4FT. BYP TITANIUM LED SERIES

GREENCREATIVE

Relamp: Dir Line LED-2-Lamp-4-Foot-Prem-10.5W

10.5T8/4F/840/BYP

PRO



BYPass

10.5W REPLACES 32W Fluo.



60% Energy Savings

- **Ultra-high efficacy 162 LPW**
- **Wide beam design: 310° light emitting area**
- **Suitable for use in totally enclosed fixtures**
- **Frosted glass tube for increased light diffusion efficiency**
- **Built-in universal voltage driver - Bypass installation**

50,000 H

120-277V UNIVERSAL

162 LPW EFFICACY

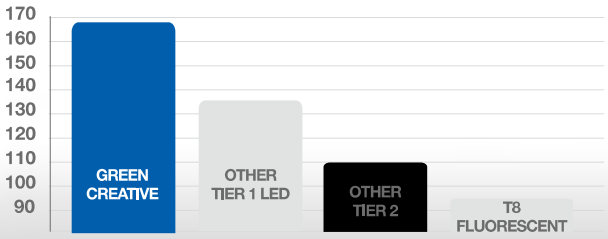
5 YR WARRANTY

82 CRI (Ra)

ENCLOSED*

TUBE FEATURES

Ultra-high Efficacy



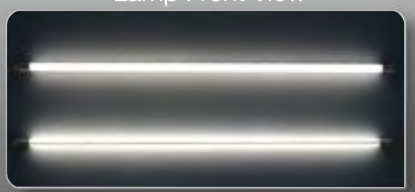
At 162 LPW, GREEN CREATIVE's ultra-high efficacy T8 BYP tube is 24% more efficient than the Tier 1 LED T8 industry average . This energy-saving, high-performance T8 is a smart retrofit choice that provides a faster ROI than traditional T8 LED tubes.

Extra Wide Beam Design - Frosted Glass Body

This lamp uses an innovative coated glass design that diffuses heat and light more evenly than plastic. As a result of its compact light engine, this lamp produces a light emitting area of 310°. This wider beam angle improves a fixture's total light distribution and creates a more complete lighting effect.



Lamp Front View

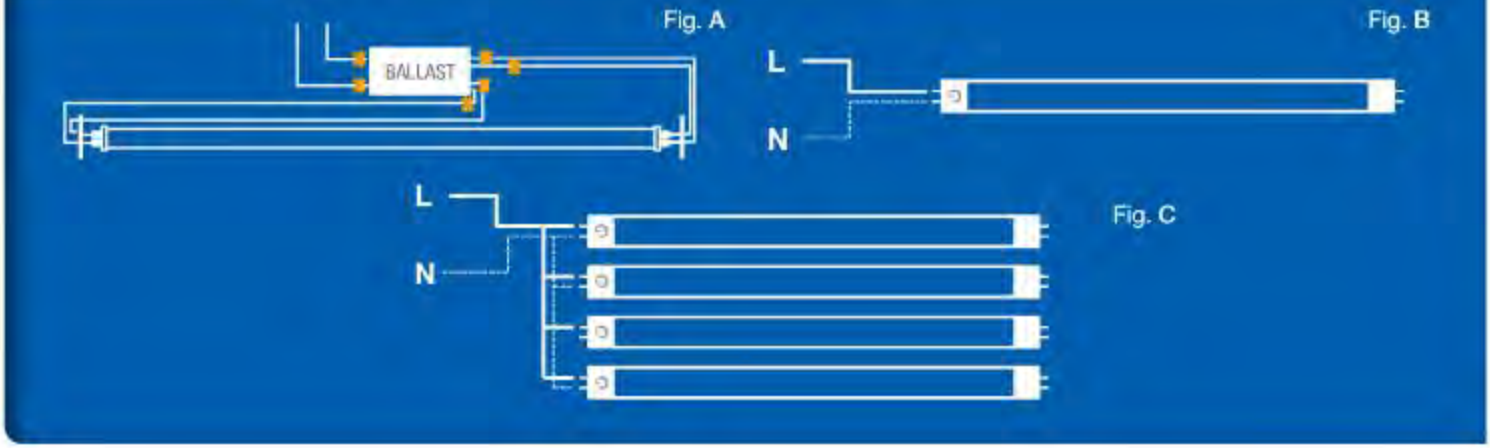


Lamp Back View

T8 10.5W 4FT. BYP TITANIUM LED SERIES

GREENCREATIVE

BYPASS INSTALLATION



- Bypass ballast by cutting all wires as in Fig. A
- Directly wire Live + Neutral on a single end as in Fig. B for single tube or as in Fig. C for multiple tubes
- Replace shunted lamp holder with non-shunted one if applicable (Instant Start)
- Existing fixture maintains original UL compliance thanks to UL1598C tube

SPECIFICATIONS

Product Model	98379 10.5T8/4F/830/BYP	98380 10.5T8/4F/835/BYP	98381 10.5T8/4F/840/BYP	98382 10.5T8/4F/850/BYP
Type	T8	T8	T8	T8
Base	Medium Bi-Pin G13	Medium Bi-Pin G13	Medium Bi-Pin G13	Medium Bi-Pin G13
Power (W)	10.5	10.5	10.5	10.5
Voltage - Frequency	120-277V 50-60Hz	120-277V 50-60Hz	120-277V 50-60Hz	120-277V 50-60Hz
Color Temp. (ANSI)	Warm White 3000K	Neutral White 3500K	Cool White 4000K	Daylight 5000K
CRI (Ra)	82	82	82	82
Typical lumens (lm)	1650	1650	1700	1700
Efficacy (LPW)	157	157	162	162
Light Emitting Area	310°	310°	310°	310°
Beam Angle	160°	160°	160°	160°
Dimmable	No	No	No	No
Power Factor	0.9	0.9	0.9	0.9
THD	<20%	<20%	<20%	<20%
Rated Lifetime - L70 (hrs.)	50,000	50,000	50,000	50,000
Dia. x MOL	1.14"x47.76" (29x1213mm)	1.14"x47.76" (29x1213mm)	1.14"x47.76" (29x1213mm)	1.14"x47.76" (29x1213mm)
Weight (lb. / g)	0.57lb. / 259g	0.57lb. / 259g	0.57lb. / 259g	0.57lb. / 259g

* Suitable for use in totally enclosed fixtures
** Suitable for damp locations. Not for use where directly exposed to the weather or water
*** Full installation guide and more details available on website

Model# 10.5T8/4F/840/BYP

Manufacturer: Green Creative LTD
Brand: GREEN CREATIVE
Technical Requirements Version: 4.4
Date Qualified: 09/05/2018
Product ID: PL299HA1S71O

Categorization

Main: Linear Replacement Lamp
General Application: T8 Four-Foot
Primary Use: Internal Driver/Line Voltage (UL Type B) Lamps
System Type: AC

Classification: standard
Is Parent Product: No
DLC Family Code: TTTVEH
Listing Status: Listed

View Notes

Reported Data | Zonal Lumens | Spacing Criteria | Product Features | Version History | Family Data

Light Output: 1700 lm
Wattage: 10.5 W
Efficacy (AC): 162 lm/W
Power Factor: 0.9
CCT: 4000 K
CRI: 82
Total Harmonic Distortion: 20 %

Specification Sheet: G5 SEP Plastic T8 LED Tube Lamp

Retrofitting Is Easy with Our Energy Efficient Led Tubes

Revolution Lighting's high-performance G5 SEP T8 LED Tube Lamp can reduce your lighting energy use by as much as 65% compared to conventional fluorescent tubes while providing superior light output.

These high-efficacy, UL Type-B single-end-powered tube lamps install easily and are backed with our 55,000-hour rated lamp life and 10-year warranty.

See order logic table below for our TAA and BAA compliant products. Contact your Revolution Lighting representative for pricing and more information.

APPLICATIONS

- Offices & Commercial Buildings
- Big-Box Retail Outlets
- Hotels
- Schools
- Hospitals
- Warehouses
- Assisted Living Facilities
- Recreation Centers
- Military & Government Facilities

ILLUMINATION ANGLE



Revolution Lighting Light Distribution

CAN DECREASE ENERGY USAGE BY



vs. Similar Fluorescent Lamps

WARRANTY



Our Industry-Leading 10-Year Limited Warranty Guarantees Unsurpassed Quality

PRODUCT BENEFITS

OPERATIONAL

- 3X greater lamp life than fluorescent, supported by industry-leading 10-year warranty
- 55,000 hour lamp life and eliminated ballast reduce long-term maintenance costs
- Instant on, no warm-up time
- No buzzing

SAFETY

- Single-end-power installation
- Glass-free lightweight, seamless plastic tube
- Complies with UL 1598C and UL 1993
- Suitable for use in dry and damp locations

SUSTAINABILITY

- Lack of UV minimizes concerns with fading or discoloration
- Mercury-free, allowing for non-hazardous disposal
- 100% recyclable



ORDER LOGIC (EX. G5SEP-48-15-FP-40 or G5SEP-48-15-FP-40-USA)

Product Description	Length (in.)	Wattage	Lens	CCT (K Temp)	TAA/BAA
G5SEP = G5 UL Type-B Plastic T8 SEP LED Tube Lamp	24 = 2 ft 36 = 3 ft 48 = 4 ft	9 = 9W 12 = 12W 10.5 = 10.5W 15 = 15W 18 = 18W	FP = Frosted Plastic	30 = 3000K 35 = 3500K 40 = 4000K 50 = 5000K	Blank = Standard (no TAA/BAA) A = TAA (Trade Agreements Act) USA = BAA (Buy American Act)

Revolution Lighting Technologies, Inc.
177 Broad Street · 12th Floor · Stamford, CT 06901
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Specifications subject to change without notice.

For more information, visit rvtl.com or call 877-578-2536.

Specification Sheet: G5 SEP Plastic T8 LED Tube Lamp

TECHNICAL DATA (Subject to change)

Catalog No.	Product SKU No.*	TAA/ BAA Option*	Rated Watts	Base	Lens	Color Temp (K) †	Input Voltage (VAC)	Rated Lumens	Rated Efficacy (lm/W)	CRI	Illumination Angle (°)	Rated Life (Hours)	Operating Temp. (°F)
9W 2-FT G5 SEP Plastic T8 LED Tube Lamp													
G5SEP-24-9-FP-30	202000-511	Yes	9.3	G13	Frosted	3000	120-277	1,119	120	82	312	55,000	-4 to 113
G5SEP-24-9-FP-35	202000-512	Yes	9.4	G13	Frosted	3500	120-277	1,138	120	82	312	55,000	-4 to 113
G5SEP-24-9-FP-40	202000-513	Yes	9.4	G13	Frosted	4000	120-277	1,156	122	82	312	55,000	-4 to 113
G5SEP-24-9-FP-50	202000-515	Yes	9.5	G13	Frosted	5000	120-277	1,193	124	82	312	55,000	-4 to 113
12W 3-FT G5 SEP Plastic T8 LED Tube Lamp													
G5SEP-36-12-FP-30	203002-511	Yes	12.7	G13	Frosted	3000	120-277	1,469	116	82	312	55,000	-4 to 113
G5SEP-36-12-FP-35	203002-512	Yes	12.8	G13	Frosted	3500	120-277	1,491	116	82	312	55,000	-4 to 113
G5SEP-36-12-FP-40	203002-513	Yes	12.8	G13	Frosted	4000	120-277	1,513	118	82	312	55,000	-4 to 113
G5SEP-36-12-FP-50	203002-515	Yes	12.9	G13	Frosted	5000	120-277	1,556	120	83	312	55,000	-4 to 113
10.5W 4-FT G5 SEP Plastic T8 LED Tube Lamp													
G5SEP-48-10.5-FP-30	204001-511	Yes	10.8	G13	Frosted	3000	120-277	1,680	155	85	312	55,000	-4 to 113
G5SEP-48-10.5-FP-35	204001-512	Yes	10.8	G13	Frosted	3500	120-277	1,685	156	85	312	55,000	-4 to 113
G5SEP-48-10.5-FP-40	204001-513	Yes	10.8	G13	Frosted	4000	120-277	1,690	156	85	312	55,000	-4 to 113
G5SEP-48-10.5-FP-50	204001-515	Yes	10.8	G13	Frosted	5000	120-277	1,700	157	84	312	55,000	-4 to 113
15W 4-FT G5 SEP Plastic T8 LED Tube Lamp													
G5SEP-48-15-FP-30	204004-511	Yes	16.1	G13	Frosted	3000	120-277	2,259	140	82	312	55,000	-4 to 113
G5SEP-48-15-FP-35	204004-512	Yes	16.1	G13	Frosted	3500	120-277	2,271	140	82	312	55,000	-4 to 113
G5SEP-48-15-FP-40	204004-513	Yes	16.1	G13	Frosted	4000	120-277	2,282	141	82	312	55,000	-4 to 113
G5SEP-48-15-FP-50	204004-515	Yes	16.2	G13	Frosted	5000	120-277	2.305	142	83	312	55,000	-4 to 113
18W 4-FT G5 SEP Plastic T8 LED Tube Lamp													
G5SEP-48-18-FP-30	204005-511	Yes	18.9	G13	Frosted	3000	120-277	2,565	135	82	312	55,000	-4 to 113
G5SEP-48-18-FP-35	204005-512	Yes	19	G13	Frosted	3500	120-277	2,593	136	82	312	55,000	-4 to 113
G5SEP-48-18-FP-40	204005-513	Yes	19	G13	Frosted	4000	120-277	2,620	138	82	312	55,000	-4 to 113
G5SEP-48-18-FP-50	204005-515	Yes	19	G13	Frosted	5000	120-277	2,675	140	82	312	55,000	-4 to 113

Product is DLC listed.

** Note: When ordering TAA-Compliant tubes, include the extension "-A" after the SKU No., as shown in the Order Logic table. Example: 204001-515-A*

When ordering BAA-Compliant tubes, include the extension "-USA" after the SKU No., as shown in the Order Logic table. Example: 204001-515-USA

† All products are designed to comply with ANSI 078.377-2008 chromaticity standards for solid-state lighting.

PHYSICAL DATA

Catalog No.	Product SKU No.	Product Dimensions (in.)	Product Weight (lb)
2-ft 9W G5 SEP Plastic T8 LED Tube Lamp			
G5SEP-24-9-FP-30	202000-511	24L x 1 Dia.	0.24
G5SEP-24-9-FP-35	202000-512	24L x 1 Dia.	0.24
G5SEP-24-9-FP-40	202000-513	24L x 1 Dia.	0.24
G5SEP-24-9-FP-50	202000-515	24L x 1 Dia.	0.24
3-ft 12W G5 SEP Plastic T8 LED Tube Lamp			
G5SEP-36-12-FP-30	203002-511	36L x 1 Dia.	0.33
G5SEP-36-12-FP-35	203002-512	36L x 1 Dia.	0.33
G5SEP-36-12-FP-40	203002-513	36L x 1 Dia.	0.33
G5SEP-36-12-FP-50	203002-515	36L x 1 Dia.	0.33
4-ft 10.5W G5 SEP Plastic T8 LED Tube Lamp			
G5SEP-48-10.5-FP-30	204001-511	48L x 1 Dia.	0.44
G5SEP-48-10.5-FP-35	204001-512	48L x 1 Dia.	0.44
G5SEP-48-10.5-FP-40	204001-513	48L x 1 Dia.	0.44
G5SEP-48-10.5-FP-50	204001-515	48L x 1 Dia.	0.44
4-ft 15W G5 SEP Plastic T8 LED Tube Lamp			
G5SEP-48-15-FP-30	204004-511	48L x 1 Dia.	0.44
G5SEP-48-15-FP-35	204004-512	48L x 1 Dia.	0.44
G5SEP-48-15-FP-40	204004-513	48L x 1 Dia.	0.44
G5SEP-48-15-FP-50	204004-515	48L x 1 Dia.	0.44
4-ft 18W G5 SEP Plastic T8 LED Tube Lamp			
G5SEP-48-18-FP-30	204005-511	48L x 1 Dia.	0.44
G5SEP-48-18-FP-35	204005-512	48L x 1 Dia.	0.44
G5SEP-48-18-FP-40	204005-513	48L x 1 Dia.	0.44
G5SEP-48-18-FP-50	204005-515	48L x 1 Dia.	0.44

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For more information, visit rvlti.com or call 877-578-2536.

Specifications subject to change without notice.

Specification Sheet: T8 SEPLV LED External-Driver Tubes

Retrofitting Is Easy with Our Energy Efficient LED Tubes

Our T8 SEPLV External-Driver Tube Lamps offer a simple, dimmable, energy-efficient solution for outdated fluorescent lighting. Each LED lamp kit comes with a matched driver customized for 1-, 2-, or 3-tube luminaires. Just swap out your fluorescent ballast and tubes with our LED driver and tubes, and start saving energy and money. These lightweight, shatterproof LED tube lamps can decrease your energy usage by as much as 60% and feature advanced "Nano" polycarbonate lenses for uniform light distribution.

The low-voltage, single-end-power (SEPLV) lamp design allows for easy installation, and the 0-10V dimmable external driver operates from 120VAC to 277VAC. With an industry-leading rated lifetime of 50,000 hours, our T8 SEPLV External-Driver Tube Lamps are also backed by a 10-year warranty.

APPLICATIONS

- Offices & Commercial Buildings
- Retail Settings
- Hotels
- Schools
- Hospitals
- Warehouses
- Assisted Living Facilities
- Parking Garages
- Recreation Centers
- Food Processing Centers

ILLUMINATION ANGLE

170°

As tested in DLC-approved fixture

CAN DECREASE ENERGY USAGE BY

60%

vs. Similar Fluorescent Lamps

WARRANTY

10 YEAR WARRANTY

Our Industry-Leading 10-Year Limited Warranty Guarantees Unsurpassed Quality

PRODUCT BENEFITS

OPERATIONAL

- Very high efficacies up to 140 lm/W
- 0-10V dimming
- 3X greater lamp life than fluorescent, supported by industry-leading 10-year warranty
- 50,000 hour lamp life and eliminated ballast reduce long-term maintenance costs
- Instant on, no warm-up time

SAFETY

- No glass
- Negligible light depreciation over time
- Superior light output
- Includes External Driver to power LED tube
- These UL Type C tube lamps are tested to comply with UL 1598C

SUSTAINABILITY

- Lack of UV or IR minimizes concerns with fading or discoloration
- Mercury-free, allowing for non-hazardous disposal
- 100% recyclable



ORDER LOGIC (Ex. SEPLVED-24-9-N-35-2)

Product Description		Length (in.)		Wattage		Lens		CCT (K Temp)		Tube No.
SEPLVED = Single-End-Power, Low-Voltage Ext. Driver	-	24 = 24 in.	-	9 = 9W	-	N = Nano	-	35 = 3500K 40 = 4000K 50 = 5000K	-	1 = Single Tube 2 = Two Tubes 3 = Three Tubes

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Specification Sheet: T8 SEPLV LED External-Driver Tubes

TECHNICAL DATA* (Subject to change)

Catalog No.	Product SKU No.	Rated Watts (per kit)	Lens	Base	Drive Input Voltage (VAC)	Color Temp (K)	Rated Lumens	Rated Efficacy (lm/W)	CRI	Illumination Angle	Rated Lifetime (Hours)	Operating Temp. (°F)	NSF Listed
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Single-Tube Kit													
SEPLVED-24-9-N-35-1	202420-112	9 (Kit: 9 x 1)	Nano	G13	120-277	3500	1,260 (Kit: 1,201 x 1)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-40-1	202420-113	9 (Kit: 9 x 1)	Nano	G13	120-277	4000	1,260 (Kit: 1,201 x 1)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-50-1	202420-115	9 (Kit: 9 x 1)	Nano	G13	120-277	5000	1,260 (Kit: 1,201 x 1)	140	80	170	50,000	-4 to 113	•
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Two-Tube Kit													
SEPLVED-24-9-N-35-2	202421-112	18 (Kit: 9 x 2)	Nano	G13	120-277	3500	2,520 (Kit: 1,260 x 2)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-40-2	202421-113	18 (Kit: 9 x 2)	Nano	G13	120-277	4000	2,520 (Kit: 1,260 x 2)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-50-2	202421-115	18 (Kit: 9 x 2)	Nano	G13	120-277	5000	2,520 (Kit: 1,260 x 2)	140	80	170	50,000	-4 to 113	•
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Three-Tube Kit													
SEPLVED-24-9-N-35-3	202422-112	27 (Kit: 9 x 3)	Nano	G13	120-277	3500	3,780 (Kit: 1,208 x 3)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-40-3	202422-113	27 (Kit: 9 x 3)	Nano	G13	120-277	4000	3,780 (Kit: 1,208 x 3)	140	80	170	50,000	-4 to 113	•
SEPLVED-24-9-N-50-3	202422-115	27 (Kit: 9 x 3)	Nano	G13	120-277	5000	3,780 (Kit: 1,208 x 3)	140	80	170	50,000	-4 to 113	•

Product is DLC listed.

** Note: External-Driver SEPLV T8 tube-lamp kits must be ordered in full case quantities: 12 kits per case for the one-, two-, and three-tube kits. For more information, please contact your Revolution Lighting sales representative.*

PHYSICAL DATA

Catalog No.	Product SKU No.	Product Dimensions† (in.)	Product Weight† (lb)
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Single-Tube Kit			
SEPLVED-24-9-N-35-1	202420-112	24L x 1 Dia.	0.16
SEPLVED-24-9-N-40-1	202420-113	24L x 1 Dia.	0.16
SEPLVED-24-9-N-50-1	202420-115	24L x 1 Dia.	0.16
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Two-Tube Kit			
SEPLVED-24-9-N-35-2	202421-112	24L x 1 Dia.	0.16
SEPLVED-24-9-N-40-2	202421-113	24L x 1 Dia.	0.16
SEPLVED-24-9-N-50-2	202421-115	24L x 1 Dia.	0.16
2-foot 9W Low-Voltage Single-End-Power External-Driver LED Tube, Three-Tube Kit			
SEPLVED-24-9-N-35-3	202422-112	24L x 1 Dia.	0.16
SEPLVED-24-9-N-40-3	202422-113	24L x 1 Dia.	0.16
SEPLVED-24-9-N-50-3	202422-115	24L x 1 Dia.	0.16

† Note: Product dimensions and weights are for individual LED tube lamps; they do not include the driver.

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Specification Sheet: SEP Plastic T5 LED Tube Lamp

The Energy Efficient LED Solution

Revolution Lighting's high-performance SEP Plastic T5 LED Tube Lamps can reduce your lighting energy use by as much as 55% compared to conventional fluorescent tubes while providing superior light output.

These high-efficacy UL Type-B SEP tube lamps install easily and are backed with our 70,000-hour rated lamp life and 7-year warranty.

APPLICATIONS

- Offices & Commercial Buildings
- Hotels
- Schools
- Hospitals
- Warehouses
- Assisted Living Facilities
- Recreation Centers

BEAM ANGLE

120°

Revolution Lighting Light Distribution

CAN DECREASE ENERGY USAGE BY

55%

vs. Similar Fluorescent Lamps

WARRANTY

7 YEAR WARRANTY

Our Industry-Leading 7-Year Limited Warranty Guarantees Unsurpassed Quality

PRODUCT BENEFITS

OPERATIONAL

- 3X greater lamp life than fluorescent
- 70,000-hour lamp life reduces long-term maintenance costs
- Instant on, no warm-up time
- Lightweight, seamless plastic tube

SAFETY

- No glass
- Negligible light depreciation over time
- Superior light output
- Complies with UL 1598C
- Suitable for use in IC- and non-IC-rated fixtures
- Suitable for use in dry and damp locations
- NSF-Listed for Splash and Non-Food Zones

SUSTAINABILITY

- Lack of UV minimizes concerns with fading or discoloration
- Mercury-free, allowing for non-hazardous disposal
- 100% recyclable



ORDER LOGIC (Ex. T5SEP-46-25-FP-40)

Product Description		Length (in.)		Rated Watts		Lens		CCT (K Temp)
T5SEP = Type-B SEP Plastic T5 LED Tube Lamp	–	22 = 2 ft (22 in.)	–	9.5 = 9.5W (H.E.) 11 = 11W (H.O.)	–	FP = Frosted Plastic	–	30 = 3000K 35 = 3500K 40 = 4000K 50 = 5000K
	–	34 = 3 ft (34 in.)	–	12 = 12W (H.E.) 15 = 15W (H.O.)				
	–	46 = 4 ft (46 in.)	–	14.5 = 14.5W (H.E.) 25 = 25W (H.O.)				

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Specification Sheet: SEP Plastic T5 LED Tube Lamp

TECHNICAL DATA (Subject to change.)

Catalog No.	Product SKU No.	Rated Watts	Base	Lens	Color Temp (K)	Input Voltage (VAC)	Rated Lumens	Rated Efficacy (lm/W)	CRI	Beam Angle (°)	Rated Life (Hours)	Operating Temp. (°F)
2-ft 9.5W SEP Plastic T5 H.E. LED Tube Lamp												
T5SEP-22-9.5-FP-30	202100-111	9.5	G5	Frosted	3000	120-277	1,200	126	82	120	70,000	14 to 122
T5SEP-22-9.5-FP-35	202100-112	9.5	G5	Frosted	3500	120-277	1,200	126	82	120	70,000	14 to 122
T5SEP-22-9.5-FP-40	202100-113	9.5	G5	Frosted	4000	120-277	1,200	126	82	120	70,000	14 to 122
T5SEP-22-9.5-FP-50	202100-115	9.5	G5	Frosted	5000	120-277	1,200	126	82	120	70,000	14 to 122
2-ft 11W SEP Plastic T5 H.O. LED Tube Lamp												
T5SEP-22-11-FP-30	202101-111	11	G5	Frosted	3000	120-277	1,500	136	82	120	70,000	14 to 122
T5SEP-22-11-FP-35	202101-112	11	G5	Frosted	3500	120-277	1,500	136	82	120	70,000	14 to 122
T5SEP-22-11-FP-40	202101-113	11	G5	Frosted	4000	120-277	1,500	136	82	120	70,000	14 to 122
T5SEP-22-11-FP-50	202101-115	11	G5	Frosted	5000	120-277	1,500	136	82	120	70,000	14 to 122
3-ft 12W SEP Plastic T5 H.E. LED Tube Lamp												
T5SEP-34-12-FP-30	203100-111	12	G5	Frosted	3000	120-277	1,500	125	82	120	70,000	14 to 122
T5SEP-34-12-FP-35	203100-112	12	G5	Frosted	3500	120-277	1,500	125	82	120	70,000	14 to 122
T5SEP-34-12-FP-40	203100-113	12	G5	Frosted	4000	120-277	1,500	125	82	120	70,000	14 to 122
T5SEP-34-12-FP-50	203100-115	12	G5	Frosted	5000	120-277	1,500	125	82	120	70,000	14 to 122
3-ft 15W SEP Plastic T5 H.O. LED Tube Lamp												
T5SEP-34-15-FP-30	203101-111	15	G5	Frosted	3000	120-277	1,900	126	82	120	70,000	14 to 122
T5SEP-34-15-FP-35	203101-112	15	G5	Frosted	3500	120-277	1,900	126	82	120	70,000	14 to 122
T5SEP-34-15-FP-40	203101-113	15	G5	Frosted	4000	120-277	1,900	126	82	120	70,000	14 to 122
T5SEP-34-15-FP-50	203101-115	15	G5	Frosted	5000	120-277	1,900	126	82	120	70,000	14 to 122
4-ft 14.5W SEP Plastic T5 H.E. LED Tube Lamp												
T5SEP-46-14.5-FP-30	204100-111	14.5	G5	Frosted	3000	120-277	2,000	138	82	120	70,000	14 to 122
T5SEP-46-14.5-FP-35	204100-112	14.5	G5	Frosted	3500	120-277	2,000	138	82	120	70,000	14 to 122
T5SEP-46-14.5-FP-40	204100-113	14.5	G5	Frosted	4000	120-277	2,000	138	82	120	70,000	14 to 122
T5SEP-46-14.5-FP-50	204100-115	14.5	G5	Frosted	5000	120-277	2,000	138	82	120	70,000	14 to 122
4-ft 25W SEP Plastic T5 H.O. LED Tube Lamp												
T5SEP-46-25-FP-30	204101-111	25	G5	Frosted	3000	120-277	3,200	128	82	120	70,000	14 to 122
T5SEP-46-25-FP-35	204101-112	25	G5	Frosted	3500	120-277	3,200	128	82	120	70,000	14 to 122
T5SEP-46-25-FP-40	204101-113	25	G5	Frosted	4000	120-277	3,200	128	82	120	70,000	14 to 122
T5SEP-46-25-FP-50	204101-115	25	G5	Frosted	5000	120-277	3,200	128	82	120	70,000	14 to 122

Product is DLC listed.

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Specification Sheet: SEP Plastic T5 LED Tube Lamp

PHYSICAL DATA

Catalog No.	Product SKU No.	Product Dimensions (in.)	Product Weight (lb)
2-ft 9.5W SEP Plastic T5 H.E. LED Tube Lamp			
T5SEP-22-9.5-FP-30	202100-111	22L x 0.75 Dia.	0.19
T5SEP-22-9.5-FP-35	202100-112	22L x 0.75 Dia.	0.19
T5SEP-22-9.5-FP-40	202100-113	22L x 0.75 Dia.	0.19
T5SEP-22-9.5-FP-50	202100-115	22L x 0.75 Dia.	0.19
2-ft 11W SEP Plastic T5 H.O. LED Tube Lamp			
T5SEP-22-11-FP-30	202101-111	22L x 0.75 Dia.	0.19
T5SEP-22-11-FP-35	202101-112	22L x 0.75 Dia.	0.19
T5SEP-22-11-FP-40	202101-113	22L x 0.75 Dia.	0.19
T5SEP-22-11-FP-50	202101-115	22L x 0.75 Dia.	0.19
3-ft 12W SEP Plastic T5 H.E. LED Tube Lamp			
T5SEP-34-12-FP-30	203100-111	34L x 0.75 Dia.	0.28
T5SEP-34-12-FP-35	203100-112	34L x 0.75 Dia.	0.28
T5SEP-34-12-FP-40	203100-113	34L x 0.75 Dia.	0.28
T5SEP-34-12-FP-50	203100-115	34L x 0.75 Dia.	0.28
3-ft 15W SEP Plastic T5 H.O. LED Tube Lamp			
T5SEP-34-15-FP-30	203101-111	34L x 0.75 Dia.	0.28
T5SEP-34-15-FP-35	203101-112	34L x 0.75 Dia.	0.28
T5SEP-34-15-FP-40	203101-113	34L x 0.75 Dia.	0.28
T5SEP-34-15-FP-50	203101-115	34L x 0.75 Dia.	0.28
4-ft 14.5W SEP Plastic T5 H.E. LED Tube Lamp			
T5SEP-46-14.5-FP-30	204100-111	46L x 0.75 Dia.	0.49
T5SEP-46-14.5-FP-35	204100-112	46L x 0.75 Dia.	0.49
T5SEP-46-14.5-FP-40	204100-113	46L x 0.75 Dia.	0.49
T5SEP-46-14.5-FP-50	204100-115	46L x 0.75 Dia.	0.49
4-ft 25W SEP Plastic T5 H.O. LED Tube Lamp			
T5SEP-46-25-FP-30	204101-111	46L x 0.75 Dia.	0.49
T5SEP-46-25-FP-35	204101-112	46L x 0.75 Dia.	0.49
T5SEP-46-25-FP-40	204101-113	46L x 0.75 Dia.	0.49
T5SEP-46-25-FP-50	204101-115	46L x 0.75 Dia.	0.49

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A19 9W DIM. TITANIUM LED SERIES

GREENCREATIVE

ENERGY STAR

PRO



9W REPLACES



60W Inc.

80% Energy Savings

$151 Savings per lamp*

- Exceptional efficacy 89 LPW in Soft White
- 40% more energy savings than CFL
- Comfortable warm diffused light
- Natural A-lamp shape fits all applications
- Ideal for lamps with shades
- Suitable for use in totally enclosed fixtures

25,000 H

DIMMABLE

89 LPW EFFICACY

3 YR WARRANTY

82 CRI (Ra)

ENCLOSED**

c UL us LISTED FC LM 79 LM 80 TM 21 IES

A19 PRODUCT FEATURES

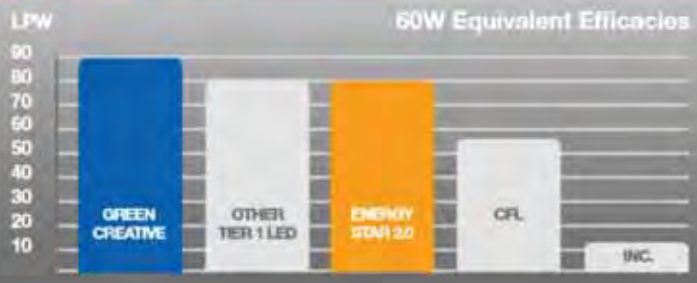
Suitable for Enclosed Fixtures

This A19 is suitable for use in totally enclosed fixtures and capable of operating in a broad range of applications. Whether it is installed in fully enclosed flushmounts or sconces, this lamp's advanced thermal design ensures optimal performance over the course of its lifetime.

ENCLOSED



Exceptional Efficacy



At 89 LPW, this lamp's efficacy is higher than the Tier 1 LED A19 60W replacement industry average and exceeds new ENERGY STAR 2.0 requirements. This energy-saving performance makes this lamp a smart retrofit choice for incandescent and CFL bulbs.

A19 9W DIM. TITANIUM LED SERIES

GREENCREATIVE

APPLICATIONS







SPECIFICATIONS

Product Model	97780 9A19DIM/827	97781 9A19DIM/830	97782 9A19DIM/840
Type	A19	A19	A19
Base	E26	E26	E26
Power (W)	9	9	9
Voltage - Frequency	120V 60Hz	120V 60Hz	120V 60Hz
Color Temp. (ANSI)	Soft White 2700K	Warm White 3000K	Cool White 4000K
CRI (Ra) (typ.)	82	82	82
Typical lumens (lm)	800	820	860
Efficacy (LPW)	89	91	96
Beam Angle	240°	240°	240°
Dimmable	Yes**	Yes**	Yes**
Power Factor	0.9	0.9	0.9
Rated Lifetime - L70 (hrs.)	25,000	25,000	25,000
Dia. x MOL	2.36"x4.41" (60x112mm)	2.36"x4.41" (60x112mm)	2.36"x4.41" (60x112mm)
Weight (lb. / g)	0.10lb. / 45g	0.10lb. / 45g	0.10lb. / 45g

* Savings per lamp based on $0.11 / kw energy cost, 12 hrs / day lamp usage, $2 incandescent with 1000-hr lifetime, $16 LED with 25,000-hr lifetime

** Suitable for use in totally enclosed fixtures

*** Suitable for damp locations. Not for use where directly exposed to weather or water

A21 18.5W DIM. TITANIUM LED CRI^{SP} SERIES

GREENCREATIVE

ENERGY STAR

HIGH CRI

LED TECHNOLOGY

CRI^{SP}

CEC



18.5W REPLACES



100W Inc.

80% Energy Savings

$211 Savings per lamp*

- Omnidirectional: 330° beam angle
- Exceptional color rendering 90 CRI
- Exceptional efficacy 86 LPW in Warm White
- Suitable for use in totally enclosed fixtures
- Richer reds and natural skin tones (R9 60, R13 90)
- Tight LED binning for consistent CCT across all lamps

25,000 H

DIMMABLE

86 LPW EFFICACY

5 YR WARRANTY

90 CRI (Ra)

ENCLOSED**

c UL us LISTED

FC

lighting facts

LM 79 LM 80 TM 21 IES

A21 PRODUCT FEATURES

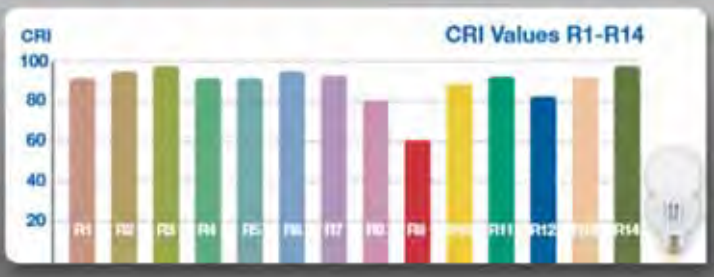
Omnidirectional Lighting

This A21 meets the new ENERGY STAR® V1.1 requirements for omnidirectional bulbs by providing 330° of evenly distributed light intensity. In the 135° to 180° zone, this lamp emits 65% more lumens than what is required by ENERGY STAR, providing a fuller light than other LED A-lamps.





CRI & CA Quality Specification



The CRI^{SP} SERIES A21 18.5W lamp features a typical CRI 90, R9 60 and R13 90, providing crisp and vibrant colors across the whole spectrum. Its exceptional R9-R14 values (R9 & R13) provide redder reds, natural looking skin tones and whiter whites.

This lamp meets the California Quality Specification which requires a CRI of 90+ and demands color temperatures fall within a 4-step Macadam ellipse to ensure minimal color deviation across lamps.

A21 18.5W DIM. TITANIUM LED CRI^{SP} SERIES

GREENCREATIVE

APPLICATIONS

General Lighting



Downlighting



Uplighting



SPECIFICATIONS

Product Model	16329 18.5A21DIM/927
Type	A21
Base	E26
Power (W)	18.5
Voltage - Frequency	120V 60Hz
Color Temp. (ANSI)	Warm White 2700K
CRI (Ra) (typ.)	90
R9 / R13 (typ.)	60 / 90
Typical lumens (lm)	1600
Efficacy (LPW)	86
Beam Angle	330°
Dimmable	Yes***
Power Factor	0.9
Rated Lifetime - L70 (hrs.)	25,000
Dia. x MOL	2.55"x5.00" (65x127mm)
Weight (lb. / g)	0.50lb. / 227g

* Savings per lamp based on $0.11 / kw energy cost, 12 hrs / day lamp usage, $2 incandescent with 1000-hr lifetime, $29 LED with 25,000-hr lifetime
** Suitable for use in totally enclosed fixtures
*** List of tested dimmer switches available on website
**** Suitable for damp locations. Not for use where directly exposed to weather or water

Project Name:	Type:
Part Number:	Date:

GREENCREATIVE

Value Select MR Family

FEATURES

- Suitable to replace 20W, 35W, 50W, 60W Halogen MR16 lamps
- Compatible with most low-voltage electronic transformers
- Smooth dimming with most electronic low-voltage dimming controls
- Compact size 1:1 halogen form factor
- Flood beam angles
- Suitable for use in totally enclosed fixtures
- Suitable for use in damp location
- Operating temperature: -4°F / -20°C to +95°F / +35°C
- Rated Lifetime (L70): 25,000hrs
- 3 year limited warranty



c UL us LISTED

FC

ENERGY STAR

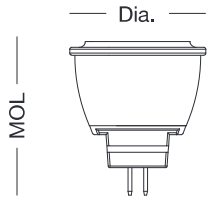
SPECIFICATIONS

Product	Model	Equiv.	Wattage (W)	CCT	Lumens	Efficacy (LPW)	Input Voltage	Beam Angle	CBCP (cd)	CRI	Dim.*	Power Factor	Base	Fixture Rating	Cert.
40713	3MR11/827NF30	20W	3	2700K	200	67	12V	NF 30°	600	82	No	0.9	GU4	Enclosed	-
40715	3MR11/840NF30	20W	3	4000K	220	73	12V	NF 30°	620	82	No	0.9	GU4	Enclosed	-
58285	6MR16DIM/827FL35/35W/R	35W	6	2700K	425	71	12V	FL 35°	910	82	Yes	0.9	GU5.3	Enclosed	ES
58286	6MR16DIM/830FL35/35W/R	35W	6	3000K	450	75	12V	FL 35°	910	82	Yes	0.9	GU5.3	Enclosed	ES
57984	6MR16DIM/827FL35/R	50W	6	2700K	480	80	12V	FL 35°	1350	82	Yes	0.9	GU5.3	Enclosed	ES
57985	6MR16DIM/830FL35/R	50W	6	3000K	500	83	12V	FL 35°	1400	82	Yes	0.9	GU5.3	Enclosed	ES
57986	6MR16DIM/840FL35/R	50W	6	4000K	520	86	12V	FL 35°	1450	82	Yes	0.9	GU5.3	Enclosed	ES
57987	6GU10DIM/827FL35/R	50W	6	2700K	480	80	120V	FL 35°	1000	82	Yes	0.9	GU10	Enclosed	ES
57988	6GU10DIM/830FL35/R	50W	6	3000K	500	83	120V	FL 35°	1050	82	Yes	0.9	GU10	Enclosed	ES
57990	6PAR16DIM/827FL35/R	60W	6	2700K	480	80	120V	FL 35°	1000	82	Yes	0.9	E26	Enclosed	ES
57991	6PAR16DIM/830FL35/R	60W	6	3000K	500	83	120V	FL 35°	1050	82	Yes	0.9	E26	Enclosed	ES

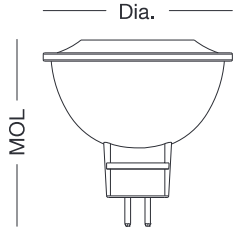
* This lamp might not be compatible with all dimmers and low-voltage transformers. Please visit www.greencreative.com for compatibility information.

Value Select MR Family

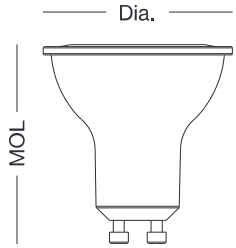
DIMENSIONS & WEIGHT



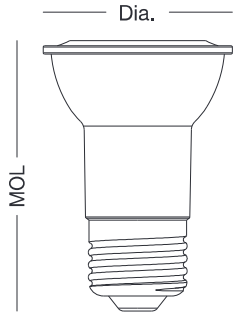
Model	Base	MOL	Dia.	Weight
3MR11/827NF30	GU4	1.53”	1.38”	0.07lb
3MR11/840NF30	GU4	1.53”	1.38”	0.07lb



Model	Base	MOL	Dia.	Weight
6MR16DIM/827FL35/35W/R	GU5.3	1.91”	1.97”	0.09lb
6MR16DIM/830FL35/35W/R	GU5.3	1.91”	1.97”	0.09lb
6MR16DIM/827FL35/R	GU5.3	1.95”	1.97”	0.10lb
6MR16DIM/830FL35/R	GU5.3	1.95”	1.97”	0.10lb
6MR16DIM/840FL35/R	GU5.3	1.95”	1.97”	0.10lb



Model	Base	MOL	Dia.	Weight
6GU10DIM/827FL35/R	GU10	2.13”	1.97”	0.09lb
6GU10DIM/830FL35/R	GU10	2.13”	1.97”	0.09lb

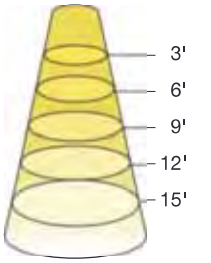


Model	Base	MOL	Dia.	Weight
6PAR16DIM/827FL35/R	E26	2.81”	1.97”	0.10lb
6PAR16DIM/827FL35/R	E26	2.81”	1.97”	0.10lb

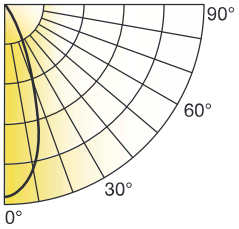
Value Select MR Family

ILLUMINANCE & CANDELA DISTRIBUTION

3MR11/827NF30

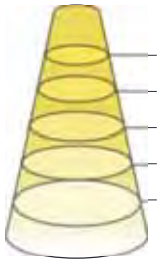


Diameter	Footcandles
1.6	67
3.2	17
4.8	7
6.4	4
8.0	3

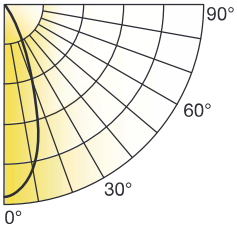


Degree	Candela
0	600
5	563
15	316
25	99
35	25
45	9

3MR11/840NF30

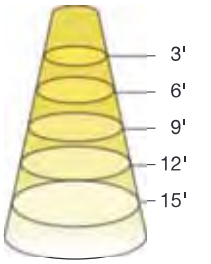


Diameter	Footcandles
1.6	69
3.2	17
4.8	8
6.4	4
8.0	3

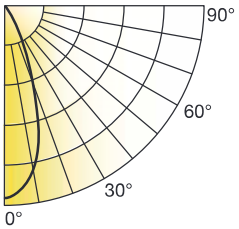


Degree	Candela
0	620
5	583
15	326
25	102
35	26
45	9

6MR16DIM/827FL35/35W/R

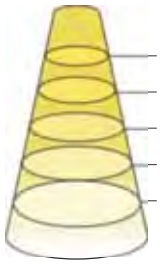


Diameter	Footcandles
1.9	101
3.8	25
5.7	11
7.6	6
9.5	4

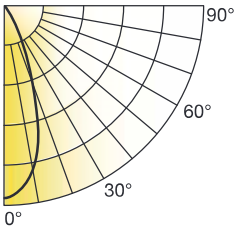


Degree	Candela
0	910
5	904
15	465
25	121
35	81
45	31

6MR16DIM/830FL35/35W/R

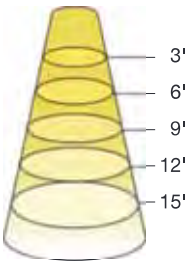


Diameter	Footcandles
1.9	101
3.8	25
5.7	11
7.6	6
9.5	4

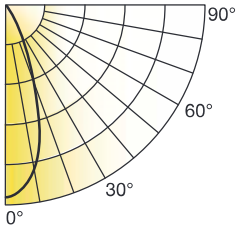


Degree	Candela
0	910
5	904
15	465
25	121
35	81
45	31

6MR16DIM/827FL35/R

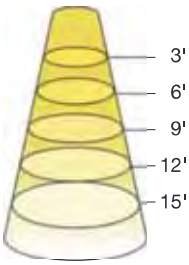


Diameter	Footcandles
1.9	150
3.8	38
5.7	17
7.6	9
9.5	6

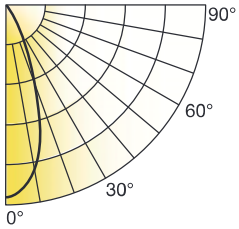


Degree	Candela
0	1350
5	1293
15	650
25	147
35	33
45	11

6MR16DIM/830FL35/R

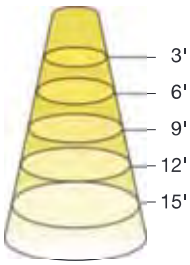


Diameter	Footcandles
1.9	156
3.8	39
5.7	17
7.6	10
9.5	6

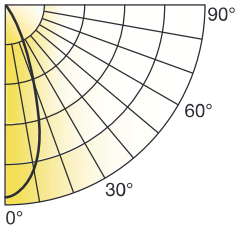


Degree	Candela
0	1400
5	1341
15	674
25	153
35	34
45	11

6MR16DIM/840FL35/R



Diameter	Footcandles
1.9	161
3.8	40
5.7	18
7.6	10
9.5	6

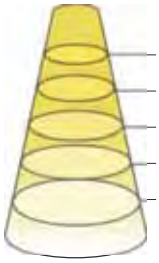


Degree	Candela
0	1450
5	1389
15	698
25	158
35	36
45	12

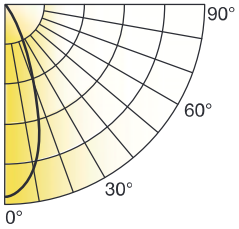
Value Select MR Family

ILLUMINANCE & CANDELA DISTRIBUTION

6GU10DIM/827FL35/R

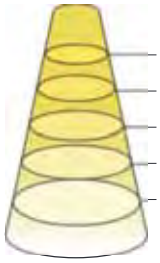


Diameter	Footcandles
1.9	111
3.8	28
5.7	12
7.6	7
9.5	4

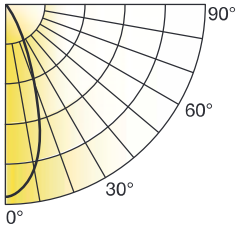


Degree	Candela
0	910
5	904
15	465
25	121
35	81
45	31

6GU10DIM/827FL35/R

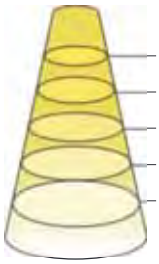


Diameter	Footcandles
1.9	111
3.8	28
5.7	12
7.6	7
9.5	4

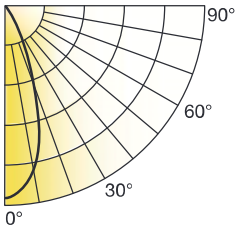


Degree	Candela
0	910
5	904
15	465
25	121
35	81
45	31

6PAR16DIM/827/FL35/R

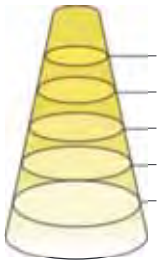


Diameter	Footcandles
1.9	111
3.8	28
5.7	12
7.6	7
9.5	4

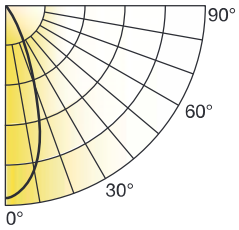


Degree	Candela
0	1000
5	978
15	371
25	156
35	70
45	30

6PAR16DIM/830/FL35/R



Diameter	Footcandles
1.9	117
3.8	29
5.7	13
7.6	7
9.5	5



Degree	Candela
0	1050
5	1027
15	390
25	164
35	73
45	31

PAR30 13W DIM. TITANIUM CRI^{SP} LED SERIES

GREENCREATIVE

HIGH CRI

LED TECHNOLOGY

REFINE SERIES

CRI^{SP}





13W REPLACES



75W Hal.

80% Energy Savings

$244 Savings per lamp*

- Full-face REFINE optic and sleek design
- Exceptional color rendering CRI 90
- Richer reds and natural skin tones (R9 65, R13 90)
- Tight LED binning for consistent CCT across all lamps
- High efficacy 81 LPW in Warm White
- Suitable for use in totally enclosed fixtures

50,000 H

DIMMABLE

81 LPW EFFICACY

5 YR WARRANTY

90 CRI (Ra)

ENCLOSED**

c UL us LISTED

FC

LM 79 LM 80 TM 21 IES

PATENTED REFINE OPTIC

The innovative REFINE optic provides a high candela to lumen ratio, optimizing light usage for directional applications.

REFINE SERIES

REFLECTOR
Directs light



FOCUS LENS
Focuses center beam



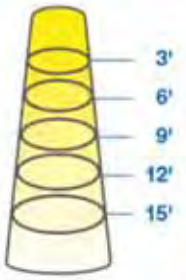
SHAPING LENS
Refines beam pattern

PAR30 13W DIM. TITANIUM CRI^{SP} LED SERIES

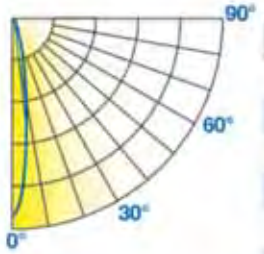
GREENCREATIVE

ILLUMINANCE & CANDELA DISTRIBUTION

13PAR30DIM/930SP15

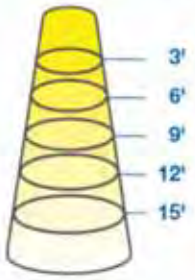


Diameter	Foot-candles
0.8	889
1.6	222
2.4	99
3.2	56
3.9	36

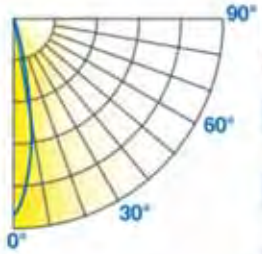


Degree	Candela
0	8000
5	5154
15	1308
25	249
35	87
45	52

13PAR30DIM/930NF25

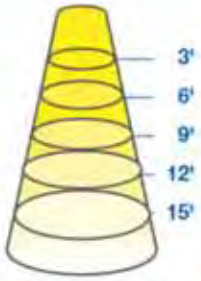


Diameter	Foot-candles
1.3	522
2.7	131
4.0	58
5.3	33
6.7	21

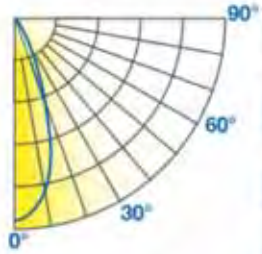


Degree	Candela
0	4700
5	4630
15	1299
25	275
35	113
45	78

13PAR30DIM/930FL40



Diameter	Foot-candles
2.2	256
4.4	64
6.6	28
8.7	16
10.9	10



Degree	Candela
0	2300
5	2257
15	1466
25	445
35	179
45	104

For other CCT use the following multipliers: 2700K 0.96, 4000K 1.05

Base:	E26
Voltage:	120V
Dimmable:	Yes***
PF:	0.9
Lifetime (L70):	50,000 hrs
Weight:	0.40lb / 180g
	0.52lb / 236g (SP15 models only)



SPECIFICATIONS

Model	Product	Power (W)	CCT	CRI (typ.)	R9 / R13 (typ.)	Lumens	LPW	Beam Angle	CBCP (cd)
13PAR30DIM/927SP15	58113	13	Soft White 2700K	90	65/90	870	67	SP 15°	7800
13PAR30DIM/927NF25	58114	13	Soft White 2700K	90	65/90	1000	77	NF 25°	4500
13PAR30DIM/927FL40	58115	13	Soft White 2700K	90	65/90	1000	77	FL 40°	2200
13PAR30DIM/930SP15	58116	13	Warm White 3000K	90	65/90	880	68	SP 15°	8000
13PAR30DIM/930NF25	58117	13	Warm White 3000K	90	65/90	1050	81	NF 25°	4700
13PAR30DIM/930FL40	58118	13	Warm White 3000K	90	65/90	1050	81	FL 40°	2300
13PAR30DIM/940FL40	58121	13	Cool White 4000K	90	65/90	1100	85	FL 40°	2500
13PAR30DIM/930FL40/B •	97902	13	Warm White 3000K	90	65/90	1050	81	FL 40°	2300

• Black finish

* Savings per lamp based on $0.11 / kw energy cost, 12 hrs / day lamp usage, $8 halogen with 1500-hr lifetime, $22 LED with 50,000-hr lifetime
** Suitable for use in totally enclosed fixtures
*** List of tested dimmer switches available on website
**** Suitable for damp locations. Not for use where directly exposed to weather or water

PAR38 17W DIM. TITANIUM CRI^{SP} LED SERIES

GREENCREATIVE

ENERGY STAR

HIGH CRI

REFINE SERIES

CRI^{SP}





17W REPLACES



120W Hal.

80% Energy Savings

$340 Savings per lamp*

- Full-face REFINE optic and sleek design
- High efficacy 84 LPW in Warm White
- Exceptional color rendering CRI 90
- Richer reds and natural skin tones (R9 65, R13 90)
- Tight LED binning for consistent CCT across all lamps
- Suitable for use in totally enclosed fixtures

50,000 H

DIMMABLE

84 LPW EFFICACY

5 YR WARRANTY

90 CRI (Ra)

ENCLOSED**

c UL us LISTED

FC

LM 79 LM 80 TM 21 IES

PATENTED REFINE OPTIC

The innovative REFINE optic provides a high candela to lumen ratio, optimizing light usage for directional applications.

REFINE SERIES

REFLECTOR
Directs light



FOCUS LENS
Focuses center beam

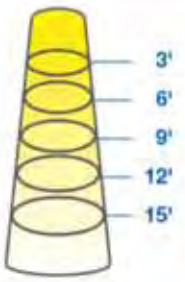
SHAPING LENS
Refines beam pattern

PAR38 17W DIM. TITANIUM CRI^{SP} LED SERIES

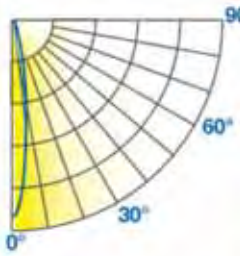
GREENCREATIVE

ILLUMINANCE & CANDELA DISTRIBUTION

17PAR38DIM/930SP15

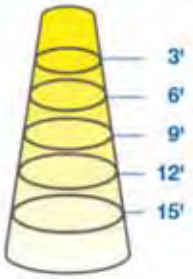


Diameter	Footcandles
1.3	1389
2.7	347
4	154
5.3	87
6.7	56

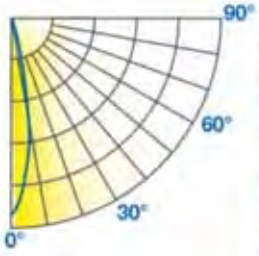


Degree	Candela
0	12500
5	7030
15	1004
25	227
35	122
45	96

17PAR38DIM/930NF25

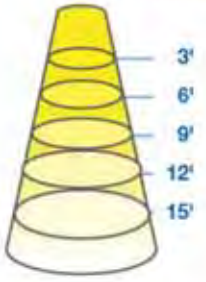


Diameter	Footcandles
1.3	833
2.7	208
4	93
5.3	52
6.7	33

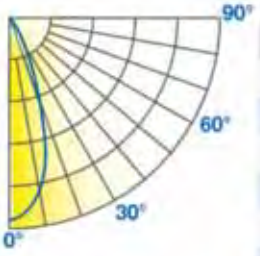


Degree	Candela
0	7500
5	6509
15	1970
25	435
35	144
45	76

17PAR38DIM/930FL40



Diameter	Footcandles
2.2	358
4.4	89
6.6	40
8.7	22
10.9	14



Degree	Candela
0	3200
5	3200
15	2012
25	557
35	188
45	104

For other CCT use the following multipliers: 2700K .97, 4000K 1.03

Base: E26
Voltage: 120V
Dimmable: Yes***
PF: 0.9
Lifetime (L70): 50,000 hrs
Weight: 0.60lb / 272g
0.76lb / 345g (SP15 models only)



SPECIFICATIONS

Model	Product	Power (W)	CCT	CRI (typ.)	R9 / R13 (typ.)	Lumens	LPW	Beam Angle	CBCP (cd)
17PAR38DIM/927SP15	58149	17	Soft White 2700K	90	65 / 90	1150	68	SP 15°	12,200
17PAR38DIM/927NF25	58150	17	Soft White 2700K	90	65 / 90	1400	82	NF 25°	7300
17PAR38DIM/927FL40	58151	17	Soft White 2700K	90	65 / 90	1400	82	FL 40°	3100
17PAR38DIM/930SP15	58152	17	Warm White 3000K	90	65 / 90	1200	71	SP 15°	12,500
17PAR38DIM/930NF25	58153	17	Warm White 3000K	90	65 / 90	1430	84	NF 25°	7500
17PAR38DIM/930FL40	58154	17	Warm White 3000K	90	65 / 90	1430	84	FL 40°	3200
17PAR38DIM/940FL40	58157	17	Cool White 4000K	90	65 / 90	1450	85	FL 40°	3300
17PAR38DIM/930NF25/B •	97904	17	Warm White 3000K	90	65 / 90	1430	84	NF 25°	7500
17PAR38DIM/930FL40/B •	97905	17	Warm White 3000K	90	65 / 90	1430	84	FL 40°	3200

• Black finish

* Savings per lamp based on $0.11 / kw energy cost, 12 hrs / day lamp usage, $8 halogen with 1500-hr lifetime, $25 LED with 50,000-hr lifetime
** Suitable for use in totally enclosed fixtures
*** List of tested dimmer switches available on website
**** Not for use where directly exposed to weather or water

Project Name:	Type:
Part Number:	Date:

GREENCREATIVE

R20 7.5W DIM.

FEATURES

- ENERGY STAR certified
- 45W incandescent replacement
- Energy efficient
- Environmentally friendly
- Providing a comfortable diffused level of light
- Smooth dimming with existing installations
- Suitable for use in totally enclosed fixtures
- Suitable for use in damp locations
- Operating temperature: -4°F / -20°C to +95°F / +35°C
- Rated Lifetime (L70): 25,000hrs
- 3 years limited warranty
- Shatterproof

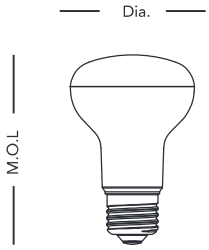


SPECIFICATIONS

Product	Model	CCT	Base	Lumens	Efficacy (LPW)	Power Factor	Input Voltage	CRI	Dim.	Beam Angle	Lifetime (L70)
98460	7.5R20DIM/827	2700K	E26	525	70	0.9	120V 60Hz	82	Yes*	120°	25,000

* This lamp might not be compatible with all dimmers. Please visit www.greencreative.com for compatibility information.

DIMENSION & WEIGHT



Base	E26
M.O.L	3.78” (96mm)
Dia.	2.48” (63mm)
Weight	0.11lb/51g

Project Name:	Type:
Part Number:	Date:

GREENCREATIVE

Value Select A Lamp Family

FEATURES

- Suitable to replace 40W, 60W, 75W, 100W Incandescent
- Comfortable diffused light
- Smooth dimming with existing dimmers*
- Suitable for use in damp locations
- Operating temperature: -4°F / -20°C to +95°F / +35°C
- Rated Lifetime (L70): 25,000hrs
- 3 year limited warranty



c UL us LISTED FC ENERGY STAR

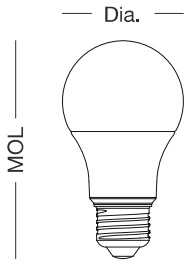
SPECIFICATIONS

Product	Model	Equiv.	Wattage (W)	CCT	Lumens	Efficacy (LPW)	Input Voltage	Beam Angle	CRI	Dim.*	Power Factor	Base	Fixture Rating	Lifetime (L70) (hrs)	Cert.
97985	6A19DIM/827/R	40W	6	2700K	480	80	120V	220°	82	Yes	0.9	E26	Non-Enclosed	25,000	ES
97986	6A19DIM/830/R	40W	6	3000K	480	80	120V	220°	82	Yes	0.9	E26	Non-Enclosed	25,000	ES
98011	8A19DIM/827/R	60W	8	2700K	800	100	120V	220°	82	Yes	0.9	E26	Non-Enclosed	25,000	ES
98012	8A19DIM/830/R	60W	8	3000K	800	100	120V	220°	82	Yes	0.9	E26	Non-Enclosed	25,000	ES
98013	8A19DIM/840/R	60W	8	4000K	800	100	120V	220°	82	Yes	0.9	E26	Non-Enclosed	25,000	ES
97908	9A19DIM/827/GU24/R	60W	9	2700K	800	89	120V	240°	82	Yes	0.9	GU24	Enclosed	25,000	ES
97909	9A19DIM/830/GU24/R	60W	9	3000K	820	91	120V	240°	82	Yes	0.9	GU24	Enclosed	25,000	ES
97910	9A19DIM/840/GU24/R	60W	9	4000K	860	96	120V	240°	82	Yes	0.9	GU24	Enclosed	25,000	ES
98138	11A19DIM/827	75W	11	2700K	1100	100	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98139	11A19DIM/830	75W	11	3000K	1150	105	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98140	11A19DIM/840	75W	11	4000K	1200	109	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98144	15A21DIM/827	100W	15	2700K	1600	107	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98145	15A21DIM/830	100W	15	3000K	1650	110	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98146	15A21DIM/840	100W	15	4000K	1700	113	120V	240°	82	Yes	0.9	E26	Enclosed	25,000	ES
98150	15A21DIM/827/GU24	100W	15	2700K	1600	107	120V	240°	82	Yes	0.9	GU24	Enclosed	25,000	ES
98083	14A19/827/3WAY	40W 60W 100W	4 8 14	2700K	500 1000 1500	125 125 107	120V	230°	82	No	0.9	E26d	Non-Enclosed	15,000	ES

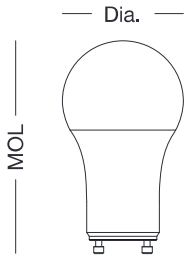
* This lamp might not be compatible with all dimmers. Please visit www.greencreative.com for compatibility information.

Value Select A Lamp Family

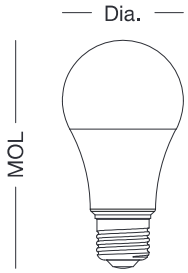
DIMENSIONS & WEIGHT



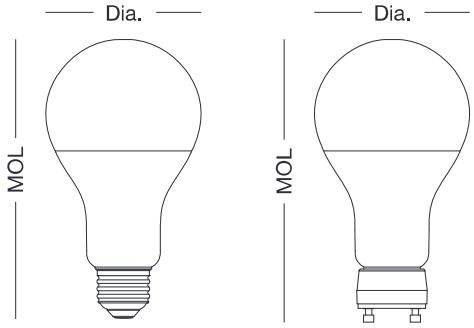
Model	Base	MOL	Dia.	Weight
6A19DIM/827/R	E26	4.21”	2.36”	0.07lb
6A19DIM/830/R	E26	4.21”	2.36”	0.07lb
8A19DIM/827/R	E26	4.21”	2.36”	0.08lb
8A19DIM/830/R	E26	4.21”	2.36”	0.08lb
8A19DIM/840/R	E26	4.21”	2.36”	0.08lb



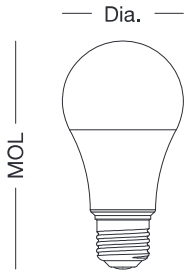
Model	Base	MOL	Dia.	Weight
9A19DIM/827/GU24/R	GU24	4.17”	2.36”	0.11lb
9A19DIM/830/GU24/R	GU24	4.17”	2.36”	0.11lb
9A19DIM/840/GU24/R	GU24	4.17”	2.36”	0.11lb



Model	Base	MOL	Dia.	Weight
11A19DIM/827	E26	4.43”	2.36”	0.13lb
11A19DIM/830	E26	4.43”	2.36”	0.13lb
11A19DIM/840	E26	4.43”	2.36”	0.13lb



Model	Base	MOL	Dia.	Weight
15A21DIM/827	E26	5.43”	3.03”	0.23lb
15A21DIM/830	E26	5.43”	3.03”	0.23lb
15A21DIM/840	E26	5.43”	3.03”	0.23lb
15A21/827/GU24	GU24	5.51”	3.03”	0.26lb



Model	Base	MOL	Dia.	Weight
14A19/827/3WAY	E26d	4.65”	2.36”	0.25lb

A23-24-EX39-840-ND 120-277V

RAB Lamps



These omnidirectional lamps replace 70-150W HID. Universal voltage and compact design allows for installation across many applications.

Color: White Weight: 0.8 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Watts	23.50W
Color Temp	4000K (Cool White)
Lumens	3,100
Efficacy	131.9 LPW
Color Accuracy	80 CRI
L70 Accuracy	50,000

LED Info

Input Voltage	120-277
Power Factor	>0.9
Flicker	N/A
THDi	N/A
R9	

Technical Specifications

Technical Specifications

Product Type:
HID

Bulb Shape:
A23

Wattage:
23.5W

Wattage Equivalency:
70 -100W HID

Typical Lumen Output:
3100

Efficacy:
127 lm/W

Color Temperature:
4000K Cool White

CRI:
80

Base Type:
EX39

L70 Lifespan:
50,000 hours

Operating Temperature:
-20°C - 45°C

Dimmable:
No

Beam Angle:
230°

Warranty:
5-Year, No-Compromise Warranty

Installation Orientation:
Universal Installation

For Use in Emergency Fixtures:
No

For Use Outdoors in Open Fixtures:
No

Electrical Characteristics

Input Voltage:
120-277V

Power Factor:
>0.9

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A23-24-EX39-840-ND 120-277V

RAB Lamps

Technical Specifications (continued)

Electrical Characteristics

Operating Frequency:

60 Hz

Input Current @ 120V:

249mA

Input Current @ 277V:

108mA

THDi:

≤25%

Listings

UL Listed:

Yes

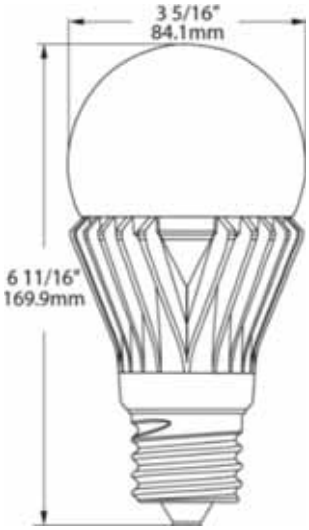
UL Classified:

Yes

CEC Status:

Lawful for sale in California

Dimensions



Features

- OMNIDIRECTIONAL - HID lamp replacement from 70W up to 150W
- UNIVERSAL voltage and compact design allows for installation across many applications.
- INSTALLATION ORIENTATION - Lamps can be installed base up, down, or horizontal
- DAMP RATED - Suitable for use outdoors
- BALLAST BYPASS- Reduces maintenance costs
- ENCLOSED FIXTURE RATED - May be used in enclosed and open fixtures

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PS25-32-EX39-840-ND 120-277V

RAB Lamps



These omnidirectional lamps replace 70-150W HID. Universal voltage and compact design allows for installation across many applications.

Color: White Weight: 1.2 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Watts	31.50W
Color Temp	4000K (Cool White)
Lumens	4,100
Efficacy	130.2 LPW
Color Accuracy	80 CRI
L70 Accuracy	50,000

LED Info

Input Voltage	120-277
Power Factor	>0.9
Flicker	N/A
THDi	N/A
R9	

Technical Specifications

Technical Specifications

Product Type:
HID

Bulb Shape:
PS25

Wattage:
31.5W

Wattage Equivalency:
150W HID

Typical Lumen Output:
4100

Efficacy:
128 lm/W

Color Temperature:
4000K Cool White

CRI:
80

Base Type:
EX39

L70 Lifespan:
50,000 hours

Operating Temperature:
-20°C - 45°C

Dimmable:
No

Beam Angle:
230°

Warranty:
5-Year, No-Compromise Warranty

Installation Orientation:
Universal Installation

For Use in Emergency Fixtures:
No

For Use Outdoors in Open Fixtures:
No

Electrical Characteristics

Input Voltage:
120-277V

Power Factor:
>0.9

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PS25-32-EX39-840-ND 120-277V

RAB Lamps

Technical Specifications (continued)

Electrical Characteristics

Operating Frequency:

60 Hz

Input Current @ 120V:

330mA

Input Current @ 277V:

143mA

THDi:

≤25%

Listings

UL Listed:

Yes

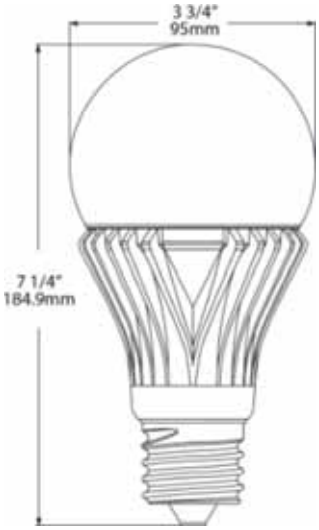
UL Classified:

Yes

CEC Status:

Lawful for sale in California

Dimensions



Features

- OMNIDIRECTIONAL - HID lamp replacement from 70W up to 150W
- UNIVERSAL voltage and compact design allows for installation across many applications.
- INSTALLATION ORIENTATION - Lamps can be installed base up, down, or horizontal
- DAMP RATED - Suitable for use outdoors
- BALLAST BYPASS- Reduces maintenance costs
- ENCLOSED FIXTURE RATED - May be used in enclosed and open fixtures

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Specification Sheet: Eco Linear High Bays

Increase Visibility with Brighter, More Efficient Lighting

Better lighting can reduce eye-fatigue, improve visibility, and transform the appeal of a space, from warehouses to big-box stores. Our new Eco Linear High Bay fixtures provide bright, tailored illumination featuring three lens options for your specific needs: DLA, for lighting along narrow warehouse aisles; DLM, for wider aisle-illumination needs; and GPL, for broad, symmetrical illumination and low glare. Other options include: 347VAC/480VAC operation, battery backup, occupancy/daylight sensor, protective wire guards, and a surface-mounting junction box.

Designed for easy mounting (V-hook, cable, or surface mount), these strong, lightweight, fully-assembled fixtures replace existing fluorescent or MH high-bays and provide superior uniformity for high visibility. The efficiency of Eco Linear High Bays reduces energy consumption by 50% over existing fluorescent fixtures, increasing the return on your lighting investment. Moreover, these LED high bays are DLC-Premium listed, qualifying them for premium rebates. And with 0-10V dimming, our Linear High Bays can reduce energy costs even further. With a 50,000-hour rated life and 7-year warranty, our Eco Linear High Bays significantly reduce your long-term operational and maintenance costs.

APPLICATIONS

- Warehouses
- Recreation Centers
- Gymnasiums
- Big-Box Stores
- Indoor Stadiums

BEAM ANGLE

Beam Angle Depends on Lens Option Chosen

Revolution Lighting Light Distribution

CAN DECREASE ENERGY USAGE BY

50%

vs. Similar Fluorescent Lamps

WARRANTY

7 YEAR WARRANTY

Our Industry-Leading 7-Year Limited Warranty Guarantees Unsurpassed Quality



64W Eco Linear High Bay



128W Eco Linear High Bay



258W Eco Linear High Bay



100W with Battery Backup

PRODUCT BENEFITS

OPERATIONAL

- 3X greater lamp life than fluorescent
- 50,000-hour lamp life reduces long-term maintenance costs
- Instant on, no warm-up time
- 0-10V dimming
- Available with three lens options, battery backup and high-voltage models

SAFETY

- No glass
- Negligible light depreciation over time
- Superior light output
- Carries a UL rating of Suitable for Damp Locations

SUSTAINABILITY

- Lack of UV or IR minimizes concerns with fading or discoloration
- Mercury-free, allowing for non-hazardous disposal
- 100% recyclable

ORDER LOGIC (Ex. ELHB-64-12-D-DLA-SV-40 or ELHB-64-12-D-DLA-SV-40-BB)

Product Description	Power	Dimensions	Controls	Optics	Input Voltages (VAC)	CCT (K Temp)	Battery Backup Option
ELHB = Eco Linear High Bay	64 = 64W 83 = 83W	12 = 1' x 2'	D = 0-10V Dimming	DLA = Discrete Lens Aisle DLM = Discrete Lens Medium PL = Prismatic Lens	SV = 120-277	40 = 4000K 50 = 5000K	Blank = Standard BB = Battery Backup
	100 = 100W 128 = 128W 167 = 167W	22 = 2' x 2'					
	160 = 160W 258 = 258W	24 = 2' x 4'					
	70 = 70W 91 = 91W	12 = 1' x 2'	D = 0-10V Dimming	DLA = Discrete Lens Aisle DLM = Discrete Lens Medium PL = Prismatic Lens	HV = 347/480	40 = 4000K 50 = 5000K	Blank = Standard BB = Battery Backup
	140 = 140W 182 = 182W	22 = 2' x 2'					
	282 = 282W 365 = 365W	24 = 2' x 4'					

Revolution Lighting Technologies, Inc.
177 Broad Street · 12th Floor · Stamford, CT 06901
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Specifications subject to change without notice.

For more information, visit rvtl.com or call 877-576-2536.

Specification Sheet: Eco Linear High Bays

TECHNICAL DATA† (Subject to change. See footnotes and chart below for product configuration information.)

Catalog No.*	Product SKU No.*	Rated Watts	Mounting	Battery Backup Option	Input Voltage (VAC)	Color Temp (K)	Rated Lumens	Rated Efficacy (lm/W)	CRI	Beam Angles*	Rated Life (Hours)	Operating Temp. (°F)
Standard-Voltage Eco Linear High Bays (120-277VAC)												
64W 1′ x 2′ Eco Linear High Bay												
ELHB-64-12-D-XXX-SV-40	128010-1X3	65.1	V-Hook/Chain/Surface	Yes	120-277	4000	9,153	140	83	XX° x XX°	50,000	-4 to 131
ELHB-64-12-D-XXX-SV-50	128010-1X5	64.9	V-Hook/Chain/Surface	Yes	120-277	5000	9,394	144	85	XX° x XX°	50,000	-4 to 131
83W 1′ x 2′ Eco Linear High Bay												
ELHB-83-12-D-XXX-SV-40	128011-1X3	83.2	V-Hook/Chain/Surface	Yes	120-277	4000	11,519	138	83	XX° x XX°	50,000	-4 to 131
ELHB-83-12-D-XXX-SV-50	128011-1X5	84.1	V-Hook/Chain/Surface	Yes	120-277	5000	11,966	142	85	XX° x XX°	50,000	-4 to 131
100W 2′ x 2′ Eco Linear High Bay												
ELHB-100-22-D-XXX-SV-40	128016-1X3	98.8	V-Hook/Chain/Surface	Yes	120-277	4000	14,363	145	85	XX° x XX°	50,000	-4 to 131
ELHB-100-22-D-XXX-SV-50	128016-1X5	99.9	V-Hook/Chain/Surface	Yes	120-277	5000	15,011	150	85	XX° x XX°	50,000	-4 to 131
128W 2′ x 2′ Eco Linear High Bay												
ELHB-128-22-D-XXX-SV-40	128012-1X3	130.2	V-Hook/Chain/Surface	Yes	120-277	4000	18,278	140	83	XX° x XX°	50,000	-4 to 131
ELHB-128-22-D-XXX-SV-50	128012-1X5	128.9	V-Hook/Chain/Surface	Yes	120-277	5000	18,733	145	85	XX° x XX°	50,000	-4 to 131
167W 2′ x 2′ Eco Linear High Bay												
ELHB-167-22-D-XXX-SV-40	128013-1X3	165.1	V-Hook/Chain/Surface	Yes	120-277	4000	23,253	140	83	XX° x XX°	50,000	-4 to 131
ELHB-167-22-D-XXX-SV-50	128013-1X5	167.9	V-Hook/Chain/Surface	Yes	120-277	5000	24,218	144	85	XX° x XX°	50,000	-4 to 131
160W 2′ x 4′ Eco Linear High Bay												
ELHB-160-24-D-XXX-SV-40	128017-1X3	156.8	V-Hook/Chain/Surface	Yes	120-277	4000	23.312	148	84	XX° x XX°	50,000	-4 to 131
ELHB-160-24-D-XXX-SV-50	128017-1X5	158.1	V-Hook/Chain/Surface	Yes	120-277	5000	24.502	154	85	XX° x XX°	50,000	-4 to 131
258W 2′ x 4′ Eco Linear High Bay												
ELHB-258-24-D-XXX-SV-40	128014-1X3	263.5	V-Hook/Chain/Surface	Yes	120-277	4000	36,214	137	83	XX° x XX°	50,000	-4 to 131
ELHB-258-24-D-XXX-SV-50	128014-1X5	262.1	V-Hook/Chain/Surface	Yes	120-277	5000	37,120	141	85	XX° x XX°	50,000	-4 to 131
High-Voltage Eco Linear High Bays (347VAC/480VAC)												
70W 1′ x 2′ Eco Linear High Bay												
ELHB-70-12-D-XXX-HV-40	128210-1X3	68.3	V-Hook/Chain/Surface	Yes	347/480	4000	9,089	132	83	XX° x XX°	50,000	-4 to 131
ELHB-70-12-D-XXX-HV-50	128210-1X5	69.4	V-Hook/Chain/Surface	Yes	347/480	5000	9,372	135	85	XX° x XX°	50,000	-4 to 131
91W 1′ x 2′ Eco Linear High Bay												
ELHB-91-12-D-XXX-HV-40	128211-1X3	87	V-Hook/Chain/Surface	Yes	347/480	4000	11,420	131	83	XX° x XX°	50,000	-4 to 131
ELHB-91-12-D-XXX-HV-50	128211-1X5	88.1	V-Hook/Chain/Surface	Yes	347/480	5000	11,880	134	85	XX° x XX°	50,000	-4 to 131
140W 2′ x 2′ Eco Linear High Bay												
ELHB-140-22-D-XXX-HV-40	128212-1X3	138.1	V-Hook/Chain/Surface	Yes	347/480	4000	18,253	132	83	XX° x XX°	50,000	-4 to 131
ELHB-140-22-D-XXX-HV-50	128212-1X5	138.1	V-Hook/Chain/Surface	Yes	347/480	5000	18,905	136	85	XX° x XX°	50,000	-4 to 131
182W 2′ x 2′ Eco Linear High Bay												
ELHB-182-22-D-XXX-HV-40	128213-1X3	176.5	V-Hook/Chain/Surface	Yes	347/480	4000	23,184	131	83	XX° x XX°	50,000	-4 to 131
ELHB-182-22-D-XXX-HV-50	128213-1X5	177	V-Hook/Chain/Surface	Yes	347/480	5000	23,928	135	85	XX° x XX°	50,000	-4 to 131
282W 2′ x 4′ Eco Linear High Bay												
ELHB-282-24-D-XXX-HV-40	128214-1X3	278.1	V-Hook/Chain/Surface	Yes	347/480	4000	36,927	132	84	XX° x XX°	50,000	-4 to 131
ELHB-282-24-D-XXX-HV-50	128214-1X5	278.8	V-Hook/Chain/Surface	Yes	347/480	5000	37,786	135	85	XX° x XX°	50,000	-4 to 131
365W 2′ x 4′ Eco Linear High Bay												
ELHB-365-24-D-XXX-HV-40	128215-1X3	356.3	V-Hook/Chain/Surface	Yes	347/480	4000	46,895	131	84	XX° x XX°	50,000	-4 to 131
ELHB-365-24-D-XXX-HV-50	128215-1X5	357.3	V-Hook/Chain/Surface	Yes	347/480	5000	48,544	135	85	XX° x XX°	50,000	-4 to 131

Product is DLC-listed, Premium.

† *All listed specs are for the DLM (Discrete Lens Medium) lens option. Specs will vary slightly, depending on which lens option is ordered. For battery-backup specs (Fulham FireHorse Hotspot FHSBATT8-D4), contact your Revolution Lighting representative.*

* *Note 1: The Catalog No., SKU No., and Beam Angles all depend on which lens option is ordered: Discrete Lens Aisle, General Prismatic Lens, or Discrete Lens Medium. Use the following chart to determine what values to use in the above table when ordering:*

Spec	Discrete Lens Aisle	General Prismatic Lens	Discrete Lens Medium
Catalog No.	XXX = DLA	XXX = GPL	XXX = DLM
SKU No.	X = 0	X = 1	X = 2
Beam Angles	XX° x XX° = 90° x 30°	XX° x XX° = 95° x 95°	XX° x XX° = 90° x 85°

* *Note 2: When ordering with battery backup, please add '-BB' after the Order No. and the SKU. (See Order Logic examples above.)*

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Specifications subject to change without notice.

Specification Sheet: Eco Linear High Bays

OPTIONAL ACCESSORIES



Wire Guard Kits
(SKUs 128010-W01, 1' x 2'; 128010-W02, 2'x 2'; 128010-W03, 2' x 4')



IP65-Rated Microwave Motion/Daylight Sensor
(SKU 121000-C01)*

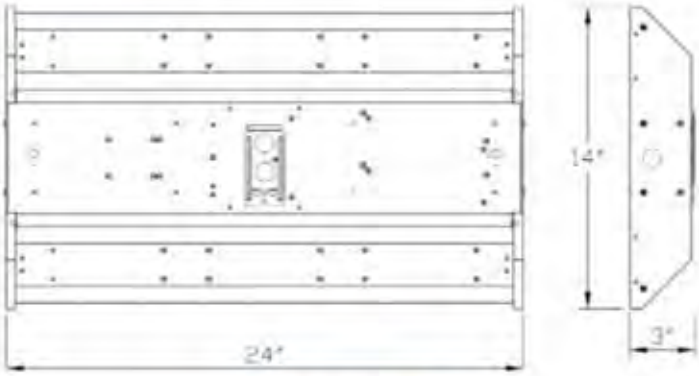


Surface-Mounting Junction Box
(SKU 128010-J00)

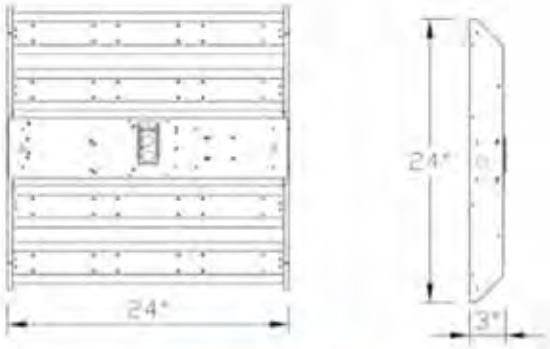
** Caution: Motion/Daylight Sensor operates only with standard 120-277VAC models. Do not use this sensor accessory with high-voltage high bays.*

Note: Order these accessories separately with the SKUs provided. Three wire guard kits are available, one for each of the three fixture sizes; the Motion/Daylight Sensor is designed to mount directly to a conduit knockout; and the Surface-Mounting Junction Box permits surface mounting of the fixture.

DIAGRAMS



64W Eco Linear High Bay



128W Eco Linear High Bay



258W Eco Linear High Bay

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Specification Sheet: Eco Linear High Bays

PHYSICAL DATA

Catalog No.	Product SKU No.	Product Dimensions (in.)	Product Weight (lb)	Product Dimensions with Battery (in.)	Product Weight with Battery (lb)
Standard-Voltage Eco Linear High Bays (120-277VAC)					
64W 1′ x 2′ Eco Linear High Bay					
ELHB-64-12-D-XXX-SV-40	128010-1X3	24L x 14W x 2.88H	8.8	24L x 14W x 6H	13.3
ELHB-64-12-D-XXX-SV-50	128010-1X5	24L x 14W x 2.88H	8.8	24L x 14W x 6H	13.3
83W 1′ x 2′ Eco Linear High Bay					
ELHB-83-12-D-XXX-SV-40	128011-1X3	24L x 14W x 2.88H	8.8	24L x 14W x 6H	13.3
ELHB-83-12-D-XXX-SV-50	128011-1X5	24L x 14W x 2.88H	8.8	24L x 14W x 6H	13.3
100W 2′ x 2′ Eco Linear High Bay					
ELHB-100-22-D-XXX-SV-40	128016-1X3	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
ELHB-100-22-D-XXX-SV-50	128016-1X5	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
128W 2′ x 2′ Eco Linear High Bay					
ELHB-128-22-D-XXX-SV-40	128012-1X3	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
ELHB-128-22-D-XXX-SV-50	128012-1X5	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
167W 2′ x 2′ Eco Linear High Bay					
ELHB-167-22-D-XXX-SV-40	128013-1X3	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
ELHB-167-22-D-XXX-SV-50	128013-1X5	24L x 24W x 2.88H	14	24L x 24W x 6H	18.5
160W 2′ x 4′ Eco Linear High Bay					
ELHB-160-24-D-XXX-SV-40	128017-1X3	48L x 24W x 2.88H	24.4	48L x 24W x 6H	28.9
ELHB-160-24-D-XXX-SV-50	128017-1X5	48L x 24W x 2.88H	24.4	48L x 24W x 6H	28.9
258W 2′ x 4′ Eco Linear High Bay					
ELHB-258-24-D-XXX-SV-40	128014-1X3	48L x 24W x 2.88H	24.4	48L x 24W x 6H	28.9
ELHB-258-24-D-XXX-SV-50	128014-1X5	48L x 24W x 2.88H	24.4	48L x 24W x 6H	28.9
High-Voltage Eco Linear High Bays (347VAC/480VAC)					
70W 1′ x 2′ Eco Linear High Bay					
ELHB-70-12-D-XXX-HV-40	128210-1X3	24L x 14W x 2.88H	11	24L x 14W x 6H	15.5
ELHB-70-12-D-XXX-HV-50	128210-1X5	24L x 14W x 2.88H	11	24L x 14W x 6H	15.5
91W 1′ x 2′ Eco Linear High Bay					
ELHB-91-12-D-XXX-HV-40	128211-1X3	24L x 14W x 2.88H	11	24L x 14W x 6H	15.5
ELHB-91-12-D-XXX-HV-50	128211-1X5	24L x 14W x 2.88H	11	24L x 14W x 6H	15.5
140W 2′ x 2′ Eco Linear High Bay					
ELHB-140-22-D-XXX-HV-40	128212-1X3	24L x 24W x 2.88H	16.5	24L x 24W x 6H	21
ELHB-140-22-D-XXX-HV-50	128212-1X5	24L x 24W x 2.88H	16.5	24L x 24W x 6H	21
182W 2′ x 2′ Eco Linear High Bay					
ELHB-182-22-D-XXX-HV-40	128213-1X3	24L x 24W x 2.88H	16.5	24L x 24W x 6H	21
ELHB-182-22-D-XXX-HV-50	128213-1X5	24L x 24W x 2.88H	16.5	24L x 24W x 6H	21
282W 2′ x 4′ Eco Linear High Bay					
ELHB-282-24-D-XXX-HV-40	128214-1X3	48L x 24W x 2.88H	29.7	48L x 24W x 6H	34.2
ELHB-282-24-D-XXX-HV-50	128214-1X5	48L x 24W x 2.88H	29.7	48L x 24W x 6H	34.2
365W 2′ x 4′ Eco Linear High Bay					
ELHB-365-24-D-XXX-HV-40	128215-1X3	48L x 24W x 2.88H	29.7	48L x 24W x 6H	34.2
ELHB-365-24-D-XXX-HV-50	128215-1X5	48L x 24W x 2.88H	29.7	48L x 24W x 6H	34.2

Note: Physical dimensions and weights will vary, depending on which optional accessories are ordered.

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Revolution Lighting



Specification Sheet:

SpunBay High Bay

Indoor

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THE POWER TO OUTPERFORM

Specification Sheet: SpunBay High Bay

Increase Productivity with Better Quality and More Efficient Lighting

Better lighting can reduce eye-fatigue, improve working conditions, and transform the appeal of a space, from industrial facilities to warehouses to parking garages. Our SpunBay fixtures bring increased energy efficiency to the workspace, increasing the return on your lighting investment.

Specifically designed with a light diffusing prismatic acrylic drop lens to provide superior uniformity and low glare illumination for high visibility, our SpunBay is 65% more efficient than traditional lighting sources, combined with a 100,000 hour rated life and 10-year warranty to significantly reduce your long-term operational and maintenance costs.

APPLICATIONS

- Factory Floors
- Food Processing Facilities
- Warehouses
- Mechanical Facilities
- Industrial Facilities
- Workshops
- Supermarkets
- Gymnasiums
- Recreation Centers

BEAM ANGLE

180°

Revolution Lighting Light Distribution

CAN DECREASE ENERGY USAGE BY

65%

vs. Similar H.I.D Fixtures

WARRANTY

10 YEAR WARRANTY

Our Industry-Leading 10-Year Limited Warranty Guarantees Unsurpassed Quality



PRODUCT BENEFITS

OPERATIONAL

- 3X greater lamp life than fluorescent, supported by industry-leading 10-year warranty
- 100,000 hour lamp life reduces long-term maintenance costs
- Instant on, no warm-up time
- Standard 0-10V Dimming Driver
- Low LED Junction Temperatures - Longer LED Life
- Light Diffusing Prismatic Acrylic Drop Lens

SAFETY

- No glass
- Negligible light depreciation over time
- Superior light output

SUSTAINABILITY

- Lack of UV or IR minimizes concerns with fading or discoloration
- Mercury-free, allowing for non-hazardous disposal
- 100% recyclable

ORDER LOGIC (Ex. RVLT-ISB-100-4K-U-HM-CP-SPD-OS-On/Off-WG)

Product Description	Rated Watts	CCT (K Temp)	Input Voltage	Mount Option	Cord Option	Surge Protector Option	Controls Options	Wire Guard Option
RVLT-ISB = SpunBay	100 = 100W 150 = 150W	4K = 4000K 5K = 5000K	U = 120-277VAC 347 =347VAC 480 = 480VAC	HM = Standard Hook PM = ¾" Pendant	CP = Cord & Plug (Specify Cord Length & Plug Type)	SPD = Surge Protector	OS-On/Off = On/Off Only Motion Sensor OS-Dim = Dimming and On/Off Motion Sensor	WG = Wire Guard

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Specification Sheet: SpunBay High Bay

TECHNICAL DATA (Subject to change.)

Catalog No.*	Rated Watts	Rated Lumens	Rated Efficacy (lm/W)	Voltage (VAC)	Color Temp (K)	CRI	Beam Angle	Rated Life (Hours)	Operating Temp. (°F)
100W SpunBay, 120-277VAC									
RVLT-ISB-100-4K-U-XX-XX-XX-XX-XX	100	> 11,000	116	120-277	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-100-5K-U-XX-XX-XX-XX-XX	100	> 11,000	116	120-277	5000	> 70	180°	100,000	-40 to 113
150W SpunBay, 120-277VAC									
RVLT-ISB-150-4K-U-XX-XX-XX-XX-XX	150	> 17,000	116	120-277	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-150-5K-U-XX-XX-XX-XX-XX	150	> 17,000	116	120-277	5000	> 70	180°	100,000	-40 to 113
100W SpunBay, 347VAC									
RVLT-ISB-100-4K-347-XX-XX-XX-XX-XX	100	> 11,000	116	347	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-100-5K-347-XX-XX-XX-XX-XX	100	> 11,000	116	347	5000	> 70	180°	100,000	-40 to 113
150W SpunBay, 347VAC									
RVLT-ISB-150-4K-347-XX-XX-XX-XX-XX	150	> 17,000	116	347	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-150-5K-347-XX-XX-XX-XX-XX	150	> 17,000	116	347	5000	> 70	180°	100,000	-40 to 113
100W SpunBay, 480VAC									
RVLT-ISB-100-4K-480-XX-XX-XX-XX-XX	100	> 11,000	116	480	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-100-5K-480-XX-XX-XX-XX-XX	100	> 11,000	116	480	5000	> 70	180°	100,000	-40 to 113
150W SpunBay, 480VAC									
RVLT-ISB-150-4K-480-XX-XX-XX-XX-XX	150	> 17,000	116	480	4000	> 70	180°	100,000	-40 to 113
RVLT-ISB-150-5K-480-XX-XX-XX-XX-XX	150	> 17,000	116	480	5000	> 70	180°	100,000	-40 to 113

** Each 'XX' variable in the Catalog No. designates an optional accessory, as defined in the Order Logic on p2. Use the Order Logic designators for each accessory ordered, or leave it blank for an accessory that is not ordered.*

PHYSICAL DATA

Catalog No.	Product Dimensions (in.)	Product Weight (lb)
100W SpunBay, 120-277VAC		
RVLT-ISB-100-4K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-100-5K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
150W SpunBay, 120-277VAC		
RVLT-ISB-150-4K-U-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-150-5K-U-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
100W SpunBay, 347VAC		
RVLT-ISB-100-4K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-100-5K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
150W SpunBay, 347VAC		
RVLT-ISB-150-4K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-150-5K-347-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
100W SpunBay, 480VAC		
RVLT-ISB-100-4K-480-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-100-5K-480-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
150W SpunBay, 480VAC		
RVLT-ISB-150-4K-480-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22
RVLT-ISB-150-5K-480-XX-XX-XX-XX-XX	19.5H x 22.7 Dia.	22

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LED BARKITJ RETROFIT FOR LINEAR FLUORESCENT LUMINAIRES

PRO
BASE

the ultimate LED retrofit kit

RemPhos' LEDBARKIT universal retrofit kit for linear fluorescent luminaires is the perfect retrofit solution. Delivers better long-term reliability, longer life (10yr warranty), controllability (standard 0-10V dimmable driver) and faster paybacks (since Utility incentives are typically higher), when compared to LED tubes. Designed to easily fit into existing T5/T8/T12 linear fluorescent fixtures. Fast, "one-man" installation.



SIMPLE INSTALLATION

Retrofits existing fluorescent fixtures quickly with unique magnetic design and quick connector technology. Designed from an installer's point of view, convert existing fixtures fast with magnets on the back of the light bars that allow hands-free placement (self-tapping screws are provided for for secure install). Electrical quick connects for simple, error-free power connections. For videos showing the simple installation go to www.remphos.com/videos

FITS BETWEEN THE SOCKETS

No need to remove existing T5/T8/T12 sockets. The LEDBAR is sized to fit in between the existing sockets, further reducing install time.

PERFORMANCE-OPTIMIZED TECHNOLOGY

Provides high-efficacy light up to 130 lumens per watt along with a remarkable 10-year system warranty.

MAXIMUM VERSATILITY

Offered in 2ft, 3ft and 4ft lengths along with multiple lamp/driver combinations (1L,2L,3L,4L) providing a fit for any application.

MANY LIGHT OUTPUT CHOICES

Systems available in 10W (1300LM) all the way to 80W (10,400LM). See ordering guide for available systems.

STANDARD 10V DIMMABLE DRIVER

CODE-COMPLIANT APPLICABILITY

Meets typical foot candle requirements for office and commercial space.

HIGH QUALITY CONSTRUCTION & MATERIALS

Top tier LED diodes. Heatsink made from extruded 6063 T5 aluminum with substantial surface area for maximum cooling.

SUITABLE FOR DRY & DAMP LOCATIONS

UL 1598C CLASSIFIED RETROFIT KIT LISTED & DLC QPL LISTED

10 YEAR WARRANTY, L70 >100,000HRS

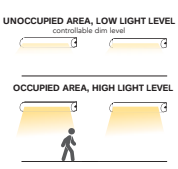
OPTIONAL "BAA" BUY AMERICA ACT

Compliant models available, assembled in our state-of-the-art Middleton, MA assembly center. (BAA SECTION 1605 COMPLIANT)

CUSTOM BRACKET DESIGNS AVAILABLE

Contact our engineering team to help design a low-cost bracket for easy mounting in direct/indirect fixture. Helps to provide up and down light with 1, 2, 3, 4 or more LED bars.

OPTIONAL HIGH/LOW MOTION SENSOR



Contact our engineering team to help choose the best low-cost integrated motion sensor which will easily install into the existing fixture, behind the lens. Our motion sensor technology can read through glass and plastic lenses. Also compatible with ZigBee wireless networks.

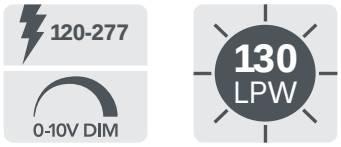
RemPhos by Light Efficient Design
lighting on target

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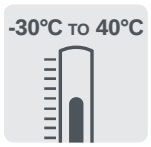
LED BARKITJ RETROFIT FOR LINEAR FLUORESCENT LUMINAIRES

PRO
BASE



VOLTAGE/DIMMING

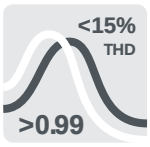
EFFICACY



OPERATING TEMP



LENS



PWR FACTOR/THD



CRI



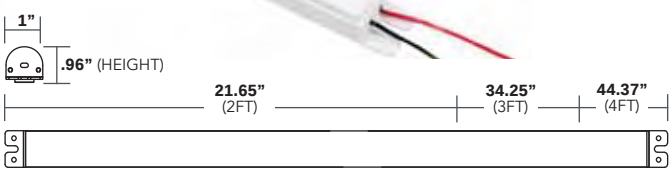
BEAM ANGLE



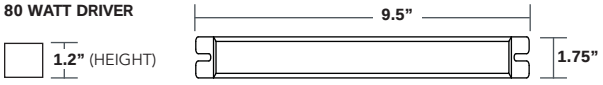
RATED LIFE



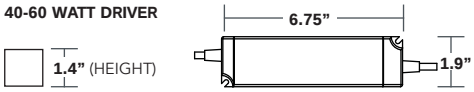
LED BAR



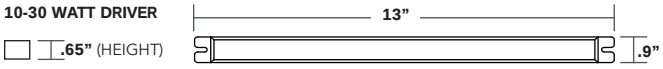
80 WATT DRIVER



40-60 WATT DRIVER



10-30 WATT DRIVER



- SIMPLE INSTALLATION
- FITS BETWEEN THE SOCKETS
- PERFORMANCE-OPTIMIZED TECHNOLOGY
- MAXIMUM VERSATILITY
- MANY LIGHT OUTPUT CHOICES
- STANDARD 10V DIMMABLE DRIVER
- CODE-COMPLIANT APPLICABILITY
- HIGH QUALITY CONSTRUCTION & MATERIALS
- SUITABLE FOR DRY & DAMP LOCATIONS
- UL 1598C CLASSIFIED RETROFIT KIT LISTED & DLC QPL LISTED
- 10 YEAR WARRANTY, L70 >100,000HRS
- OPTIONAL "BAA" BUY AMERICA ACT
- CUSTOM BRACKET DESIGNS AVAILABLE
- OPTIONAL HIGH/LOW MOTION SENSOR

EASILY RETROFIT THESE FIXTURE STYLES, AND MORE!


VAPOR TIGHT

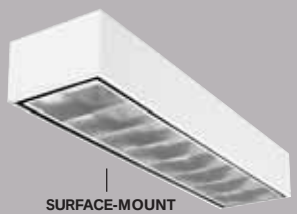

TROFFER


LOW BAY INDUSTRIAL


STRIP


WRAP


DIRECT/INDIRECT


SURFACE-MOUNT

RemPhos by Light Efficient Design
lighting on target

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LED BARKITJ RETROFIT FOR LINEAR FLUORESCENT LUMINAIRES

PRO
BASE

HOW TO EASILY ADD OCCUPANCY SENSING AND DAYLIGHT CONTROL TO YOUR FIXTURE

Choose one of the control options below which best fits your needs. Any of these options can be easily installed under the existing glass or plastic fixture lens. These controls will allow the LED Barkit to adjust it's light level depending on cccupancy or daylight levels, acheiving greater energy savings.



	PART #	DETAILS
	**HC419V**	Integrated antenna. Can be mounted behind glass or plastic lens. Adjusts for occupancy and daylight. DIP switch to adjust settings.
	**HC403VRC-KD SAM5**	Remote mounted antenna can be screwed to outside of ballast cover. Can be mounted behind glass or plastic lens. Adjusts for occupancy and daylight. Optional remote control to adjust settings.
	**LG SENSOR CONNECT**	LG's intelligent wireless lighting control system. ZigBee technology. Allows for occupancy sensing, daylight harvesting, grouping, scheduling, high-end trim and more. Adjust settings via Android app.

More details and videos are available at www.remphos.com/controls.

ORDERING DIRECTIONS (SEE ORDERING GUIDE ON NEXT PAGE)

A) Choose your desired total system wattage and lumen output.
B) Choose your desired LEDBAR length (2, 3 or 4FT) and QTY of LEDBAR(s) per driver from column C.
D) Order system part # (a system will include 1pc LED driver + LEDBAR(s). Substitute "XX" in the 8XX for your desired CCT. 35 (3500K), 40 (4000K) and 50 (5000K) are standard color temps. 27 (2700K), 30 (3000K), 65 (6500K) are custom colors and are special order.
E) The wattage of each LEDBAR in the system.
F) The lumen output of each LEDBAR in the system.
G) DLC QLP listed system Part #.
H) DLC QPL Product Code.

If the system you want is not currently a DLC listed part #, please contact us for a letter to send to your Utility for custom incentive approval.

CAUTION! MAX WATTAGES PER LEDBAR
2FT: 12W 3FT: 12W 4FT: 22W

If you require BAA SECTION 1605 COMPLIANT add -BAA at end of part number.

STANDARD COLOR TEMPS AVAILABLE

3500K, 4000K, 5000K

SPECIAL ORDER COLOR TEMPS AVAILABLE

2700K, 3000K, 6500K, RED, GREEN, BLUE, AMBER

ORDERING EXAMPLE

A 20W/2600LM system is desired utilizing 2pcs of 2FT LEDBAR in 4000K running off 1pc of driver. For this system you would order:

SYSTEM: **RPT-P-LEDBARKITJ-20W-2FT-2L-840-A** (All kits include driver)
TOTAL SYSTEM WATTAGE: **20W**
TOTAL SYSTEM LUMEN OUTPUT: **2600LM**
LENGTH OF LED BAR: **2FT** (actual 21.65in)
OF LED BARS: **2pcs**
WATTAGE PER LED BAR: **10W**
LUMENS PER LED BAR: **1300LM**
DLC LISTED KIT PART #: **RPT-LEDBARKIT-24IN-840-2L**
DLC QPL PRODUCT CODE: **PG2CRZ1T**

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FOR REMPHOS PRODUCT INFO CALL RemPhos by Light Efficient Design • 30 Log Bridge Road, Building 200 • Middleton, MA 01949 • 877.997.3674 • remphos.com

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LED BARKITJ RETROFIT FOR LINEAR FLUORESCENT LUMINAIRES

PRO
BASE

ORDERING GUIDE

A TOTAL SYSTEM WATTAGE/ LUMEN OUTPUT	B LED BAR LENGTH	C # OF BARS PER DRIVER	D SYSTEM (KIT) PART # TO ORDER	E WATTAGE PER LED BAR	F LUMENS PER LED BAR	G PART #/KIT ON DLC QPL	H DLC QPL PRODUCT CODE
10W/1300LM	2FT	1	RPT-P-LEDBARKITJ-10W-2FT-1L-8XX	10.0	1300	*	
		2	RPT-P-LEDBARKITJ-10W-2FT-2L-8XX	5.0	650	*	
		3	RPT-P-LEDBARKITJ-10W-2FT-3L-8XX	3.3	433	*	
		4	RPT-P-LEDBARKITJ-10W-2FT-4L-8XX	2.5	325	*	
	3FT	1	RPT-P-LEDBARKITJ-10W-3FT-1L-8XX	10.0	1300	*	
		2	RPT-P-LEDBARKITJ-10W-3FT-2L-8XX	5.0	650	*	
		3	RPT-P-LEDBARKITJ-10W-3FT-3L-8XX	3.3	433	*	
		4	RPT-P-LEDBARKITJ-10W-3FT-4L-8XX	2.5	325	*	
	4FT	1	RPT-P-LEDBARKITJ-10W-4FT-1L-8XX	10.0	1300	*	
		2	RPT-P-LEDBARKITJ-10W-4FT-2L-8XX	5.0	650	*	
		3	RPT-P-LEDBARKITJ-10W-4FT-3L-8XX	3.3	433	*	
		4	RPT-P-LEDBARKITJ-10W-4FT-4L-8XX	2.5	325	*	
15W/1950LM	2FT	2	RPT-P-LEDBARKITJ-15W-2FT-2L-8XX	7.5	975	*	
		3	RPT-P-LEDBARKITJ-15W-2FT-3L-8XX	5.0	650	*	
		4	RPT-P-LEDBARKITJ-15W-2FT-4L-8XX	3.8	488	*	
	3FT	2	RPT-P-LEDBARKITJ-15W-3FT-2L-8XX	7.5	975	*	
		3	RPT-P-LEDBARKITJ-15W-3FT-3L-8XX	5.0	650	*	
		4	RPT-P-LEDBARKITJ-15W-3FT-4L-8XX	3.8	488	*	
	4FT	1	RPT-P-LEDBARKITJ-15W-4FT-1L-8XX	15.0	1950	*	
		2	RPT-P-LEDBARKITJ-15W-4FT-2L-8XX	7.5	975	*	
		3	RPT-P-LEDBARKITJ-15W-4FT-3L-8XX	5.0	650	*	
		4	RPT-P-LEDBARKITJ-15W-4FT-4L-8XX	3.8	488	*	
20W/2600LM	2FT	2	RPT-P-LEDBARKITJ-20W-2FT-2L-8XX	10.0	1300	RPT-LEDBARKITJ-24IN-2L	PG2CRZ1T
		3	RPT-P-LEDBARKITJ-20W-2FT-3L-8XX	6.7	867	*	
		4	RPT-P-LEDBARKITJ-20W-2FT-4L-8XX	5.0	650	*	
	3FT	2	RPT-P-LEDBARKITJ-20W-3FT-2L-8XX	10.0	1300	*	
		3	RPT-P-LEDBARKITJ-20W-3FT-3L-8XX	6.7	867	*	
		4	RPT-P-LEDBARKITJ-20W-3FT-4L-8XX	5.0	650	*	
	4FT	1	RPT-P-LEDBARKITJ-20W-4FT-1L-8XX	20.0	2600	*	
		2	RPT-P-LEDBARKITJ-20W-4FT-2L-8XX	10.0	1300	RPT-LEDBARKITJ-48INLO-2L	PC7HUERF
		3	RPT-P-LEDBARKITJ-20W-4FT-3L-8XX	6.7	867	*	
		4	RPT-P-LEDBARKITJ-20W-4FT-4L-8XX	5.0	650	*	
30W/3900LM	2FT	3	RPT-P-LEDBARKITJ-30W-2FT-3L-8XX	10.0	1300	RPT-LEDBARKITJ-24IN-3L	PMSE9BQH
		4	RPT-P-LEDBARKITJ-30W-2FT-4L-8XX	7.5	975	*	
	3FT	3	RPT-P-LEDBARKITJ-30W-3FT-3L-8XX	10.0	1300	*	
		4	RPT-P-LEDBARKITJ-30W-3FT-4L-8XX	7.5	975	*	
	4FT	2	RPT-P-LEDBARKITJ-30W-4FT-2L-8XX	15.0	1950	*	
		3	RPT-P-LEDBARKITJ-30W-4FT-3L-8XX	10.0	1300	RPT-LEDBARKITJ-48INLO-3L	PRCTD1FW
		4	RPT-P-LEDBARKITJ-30W-4FT-4L-8XX	7.5	975	*	
36W/4680LM	2FT	3	RPT-P-LEDBARKITJ-36W-2FT-3L-8XX	12.0	1560	*	
		4	RPT-P-LEDBARKITJ-36W-2FT-4L-8XX	9.0	1170	*	
	3FT	3	RPT-P-LEDBARKITJ-36W-3FT-3L-8XX	12.0	1560	*	
		4	RPT-P-LEDBARKITJ-36W-3FT-4L-8XX	9.0	1170	*	
	4FT	2	RPT-P-LEDBARKITJ-36W-4FT-2L-8XX	18.0	2340	*	
		3	RPT-P-LEDBARKITJ-36W-4FT-3L-8XX	12.0	1560	*	
		4	RPT-P-LEDBARKITJ-36W-4FT-4L-8XX	9.0	1170	*	
40W/5200LM	2FT	4	RPT-P-LEDBARKITJ-40W-2FT-4L-8XX	10.0	1300	RPT-LEDBARKITJ-24IN-4L	PFYTMR94
	3FT	4	RPT-P-LEDBARKITJ-40W-3FT-4L-8XX	10.0	1300	*	
	4FT	2	RPT-P-LEDBARKITJ-40W-4FT-2L-8XX	20.0	2600	RPT-LEDBARKITJ-48IN-2L	PZA69V99
		3	RPT-P-LEDBARKITJ-40W-4FT-3L-8XX	13.3	1733	*	
		4	RPT-P-LEDBARKITJ-40W-4FT-4L-8XX	10.0	1300	*	
60W/7800LM	4FT	3	RPT-P-LEDBARKITJ-60W-4FT-3L-8XX	20.0	2600	RPT-LEDBARKITJ-48IN-3L	PWPGV4S3
		4	RPT-P-LEDBARKITJ-60W-4FT-4L-8XX	15.0	1950	*	
80W/10400LM	4FT	4	RPT-P-LEDBARKITJ-80W-4FT-4L-8XX	20.0	2600	RPT-LEDBARKITJ-48IN-4L	PQF48XGA

* Pending DLC approval

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LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 15.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 12 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25˚C.

LEDs provide nominal 80 CRI or 90CRI at 3000 K, 3500 K,4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/resources/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PJANKZR4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VKL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P77I8Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P8A42C1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGRBV	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PW6250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PYKOC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PJANKZR4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VKL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P77I8Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P8A42C1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGRBV	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD0SSIAD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CR WH	00191723525953	PYKOC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

LED Linear

CLX

24", 36", 48" and 96" Lengths



Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length	Nominal lumens	Performance package	Louver	Lens
CLX LED linear	L24 24" [1,2]	1500LM 1,500 lumens 2000LM 2,000 lumens 2500LM 2,500 lumens 3500LM 3,500 lumens 4500LM 4,500 lumens 5000LM 5,000 lumens [3,4]	SEF Standard efficiency[5] HEF Premium efficiency	(Blank) Less louver SBLW Straight blade louver, white[6] SBLMB Straight blade louver, matte black[6] SBLGV Straight blade louver, galvanized[6] SBLSKGY Straight blade louver, smoke gray[6]	L/Lens Less lens FDL Flat diffuse [7,8] RDL Round diffuse [7,8] WDL Wide diffuse [7,8]
	L36 36" [2]	2250LM 2,250 lumens 3000LM 3,000 lumens 3750LM 3,750 lumens 5250LM 5,250 lumens 6750LM 6,750 lumens 7500LM 7,500 lumens [3,4]			
	L48 48"	3000LM 3,000 lumens 4000LM 4,000 lumens 5000LM 5,000 lumens 7000LM 7,000 lumens [2] 9000LM 9,000 lumens [2] 10000LM 10,000 lumens [2,4]			
	L96 96"	6000LM 6,000 lumens 8000LM 8,000 lumens 10000LM 10,000 lumens 14000LM 14,000 lumens [2,4] 18000LM 18,000 lumens [2,4] 20000LM 20,000 lumens [2,4]			

Distribution	Voltage		Driver[14]	Color temperature	Coloring rendering index
(Blank) General	MVOLT 120-277V[10]	277 277V	GZ10 0-10V dimming[15]	30K 3000 K	80CRI 80 CRI
ND Narrow[8,9]	120 120V	347 347V[12,13]	EZ1 Dimming to 1%[2]	35K 3500 K	90CRI 90 CRI
WD Wide[8,9]	208 208V[11]	480 480V[12,13]		40K 4000 K	
AD2 Aisle, 24° off center[8,9]	240 240V[11]			50K 5000 K	

Options

PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant [2,11,13,16,17]
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS [2,11,13,16,17]
BGTD	Generator transfer device, not avaialble with PS1050[13,16,18]
OCS	5', 18/3 Reloc selectable One Pass cable[16]
HA	High ambient, for use in ambient temperatures up to 50°C[11]
EPNKO	Decorative endplate, no knock out[19]
OUTCTR	Wiring leads pulled through back center of fixture[20]
OUTEND	Wiring leads pulled through end of fixture[21]
Cord Sets:	
CS1W	Staight blade plug, 120V[10,16]
CS3W	NEMA twist-lock plug, 120V[10,16]
CS7W	Staight blade plug, 277V[10,16]
CS11W	NEMA twist-lock plug, 277V[10,16]
CS25W	NEMA twist-lock plug, 347V[10,16]
CS97W	NEMA twist-lock plug, 480V[10,16]
CS93W	600V SEOOW white cord, no plug (no voltage required)
CS6WG16ST0WD5D	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required)[15]
PLR__	Plug-in wiring, see page 16 for ordering information
PLR1LVG	Plug-in wiring,low voltage dimming[22]
RRL__	RELOC®-ready luminaire. See page 15 for ordering information
SPD	Surge protection device, provides up to 6kV protection[16,20]
USPOM	Assembled in the United States
nLight® Wireless: [23,24]	
NLTAIR2 RES7	nLight® Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell
NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell
NLTAIR2 RIO	No sensor control
nLight® Wired: [23,25]	
N100	nLight® without lumen management
NES7	nLight® nES 7 PIR integral occupancy sensor[26]
NESPDT7	nLight® nES PDT 7 dual technology integral occupancy control[26]
NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[26]
NESPDT7ADCX	nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell[26]
Individual controls: [23,25]	
MSD7	PIR integral occupancy sensor
MSDPDT7	PDT 7 dual technology integral occupancy control
MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell
MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell

Finish

WH	White
GALVW	Galvanized with white lens end caps
GALVB	Galvanized with black lens end caps
MB	Matte black
SKGYW	Smoke gray with white lens end caps
SKGYB	Smoke gray with black lens end caps

See Accessories and footnotes on next page

INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-315-4963 www.lithonia.com

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Accessories: *Order as separate catalog number.*

Mounting:

ZACVH	Aircraft cable 120" (one pair)
ZAC120	One adjustable aircraft cable with canopy 120" [27]
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120" [27]
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120" [27]
ZAC240	One adjustable aircraft cable with canopy 240" [27]
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240" [27]
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240" [27]
SQ__	Stem kit, 2" increments up to 48" [27]

THCLX __	Tong hanger (Must specify color) (one pair) [28]
CLXANGBKT ____	Angle bracket, (Must specify color) (one pair) [28]
HC36	Hanger chain, 36" (one pair)

Sensors & Controls:

LSXR	Sensor Switch ® LSXR occupancy sensor [29]
NPP16D	nLight® switching/dimming module
NPP16DER	nLight® switching/dimming module with emergency relay
rPP20D	nLight® air dimming/switching module
XPA CMRB0	XPoint™ Wireless 0-10V relay, external, 55°C max ambient

Reflectors:

CLXRW24___	Wide decorative 24" reflector, (Must specify color) [30]
CLXRW36___	Wide decorative 36" reflector, (Must specify color) [30]
CLXRW48___	Wide decorative 48" reflector, (Must specify color) [30]
CLXRW96___	Two wide decorative 48" reflectors, (Must specify color) [30]
CLXRWU24___	Wide decorative 24" reflector with uplight, (Must specify color) [30]
CLXRWU36___	Wide decorative 36" reflector with uplight, (Must specify color) [30]
CLXRWU48___	Wide decorative 48" reflector with uplight, (Must specify color) [30]
CLXRWU96___	Two wide decorative 48" reflectors with uplight, (Must specify color) [30]
CLXRN24	Narrow 24" reflector, (Must specify color) [31]
CLXRN36	Narrow 36" reflector, (Must specify color) [31]
CLXRN48	Narrow 48" reflector, (Must specify color) [31]
CLXRN96___	Two narrow 48" reflectors, (Must specify color) [31]

Wireguards:

WGCLX24___	24" wireguard, (Must specify color) [32]
WGCLX36___	36" wireguard, (Must specify color) [32]
WGCLX48___	48" wireguard, XX, (Must specify color) 96" fixture requires two [32]

Notes

1 Not available with OUTCTR option.
2 Not available with HA option.
3 Not available with SEF when ordered in combination with EZ1.
4 Not available with NLTAIR2 RES7, NLTAIR2 RES7PDT, or NLTAIR2 RIO.
5 Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
6 When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or WGCLX accessories. Not available with RDL lens options.
7 Only available with general distribution.
8 Not available with CLXRN accessories.
9 Available L/LENS only.
10 Not available with PS1050, E10WLCP, or BGTD.
11 Not available with BGTD option.
12 Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100.Not available with PS1050, E10WLCP or BGTD option.
13 Requires SPD option.
14 When continuous row mounting, fixtures must all have the same driver selection.
15 Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
16 Must specify voltage.
17 Not available with L24 or L36. Not available with L48 in combination with N100.
18 Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
19 Not available OUTEND.
20 Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
21 Not available with PLR options.
22 Not available with XPoint, Individual controls, NLight Wired, or NLight Wireless options.
23 Sensor housing will be the same color as lens end caps.
24 Not available with L24 in combination with 5000LM, not available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
25 Not available with any other control option. Requires EZ1.
26 Requires N100 option.
27 Ships standard as white.
28 Not available with louver, wireguards, wide reflectors.
29 More configurations on LSXR Specification Sheet.
30 L24 reflector is 22.65", L36 reflector is 34.01", L48 reflector is 46.80", L96 comes with two L48 reflectors.
31 For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
32 Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES



Narrow reflector
Ships separtely from fixture.
Order as:
CLXRN24___
CLXRN36___
CLXRN48___
CLXRN96___



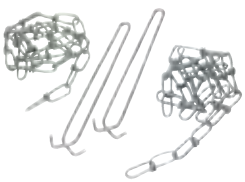
Wide decorative reflector
Ships separtely from fixture.
Order as:
CLXRW24___
CLXRW36___
CLXRW48___
CLXRW96___



Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.
Order as:
WGCLX24___
WGCLX36___
WGCLX48___



Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240



HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36



ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



Tong hanger
Ships as a pair
Order As:
THCLX___

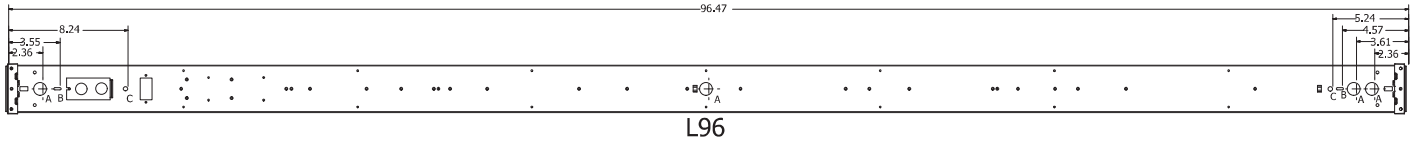
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DIMENSIONS

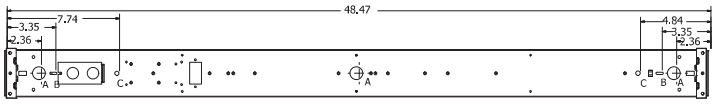
All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

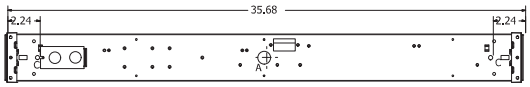
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



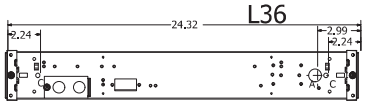
L96



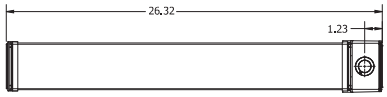
L48



L36



L24

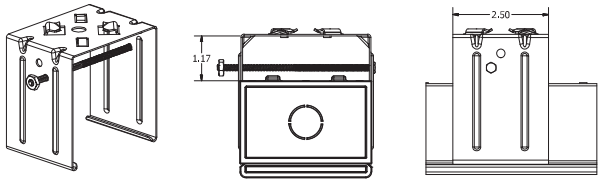


L24 WITH SENSOR

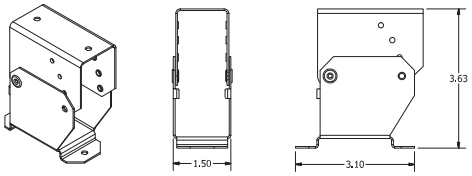
PALLET DIMENSIONS

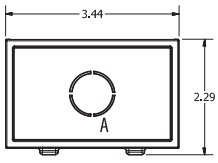
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED

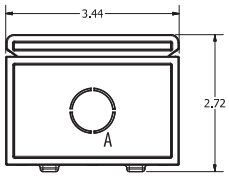


CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE

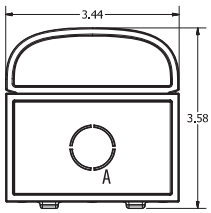




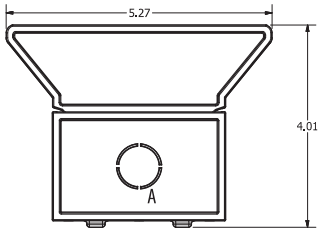
L/LENS



FDL



RDL



WDL

PHOTOMETRICS

See www.lithonia.com.

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POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6 - lamp 32WT8, 4 -lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1 or EOHN			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	Xpoint/ BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C	40C	N/A	35C	35C	35C	N/A	N/A
	2000LM	40C	40C		35C	35C	35C		
	2500LM	40C	40C		35C	35C	35C		
	3000LM	40C	40C		40C	40C	40C		
	4500LM	40C	40C		35C	35C	40C		
	5000LM	40C	40C		25C	30C	35C		
L36	2250LM	40C	40C		40C	40C	40C		
	3000LM	40C	40C		40C	40C	40C		
	3750LM	40C	40C		40C	40C	40C		
	5250LM	40C	40C		35C	35C	40C		
	6750LM	30C	40C		35C	35C	40C		
	7500LM	30C	40C		25C	30C	35C		
L48	3000LM	40C	40C	50C	40C	40C	40C	35C	25C
	4000LM	40C	40C	50C	40C	40C	40C		
	5000LM	40C	40C	50C	35C	35C	40C		
	7000LM	30C	40C	N/A	35C	35C	40C		
	9000LM	30C	40C		25C	30C	35C		
	10000LM	30C	40C		25C	30C	35C		
L96	6000LM	40C	40C	50C	35C	35C	40C		
	8000LM	30C	40C	50C	35C	35C	40C		
	10000LM	30C	40C	50C	25C	30C	35C		
	14000LM	40C	40C	N/A	35C	35C	40C		
	18000LM	30C	40C		25C	30C	35C		
	20000LM	30C	40C		25C	30C	35C		

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CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85
				90	1305	1333	1371	1441	10.85
			HEF	80	1493	1514	1582	1586	10.39
				90	1220	1237	1301	1301	10.39
		2000LM	SEF	80	2066	2125	2183	2235	14.48
				90	1801	1840	1892	1989	14.48
			HEF	80	2060	2089	2183	2189	13.46
				90	1684	1708	1796	1796	13.46
		2500LM	SEF	80	2616	2689	2763	2829	18.41
				90	2279	2329	2394	2517	18.41
			HEF	80	2607	2644	2763	2771	17.42
				90	2132	2161	2273	2273	17.42
		3500LM	SEF	80	3518	3617	3716	3804	25.83
				90	3065	3132	3220	3385	25.83
			HEF	80	3506	3556	3716	3726	25.04
				90	2867	2907	3057	3057	25.04
		4500LM	SEF	80	5040	5182	5325	5451	38.7
				90	4392	4487	4614	4851	38.7
			HEF	80	5024	5096	5325	5339	34.8
				90	4108	4165	4380	4380	34.8
		5000LM	SEF	80	5355	5506	5657	5791	41.48
				90	4667	4767	4902	5153	41.48
			HEF	80	5338	5414	5657	5672	38.11
				90	4364	4425	4653	4653	38.11
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36
				90	2479	2607	2146	2320	16.36
			HEF	80	2437	2554	1965	2095	15.47
				90	2547	2403	1992	2095	15.47
		3000LM	SEF	80	3221	3388	2730	2868	20.8
				90	3310	3133	2789	3015	20.8
			HEF	80	3167	3319	2553	2722	19.98
				90	3310	3123	2589	2722	19.98
		3750LM	SEF	80	4123	4337	3495	3671	26.47
				90	4236	4010	3570	3859	26.47
			HEF	80	4054	4248	3268	3485	25.09
				90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9
				90	5698	5393	4801	5190	39.9
			HEF	80	5452	5713	4396	4687	34.3
				90	5698	5376	4457	4687	34.3
		6750LM	SEF	80	7081	7448	6001	6303	54.85
				90	7275	6886	6131	6627	54.85
			HEF	80	6962	7294	5613	5984	47.97
				90	7275	6864	5691	5984	47.97
		7500LM	SEF	80	7756	8158	6574	6905	62.6
				90	7969	7543	6716	7260	62.6
			HEF	80	7626	7991	6148	6555	54.02
				90	7969	7519	6234	6555	54.02

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3104	3190	3265	20.32
				90	2631	2688	2764.	2906.	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2624	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6692	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8204	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3192	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2188	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6824	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2508	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6635	6822	7009	7176	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5697	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5697	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17697	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17697	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	15079	15290	16078	16078	131.6

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3102	3189	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2695	2695	25.04
		4500LM	SEF	80	4444	4570	4695	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4695	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3403	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256.	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5739	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8607	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7892	7892	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6969	7068	7386	7406	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9354	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8744	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14898	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3234	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4923	5062	5201	5324	41.48
				90	4290	4383	4506	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

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CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3918	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3918	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7120	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9573	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8988	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13168	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16970	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

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RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.



ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)



OCS



OCU



OD



DC



PT

Notes

1 C, ABE, and C12S options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.



Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits				Dimming		Ground	
			Circuits to which ballast is connected		Emergency circuit connected					
PLR	(blank)	Not required for 22	(blank)	Not required for 22	(blank)	No emergency circuit	LV	Low-voltage dimming	G	Ground
PLR22	1	Black	A	Black wire	ELA	Emergency circuit wired to black wire				
	2	Black and red	B	Red wire	ELB	Emergency circuit wired to red wire				

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple circuit with night-lights located along row as desired

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Catalog Number	
Notes	
Type	



Contractor Select™

SB LED Square Basket Wraparound

Linear Flush Mount

Square-basket LED wraparound designed to deliver ambient lighting for surface-mount ceiling applications. Ideal for schools, offices, hospitals and many other applications.

FEATURES:

- Designed to replace existing 2-lamp T8 and T12 fluorescent
- Standard MVOLT (120-277) dimming driver
- Available in two CCTs: 3500K and 4000K

Catalog Number	UPC	Description	Lumens	Input Watts	CCT	CRI	Voltage	Pallet qty.
SBL4 LP835 (CI-254RKP)	00190887819410	4' LED Wraparound	3,933	32W	3500K	80	120-277V	70
SBL4 LP840 (CI-254RKU	00190887819434	4' LED Wraparound	3,994	32W	4000K	80	120-277V	70

More configurations are available. Click here or visit www.acuitybrands.com and search for SBL LED Square Basket Wraparound.

Specifications

INTENDED USE:
SBL LED wraparound provides a digital lighting platform to deliver general ambient lighting for surface-mount applications. The SBL provides a similar look to that of an existing fluorescent wrap with all of the excellent benefits of LED: energy savings, long life, and maintenance savings. Ideal for closets, storage rooms, and offices. Certain airborne contaminants can diminish integrity of acrylic. Click here for Acrylic Environmental Compatibility table for suitable uses. **Certain airborne contaminants can diminish integrity of acrylic. Click here for Acrylic Environmental Compatibility table for suitable uses.**

CONSTRUCTION:
Linear side prisms control brightness, pyramidal bottom prisms minimize lamp image. Continuous side flanges on fixture body provide light trap and continuous diffuser support to prevent accidental opening and simplify maintenance. Full depth, white enamel end plates.

Die-formed from code gauge cold-rolled steel. Channel cover snaps into place without the use of tools. Full end cap factory installed to reduce job site labor.

OPTICS:
The translucent white diffuser reduces glare and pixilation without impacting performance.

ELECTRICAL:
Long-life LEDs, coupled with high-efficiency drivers, provide extended service life. 90% LED lumen maintenance at 50,000 hours (L90/50,000).

INSTALLATION:
Suitable for suspension by cable, surface-mounting bracket, hook monopoint or single (pendant) monopoint. Surface mounting not recommended without optional surface mounting bracket. To maintain ambient listing, fixture should be mounted at a minimum plenum height of 18".

LISTINGS:
CSA certified to U.S. and Canadian standards. Damp listed.

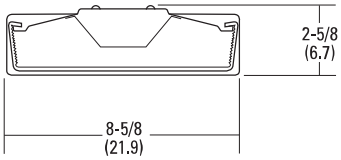
WARRANTY:
5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Dimensions

Length: 48 (122.0)
Width: 8-5/8 (21.9)
Depth: 2-5/8 (6.7)

Narrow Body
4' length



MOUNTING DATA
Individual Installation –
Two single-stem hangers required.
Row Installation –
One hanger per fixture plus one row required.



All dimensions are inches (centimeters) unless otherwise indicated.

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LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — The BLWP LED Wrap/ Wall bracket expands the BLT family with the features and aesthetics of the popular BLT and BLTR center basket design with a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLWP the perfect choice for many lighting applications including schools, offices, stairwells and other commercial spaces. With multiple mounting options, easy installation, and controls configurations, the BLWP is an excellent choice for renovation and new construction.

CONSTRUCTION — BLWP enclosure components are die-formed for dimensional consistency. For 2' and 4' product, hinged door frame allows easy access to electrical components and mounting locations without having to remove additional parts. For 8' product, suspension aircraft cables allow easy access to electrical components and mounting locations without having to remove additional parts. Available in three paint finishes: white (pre-paint), painted after fabrication white, and natural aluminum. Diffusers are extruded from impact modified acrylic for increased durability. Optional polycarbonate lens available for additional impact resistance, as well as Tamper Proof screws.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Five diffuser choices available - curved and square designs with linear prisms, a smooth frosted finish, and a smooth polycarbonate finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and qualityof illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Replaces 2 lamp fluorescent.

Configurable BLWP: Available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information on page 2.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight®controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission, while nLight AIR is commissioned easily through an intuitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Driver disconnect provided where required to comply with US and Canadian codes.

CONTROLS — **Integrated sensor (individual control):** Sensor Switch MSD7ADCX (Passive infrared (PIR)) or MSDPDT7ADCX (PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 5 for the nLight sensor options.

Integrated Smart Sensor (nLight AIR Wireless Platform): The rES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or dual technology occupancy sensor. It pairs to other luminairs and wall switches through our mobile app, CL***AIR***ITY PRO, which allows for simple sensor adjustment. See page 5 for more details on the Integrated Smart Sensor.

INSTALLATION — Intended for surface or suspend mounting. For row mounting and quick mounting to junction boxes see accessories section. Suitable for damp location.

LISTINGS — CSA Certified to meet U.S. and Canadian standards.

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Low Profile LED Wraparound

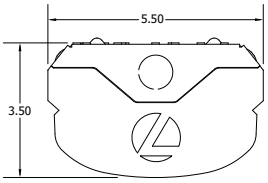
BLWP

2', 4' and 8' Lengths

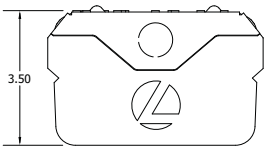


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Specifications



2' Dimensions
Length: 24 (60.96)
Width: 5.50 (13.97)
Depth: 3.50 (8.89)



4' Dimensions
Length: 48 (121.92)
Width: 5.50 (13.97)
Depth: 3.50 (8.89)

8' Dimensions
Length: 96 (243.84)
Width: 5.50 (13.97)
Depth: 3.50 (8.89)

All dimensions are inches (centimeters) unless otherwise specified.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or control networks marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

BLWP Low Profile LED Wraparound

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: BLWP4 40L ADP GZ10 LP840

Series		Lumens[1]				Lens/Diffuser		Driver		Driver		Color Temperature	
		Standard Efficiency (>100 LPW)		High Efficiency (>130 LPW)[1]									
BLWP2	2' LED Wraparound	8L	800 Lumens	8LHE	800 Lumens	ADP	Curved, linear prisms	(blank)	MVOLT	EZ1	eldoLED dims to 1% (0-10v dimming)	LP830	82CRI, 3000K
		20L	2000 Lumens	20LHE	2000 Lumens	ADSM	Curved, smooth	120	120V	GZ1	Generic dims to 1% (0-10v dimming)[4]	LP835	82CRI, 3500K
		33L	3300 Lumens	33LHE	3300 Lumens	SDP	Square, linear prisms	277	277V	GZ10	Generic dims to 10% (0-10v dimming)[4]	LP840	82CRI, 4000K
		40L	4000 Lumens	40LHE	4000 Lumens	SDSM	Square, smooth	347	347V[3]	SLD	Step-level dimming[4,25]	LP850	82CRI, 5000K
		48L	4800 Lumens	48LHE	4800 Lumens	PDSM	Curved, smooth polycarbonate[2]			GZ10	Generic dims to 10% (0-10v dimming)[4]	LP930	90CRI, 3000K
BLWP4	4' LED Wraparound	15L	1500 Lumens	15LHE	1500 Lumens	**Diffusers w/ trim rings**				SLD	Step-level dimming[4,25]	LP935	90CRI, 3500K
		20L	2000 Lumens	20LHE	2000 Lumens	ADPT	Curved, linear prisms			TD	Triac Dimming[5]	LP940	90CRI, 4000K
		30L	3000 Lumens	30LHE	3000 Lumens	ADSMT	Curved, smooth					LP950	90CRI, 5000K
		40L	4000 Lumens	40LHE	4000 Lumens	SDPT	Square, linear prisms						
		48L	4800 Lumens	48LHE	4800 Lumens	SDSMT	Square, smooth						
		60L	6000 Lumens	60LHE	6000 Lumens	PDSMT	Curved, smooth polycarbonate[2]						
		72L	7200 Lumens	72LHE	7200 Lumens								
		85L	8500 Lumens	85LHE	8500 Lumens								
		100L	10000 Lumens	100LHE	10000 Lumens								
BLWP8	8' LED Wraparound	40L	4000 Lumens	40LHE	4000 Lumens								
		60L	6000 Lumens	60LHE	6000 Lumens								
		80L	8000 Lumens	80LHE	8000 Lumens								
		100L	10000 Lumens	100LHE	10000 Lumens								
		140L	14000 Lumens	140LHE	14000 Lumens								
		180L	18000 Lumens	180LHE	18000 Lumens								
		200L	20000 Lumens	200LHE	20000 Lumens								

nLight Interface[6]		Control[6]			Standy mode[6]		Options		Finish	
nLight Wired		**nLight Wired**		**Individual Control**	(blank)	Fixture turns off when unoccupied	E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS[16]	(blank)	Standard pre-paint white
(blank)	no nLight® interface	(blank)	no nLight control	MSD7ADCX	PIR integral occupancy sensor with automatic dimming control photocell[9,11,12]	DIM10	Fixture dims to approximately 10% light output when unoccupied[14]	EL7L	700 nominal lumens battery pack[17]	PAF	Paint After Fabrication White
N80	nLight with 80% lumen management	NES7	nLight™ nES 7 PIR integral occupancy sensor[9,10]	MSDPDT7ADCX	PDT integral occupancy sensor with with automatic dimming control photocell[9,11,12]	DIM50	Fixture dims to approximately 50% light output when unoccupied[14]	EL14L	1400 nominal lumens battery pack[17]	DNA	Paint After Fabrication Natural Aluminum
N80EMG	nLight with 80% lumen management[7] For use with generator supply EM power	NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control[9,10]			NOC	Occupancy sensor disabled[15]	BGTD	Bodine Generator Transfer Device[18]		
N100	nLight without lumen management	NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[9,10]					USPOM	US Point of Manufacture		
N100EMG	nLight without lumen management[7] For use with generator supply EM power	NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell[9,10]					QMB	Quick Mount Bracket[19]		
nLight Wireless		**nLight Wireless**						TRS	Tamper Resistant Screw[20]		
(blank)	no nLight® interface	(blank)	no nLight control					GLR	Fast-blowing fuse[21]		
NLTAIR2	nLight AIR Generation 2 enabled[8]	RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities Individual Control[9,13]					GMF	Slow-blowing fuse[21]		
		RES7PDT	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Zone Control[9,13]					FAO	Field Adjustable Output[22,26]		
		RIO	nLight AIR radio module without sensor[9,13]					PLR__	Plug-in wiring, see page 8 for ordering information[23]		
								PLR1LVG	Plug-in wiring,low voltage dimming[23,24]		

See Stock configurations Accessories and footnotes on next page

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Stock configurations are offered for shorter lead times:

Ci code	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet QTY
*264V2M	BLWP2 20L SDSM LP835	191848282045	2000	16	125	3500 K	120-277	80
*264V2L	BLWP2 20L SDSM LP840	191848282038	2000	16	125	4000 K	120-277	80
*264CH0	BLWP2 33L ADP LP835	191848080825	3300	30	110	3500 K	120-277	80
*264CH1	BLWP2 33L ADP LP840	191848080832	3300	30	110	4000 K	120-277	80
*264CH2	BLWP2 40L ADP LP835	191848080849	4000	37	108	3500 K	120-277	80
*264CH4	BLWP2 40L ADP LP840	191848080856	4000	37	108	4000 K	120-277	80
*264V2K	BLWP4 30L ADP LP835	191848282021	3000	25	120	3500 K	120-277	70
*264V2H	BLWP4 30L ADP LP840	191848281994	3000	25	120	4000 K	120-277	70
*264CH5	BLWP4 40L ADP LP835	191848080863	4000	35	114	3500 K	120-277	70
*264CH6	BLWP4 40L ADP LP840	191848080870	4000	35	114	4000 K	120-277	70
*264CH7	BLWP4 48L ADP LP835	191848080900	4800	39	123	3500 K	120-277	70
*264CH8	BLWP4 48L ADP LP840	191848080917	4800	39	123	4000 K	120-277	70

Accessories: *Order as separate catalog number.*

PART number	CI CODE	QTY	Description	Application
BLWPCR	*250A0S	1	CONTINUOUS ROW MOUNT BRACKET WHT	FOR USE ON BLWP4 ONLY, FOR STD FINISH AND PAF [27]
BLWPCRDNA	*250A1S	1	CONTINUOUS ROW MOUNT BRACKET DNA	FOR USE ON BLWP4 ONLY, FOR DNA FINISH [27]
BLWP8CR	*2543C6	1	CONTINUOUS ROW MOUNT BRACKET WHT	FOR USE ON BLWP8 ONLY, FOR STD FINISH AND PAF [27]
BLWP8CRDNA	*2543CA	1	CONTINUOUS ROW MOUNT BRACKET DNA	FOR USE ON BLWP8 ONLY, FOR DNA FINISH [27]
BLWPCG36 F1	*264R3P	1	BLWPCG36 F1	ADJUSTABLE AIRCRAFT CABLE GRIPPER KIT, 36 INCH F1 CEILING TYPE
BLWPCG36 F2	*264R4G	1	BLWPCG36 F2	CABLE GRIPPER KIT, 36 INCH F2 CEILING TYPE
BLWPCG72 F1	*264R4H	1	BLWPCG72 F1	CABLE GRIPPER KIT, 72 INCH F1 CEILING TYPE
BLWPCG72 F2	*264R4M	1	BLWPCG72 F2	CABLE GRIPPER KIT, 72 INCH F2 CEILING TYPE
BLWPCGF36 F1	*264R4R	1	BLWPCGF36 F1	KIT WITH POWER FEED 36 INCH F1 CEILING TYPE
BLWPCGF36 F2	*264R4U	1	BLWPCGF36 F2	KIT WITH POWER FEED 36 INCH F2 CEILING TYPE
BLWPCGF72 F1	*264R4V	1	BLWPCGF72 F1	KIT WITH POWER FEED 72 INCH F1 CEILING TYPE
BLWPCGF72 F2	*264R4X	1	BLWPCGF72 F2	KIT WITH POWER FEED 72 INCH F2 CEILING TYPE
BLWPCGE36 F1	*264R50	1	BLWPCGE36 F1	KIT WITH EMERGENCY POWER FEED 36 INCH F1 CEILING TYPE
BLWPCGE36 F2	*264R5T	1	BLWPCGE36 F2	KIT WITH EMERGENCY POWER FEED 36 INCH F2 CEILING TYPE
BLWPCGE72 F1	*264R5V	1	BLWPCGE72 F1	KIT WITH EMERGENCY POWER FEED 72 INCH F1 CEILING TYPE
BLWPCGE72 F2	*264R53	1	BLWPCGE72 F2	KIT WITH EMERGENCY POWER FEED 72 INCH F2 CEILING TYPE
BLWP TRS T15 BIT	*2516KU	1	BLWP TRS T15 BIT	T15 WITH PIN, TORX BIT FOR TRS OPTION
BLWPQMB	*250A2S	1	BLWP Quick Mount Bracket	QUICK MOUNT BRACKET FOR INSTALLATION TO JUNCTION BOXES WITHOUT HAVING TO REMOVE ANY PARTS IN THE FIXTURE, 4FT FIXTURE ONLY.

Notes

1 Approximate lumen output. All versions may not achieve 130+ LPW including 90CRI and versions with integral sensor trim. Refer to photometry on www.acuitybrands.com. See QPL for latest DLC listings.
2 Not available with HE (high efficiency) performance package on BLWP2 and BLWP4 only. If ordered on BLWP2 with TD, must select 33L or 40L. If ordered on BLWP4 with TD, must select 30L, 40L, 48L, 85L, or 100L.
3 Not available with TD, E10WLCP, EL7L, EL14L, BGTD or BLWP4 > 85L/ 85LHE.
4 Not available with nLight Interface or Controls.
5 On BLWP2, not available with 8L, 20L, 48L, 8LHE, or 20LHE. On BLWP4, not available with 15L, 20L, 60L, 72L, 15LHE, 20LHE, 60LHE, or 72LHE.
6 Not available with TD.
7 Requires a connection to existing nLight network. Power is provided from a separate NLIGHT enabled fixture or external power pack.
8 Must select nLight wireless control
9 Must select Lens/Diffuser type with Trim Rings.
10 Requires EZ1 and nLight interface wired option to be specified.
11 Not available with nLight interface.
12 0-10V wires are not accessible via access plate.
13 Requires EZ1 and NLTAIR2 to be specified. Only available with 60L or lower lumen packages on the BLWP4. Only available with 100LHE/80L lumen packages or lower on the BLWP8.
14 Requires occupancy control. Must be ordered with nLight Wired or Individual Control sensor option. Not available with NLTAIR2 sensor option.
15 Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
16 Only available with EZ1 driver option.
17 Only available on BLWP8, 8ft length version of this fixture, in lumen packages 140L or less. Not available with TD.
18 Not available with TD or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
19 Only available with BLWP4 (4') fixture.
20 Accessory BLWP TRS T15 BIT available to be ordered with this option. See Accessories section page 3. Order as separate item.
21 Must specify voltage. 120 or 277, with GLR and GMF fusing.
22 Must specify EZ1 driver. Not available with lumen packages > 6000LM. FAO restricts use of external dimmingcontrols. See chart on page 3 for additional details.
23 Not available with BLWP2 or TD.
24 Not available with Controls options or nLight interface.
25 For ADP lens only, for additional lens options refer to photometry on www.acuitybrands.com.
26 Cannot be used with PLR1LVG.
27 Cannot be used to continuous row mount 4' fixtures with 8' fixtures.

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nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODM [color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODM DX [color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD GFX [color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODB [color] G2
On/Off two pole	rPODB 2P [color] G2
On/Off & raise/lower single pole	rPODB DX [color] G2
On/Off & raise/lower two pole	rPODB 2P DX [color] G2
On/Off & raise/lower single pole	rPODBZ DX WH G2

Replacement Parts: *Order as separate catalog number.*

2' Version Replacement Lens		4' Version Replacement Lens		8' Version Replacement Lens	
*264F5E	DBLWP24 ADP	*264F69	DBLWP48 ADP	*2543CE	DBLWP96 ADP
*264F5F	DBLWP24 SDP	*264F6E	DBLWP48 SDP	*2543CG	DBLWP96 SDP
*264F5H	DBLWP24 ADSM	*264F6F	DBLWP48 ADSM	*2543CJ	DBLWP96 ADSM
*264F5J	DBLWP24 SDSM	*264F6G	DBLWP48 SDSM	*2543CM	DBLWP96 SDSM
*264F5L	DBLWP24 ADPT	*264F6H	DBLWP48 ADPT	*2543CN	DBLWP96 ADPT
*264F5P	DBLWP24 SDPT	*264F6K	DBLWP48 SDPT	*2543CP	DBLWP96 SDPT
*264F5U	DBLWP24 ADSMT	*264F6L	DBLWP48 ADSMT	*2543CR	DBLWP96 ADSMT
*264F5W	DBLWP24 SDSMT	*264F6N	DBLWP48 SDSMT	*2543CS	DBLWP96 SDSMT
*264F66	DBLWP24 PDSM	*264F6W	DBLWP48 PDSM	*2543CW	DBLWP96 PDSM
*264F67	DBLWP24 PDSMT	*264F6X	DBLWP48 PDSMT	*2543CX	DBLWP96 PDSMT

FAO SETTINGS (Field Adjustable Output)

	0-10 Voltage Dimmer	% Lumen Output (approximate)	% Wattage (approximate)
Step 8	Full Output	100%	100%
Step 7	9.0 VDC	98%	100%
Step 6	8.0 VDC	88%	86%
Step 5	7.0 VDC	86%	82%
Step 4	6.0 VDC	82%	80%
Step 3	5.0 VDC	76%	75%
Step 2	4.0 VDC	71%	72%
Step 1	3.0 VDC	67%	71%



Simple adjustment of output through the use of a flat head screwdriver.

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Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RES7PDT	X	X	X		X

Basic nLight Zone



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

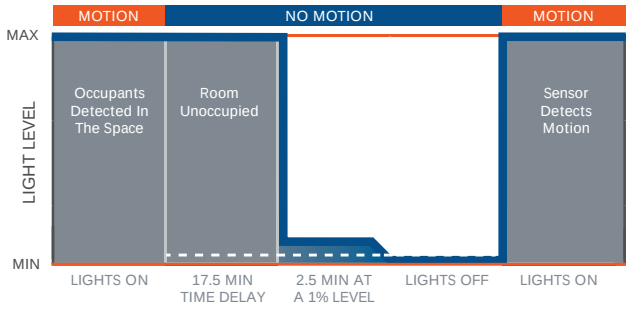
The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the NES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

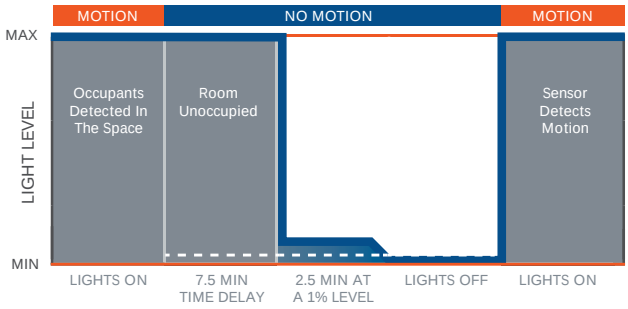
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the NESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation



*The presetting on the automatic dimming photocell is 5fc.

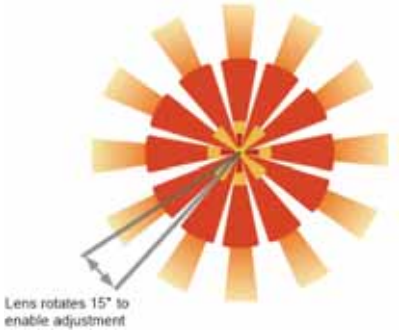
Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and costly. nLight AIR is available with or without an integral sensor. The integrated rES 7 or rES7 PDT smart sensor is part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

9 FT Mounting



5.5	18
4.6	15
3.7	12
2.7	9
1.8	6
0.9	3
0 m	0 ft
0.9	3
1.8	6
2.7	9
3.7	12
4.6	15
5.5	18



Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CL*AIR*ITY PROapp, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



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MOUNTING INFORMATION

For unit or row installation; surface or suspend mounting.

Suspension Methods:

Aircraft Cable Suspension

Order one BLWPCG_, BLWPCGF_, or BLWPCGE_ required for each suspension point.

F1 for use with most T-bar and screw slot grid ceiling applications. Designed for on-grid and off-grid installations.

F2 for use with recessed or surface-mount horizontal J-box applications..

See Accessories page on page 3 for part numbers configurations.



Stem Suspension

Individual installation — Two single-stem hangers required.

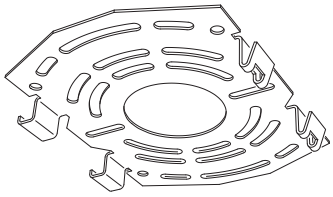


Note: 2' configurations with emergency option cannot be stem mounted.

Accessory Images

(QMB) Quick Mount Bracket

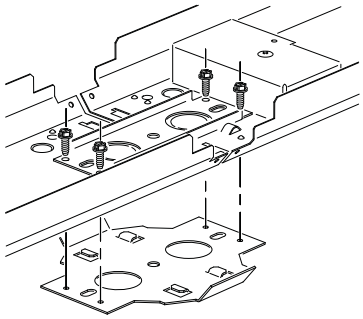
Quick Mount Bracket allows easy installation to junction boxes without having to remove any parts in the fixture.



Note: 2' and 8' configurations not available with QMB accessory.

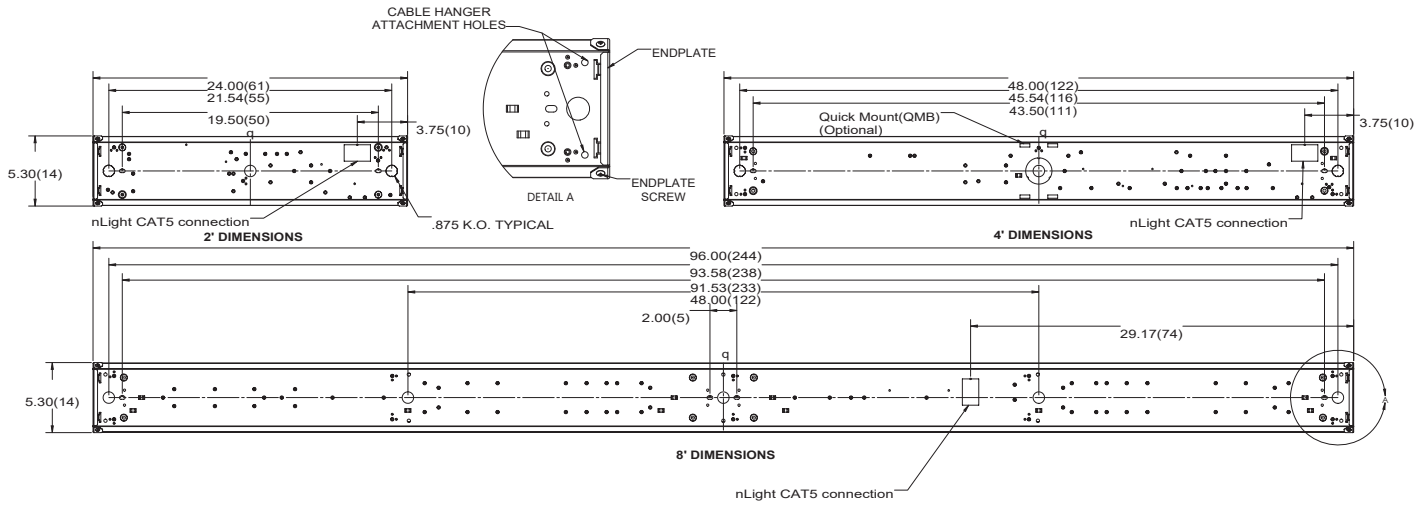
BLWPCR - continuous row mount bracket

Order one (1) BLWPCR bracket per fixture for continuous row applications. Order one hanger(Aircraft Cable Suspension Kit or Stem Suspension Kit) per fixture plus one per joiner required.



DIMENSIONS

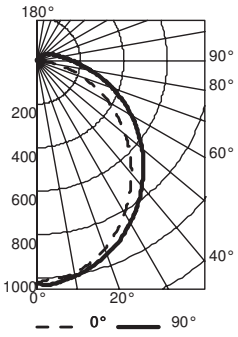
All dimensions are inches (centimeters) unless otherwise noted.



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PHOTOMETRICS

BLWP2 33L ADP LP835, 3332 delivered lumens, test no. ISF 37666, tested in accordance to IESNA LM-79.



CP Summary

	0°	90
0°	1024	1024
5°	1009	1027
15°	962	982
25°	867	910
35°	745	809
45°	604	694
55°	456	567
65°	303	436
75°	158	309
85°	36	202
90	0	161

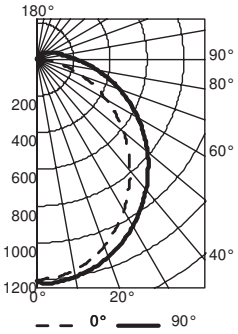
Coefficients of Utilization

RCR	pf 20% / pc 80% / pw 70%	50%	30%	10%	70%	50%	30%	10%	70%	50%	30%	10%
0		117	117	117	114	114	114	114	107	107	107	107
1		106	100	96	97	93	89	89	92	88	85	85
2		96	87	79	84	78	72	72	79	74	69	69
3		87	76	67	74	66	59	59	70	63	57	57
4		79	67	58	65	57	50	50	62	54	49	49
5		73	60	51	58	50	43	43	55	48	42	42
6		67	54	45	52	44	38	38	50	42	37	37
7		62	49	40	48	39	33	33	45	38	32	32
8		58	44	36	43	35	30	30	41	34	29	29
9		54	41	32	40	32	27	27	38	31	26	26
10		51	38	30	37	29	24	24	35	28	24	24

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	790	23.7	23.7
0° - 40°	1286	38.6	38.6
0° - 60°	2278	68.4	68.4
0° - 90°	3096	92.9	92.9
90° - 120°	184	5.5	5.5
90° - 130°	210	6.3	6.3
90° - 150°	233	7.0	7.0
90° - 180°	236	7.1	7.1
0° - 180°	3332	100.0	100.0

BLWP2 40L ADP LP835, 3923 delivered lumens, test no. ISF 37668, tested in accordance to IESNA LM-79.



CP Summary

	0°	90
0°	1210	1210
5°	1190	1219
15°	1130	1178
25°	1019	1100
35°	870	990
45°	706	856
55°	527	711
65°	352	560
75°	179	406
85°	37	268
90	1	214

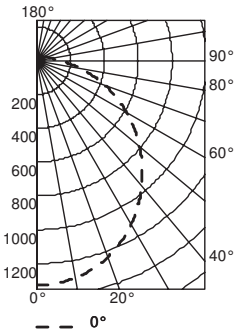
Coefficients of Utilization

RCR	pf 20% / pc 80% / pw 70%	50%	30%	10%	70%	50%	30%	10%	70%	50%	30%	10%
0		117	117	117	114	114	114	114	107	107	107	107
1		106	100	96	97	93	89	89	92	88	85	85
2		96	87	80	84	78	72	72	80	74	69	69
3		87	76	67	74	66	60	60	70	63	58	58
4		80	67	58	65	57	50	50	62	55	49	49
5		73	60	51	58	50	43	43	55	48	42	42
6		67	54	45	52	44	38	38	50	42	37	37
7		62	49	40	48	39	33	33	45	38	32	32
8		58	44	36	43	35	30	30	41	34	29	29
9		54	41	32	40	32	27	27	38	31	26	26
10		51	38	30	37	29	24	24	35	28	24	24

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	932	23.8	23.8
0° - 40°	1519	38.7	38.7
0° - 60°	2687	68.5	68.5
0° - 90°	3646	92.9	92.9
90° - 120°	215	5.5	5.5
90° - 130°	246	6.3	6.3
90° - 150°	273	7.0	7.0
90° - 180°	277	7.1	7.1
0° - 180°	3923	100.0	100.0

BLWP4 40L ADP LP835, 4391 delivered lumens, test no. ISF 37596, tested in accordance to IESNA LM-79.



CP Summary

	0°
0°	1324
5°	1321
15°	1274
25°	1180
35°	1043
45°	881
55°	705
65°	521
75°	343
85°	191
90	138

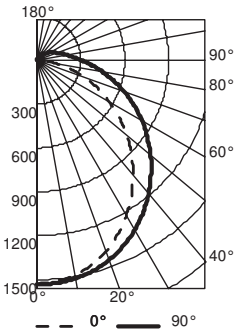
Coefficients of Utilization

RCR	pf 20% / pc 80% / pw 70%	50%	30%	10%	70%	50%	30%	10%	70%	50%	30%	10%
0		117	117	117	114	114	114	114	107	107	107	107
1		106	100	95	97	93	89	89	92	88	85	85
2		96	87	79	84	77	72	72	79	74	69	69
3		87	76	67	74	66	59	59	70	63	57	57
4		79	67	58	65	57	50	50	62	54	49	49
5		73	60	50	58	49	43	43	55	48	42	42
6		67	54	44	52	44	37	37	50	42	36	36
7		62	48	40	47	39	33	33	45	38	32	32
8		58	44	36	43	35	29	29	41	34	29	29
9		54	41	32	40	32	26	26	38	31	26	26
10		51	37	29	37	29	24	24	35	28	23	23

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1028	23.4	23.4
0° - 40°	1681	38.3	38.3
0° - 60°	2991	68.1	68.1
0° - 90°	4082	93.0	93.0
90° - 120°	249	5.7	5.7
90° - 130°	282	6.4	6.4
90° - 150°	307	7.0	7.0
90° - 180°	309	7.0	7.0
0° - 180°	4391	100.0	100.0

BLWP4 48L ADP LP835, 5137 delivered lumens, test no. ISF 37597, tested in accordance to IESNA LM-79.



CP Summary

	0°	90
0°	1528	1528
5°	1517	1528
15°	1447	1488
25°	1311	1398
35°	1129	1267
45°	913	1102
55°	691	920
65°	460	731
75°	233	540
85°	52	370
90	1	300

Coefficients of Utilization

RCR	pf 20% / pc 80% / pw 70%	50%	30%	10%	70%	50%	30%	10%	70%	50%	30%	10%
0		117	117	117	114	114	114	114	107	107	107	107
1		105	100	95	97	93	89	89	91	88	84	84
2		95	86	79	84	77	71	71	79	73	69	69
3		87	75	67	73	65	59	59	69	62	57	57
4		79	67	57	65	56	50	50	61	54	48	48
5		73	59	50	58	49	43	43	55	47	41	41
6		67	53	44	52	43	37	37	49	42	36	36
7		62	48	39	47	39	33	33	45	37	32	32
8		58	44	35	43	35	29	29	41	34	28	28
9		54	40	32	39	32	26	26	38	31	26	26
10		51	37	29	36	29	24	24	35	28	23	23

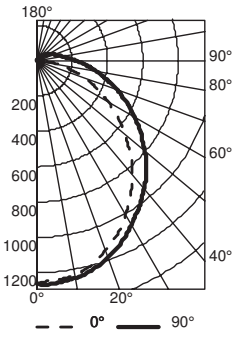
Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1188	23.1	23.1
0° - 40°	1944	37.8	37.8
0° - 60°	3464	67.4	67.4
0° - 90°	4754	92.5	92.5
90° - 120°	308	6.0	6.0
90° - 130°	349	6.8	6.8
90° - 150°	381	7.4	7.4
90° - 180°	383	7.5	7.5
0° - 180°	5137	100.0	100.0

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PHOTOMETRICS

BLWP8 40L ADP LP835, 4113 delivered lumens, test no. ISF 37290P226.



CP Summary

	0°	90
0°	1263	1263
5°	1246	1263
15°	1197	1223
25°	1083	1134
35°	928	1011
45°	750	871
55°	558	722
65°	378	564
75°	200	410
85°	57	278
90	9	221

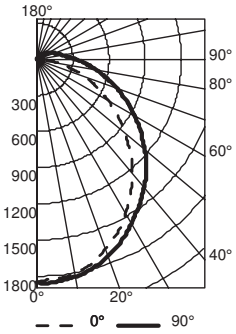
Coefficients of Utilization

RCR	pf	80%			70%			50%		
	pc	80%			70%			50%		
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0		117	117	117	114	114	114	107	107	107
1		106	100	95	97	93	89	92	88	85
2		96	87	79	84	77	72	79	74	69
3		87	76	67	74	66	59	70	63	57
4		79	67	58	65	57	50	62	54	49
5		73	60	51	58	50	43	55	48	42
6		67	54	45	52	44	38	50	42	37
7		62	49	40	48	39	33	45	38	32
8		58	44	36	43	35	30	41	34	29
9		54	41	32	40	32	27	38	31	26
10		51	38	30	37	29	24	35	28	24

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	979	23.8	23.8
0° - 40°	1593	38.7	38.7
0° - 60°	2811	68.4	68.4
0° - 90°	3825	93.0	93.0
90° - 120°	233	5.7	5.7
90° - 130°	263	6.4	6.4
90° - 150°	286	7.0	7.0
90° - 180°	288	7.0	7.0
0° - 180°	4113	100.0	100.0

BLWP8 60L ADP LP835, 6033 delivered lumens, test no. ISF 37290P386.



CP Summary

	0°	90
0°	1853	1853
5°	1827	1853
15°	1756	1794
25°	1588	1664
35°	1361	1483
45°	1101	1277
55°	819	1059
65°	555	828
75°	294	601
85°	84	408
90	13	323

Coefficients of Utilization

RCR	pf	80%			70%			50%		
	pc	80%			70%			50%		
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0		117	117	117	114	114	114	107	107	107
1		106	100	95	97	93	89	92	88	85
2		96	87	79	84	77	72	79	74	69
3		87	76	67	74	66	59	70	63	57
4		79	67	58	65	57	50	62	54	49
5		73	60	51	58	50	43	55	48	42
6		67	54	45	52	44	38	50	42	37
7		62	49	40	48	39	33	45	38	32
8		58	44	36	43	35	30	41	34	29
9		54	41	32	40	32	27	38	31	26
10		51	38	30	37	29	24	35	28	24

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1437	23.8	23.8
0° - 40°	2336	38.7	38.7
0° - 60°	4124	68.4	68.4
0° - 90°	5611	93.0	93.0
90° - 120°	342	5.7	5.7
90° - 130°	386	6.4	6.4
90° - 150°	420	7.0	7.0
90° - 180°	423	7.0	7.0
0° - 180°	6034	100.0	100.0

PRODUCT INFORMATION

Advanced plug-in system with three-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and PLR33 (3-circuit) crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.



Wiring

PLR

Advanced 3-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits				Dimming		Ground	
			Circuits to which ballast is connected		Emergency circuit connected					
PLR	(blank)	Not required for 22 or 33	(blank)	Not required for 22 or 33	(blank)	No emergency circuit	LV	Low-voltage dimming	(blank)	No ground in PLR
PLR22	1	Black	A	Black wire	ELA	Emergency circuit wired to black wire			G	Ground. Maximum 2 circuits
PLR33	2	Black and red	B	Red wire	ELB	Emergency circuit wired to red wire				
	3	Black, red and blue	C	Blue wire	ELC	Emergency circuit wired to blue wire				

Typical Applications

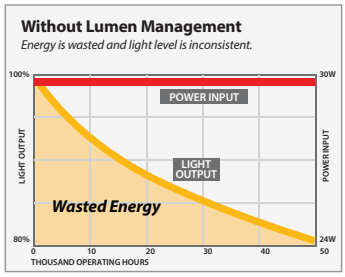
- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits, 2-circuit (PLR 22) and 3-circuit (PLR 33)
- Multiple circuit with night-lights located along row as desired

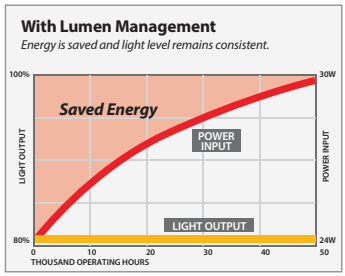
TYPICAL APPLICATIONS										
PLR 3 C	PLR 3 C	PLR 3 C	PLR 3 C	PLR 2 B	PLR 2 B	PLR 2 B	PLR 2 B	PLR 1	PLR 1	PLR 1
(All PLR22)										
Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A
(All PLR33)										
Circuit A	Circuit B	Circuit C	Circuit A	Circuit B	Circuit C	Circuit A	Circuit B	Circuit C	Circuit A	Circuit B
PLR 3 A	PLR 3 A	PLR 3 A	PLR 3 C	PLR 3 B	PLR 3 B	PLR 3 B	PLR 3 C	PLR 3 A	PLR 3 A	PLR 3 A

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Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.





How to Estimate Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Estimated Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

BLWP PERFORMANCE DATA [24]

Lumen Package	Lumens	Input Watts	LPW
BLWP2 8L ADP LP830	825	7	113
BLWP2 8L ADP LP835	855	7	117
BLWP2 8L ADP LP840	868	7	119
BLWP2 8L ADP LP850	893	7	123
BLWP2 20L ADP LP830	1876	17	113
BLWP2 20L ADP LP835	1942	17	117
BLWP2 20L ADP LP840	1973	17	119
BLWP2 20L ADP LP850	2029	17	123
BLWP2 33L ADP LP830	3180	30	107
BLWP2 33L ADP LP835	3332	30	112
BLWP2 33L ADP LP840	3345	30	112
BLWP2 33L ADP LP850	3440	30	115
BLWP2 40L ADP LP830	3914	37	105
BLWP2 40L ADP LP835	3923	37	105
BLWP2 40L ADP LP840	4117	37	110
BLWP2 40L ADP LP850	4234	37	113
BLWP2 48L ADP LP830	4772	44	109
BLWP2 48L ADP LP835	4940	44	112
BLWP2 48L ADP LP840	5019	44	114
BLWP2 48L ADP LP850	5162	44	118
BLWP4 15L ADP LP830	1372	11	126
BLWP4 15L ADP LP835	1420	11	131
BLWP4 15L ADP LP840	1443	11	133
BLWP4 15L ADP LP850	1484	11	137
BLWP4 20L ADP LP830	1985	16	127
BLWP4 20L ADP LP835	2055	16	131
BLWP4 20L ADP LP840	2088	16	133
BLWP4 20L ADP LP850	2147	16	137
BLWP4 30L ADP LP830	2960	25	118
BLWP4 30L ADP LP835	3065	25	123
BLWP4 30L ADP LP840	3114	25	125
BLWP4 30L ADP LP850	3203	25	128
BLWP4 40L ADP LP830	4027	35	117
BLWP4 40L ADP LP835	4391	35	127
BLWP4 40L ADP LP840	4236	35	123
BLWP4 40L ADP LP850	4357	35	126
BLWP4 48L ADP LP830	4948	40	124
BLWP4 48L ADP LP835	5137	40	129
BLWP4 48L ADP LP840	5205	40	131
BLWP4 48L ADP LP850	5353	40	134
BLWP4 60L ADP LP830	6059	49	123
BLWP4 60L ADP LP835	6273	49	127
BLWP4 60L ADP LP840	6373	49	129
BLWP4 60L ADP LP850	6555	49	133
BLWP4 72L ADP LP830	7088	59	121
BLWP4 72L ADP LP835	7338	59	125
BLWP4 72L ADP LP840	7455	59	127
BLWP4 72L ADP LP850	7668	59	131
BLWP4 85L ADP LP830	7972	68	117
BLWP4 85L ADP LP835	8253	68	121
BLWP4 85L ADP LP840	8385	68	123
BLWP4 85L ADP LP850	8624	68	127
BLWP4 100L ADP LP830	9316	85	110
BLWP4 100L ADP LP835	9645	85	114
BLWP4 100L ADP LP840	9799	85	116
BLWP4 100L ADP LP850	10079	85	119

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BLWP PERFORMANCE DATA (continued)

Lumen Package	Lumens	Input Watts	LPW
BLWP2 8LHE ADP LP830	851	8	113
BLWP2 8LHE ADP LP835	881	8	117
BLWP2 8LHE ADP LP840	895	8	119
BLWP2 8LHE ADP LP850	921	8	122
BLWP2 20LHE ADP LP830	1932	16	120
BLWP2 20LHE ADP LP835	2000	16	125
BLWP2 20LHE ADP LP840	2032	16	127
BLWP2 20LHE ADP LP850	2090	16	130
BLWP2 33LHE ADP LP830	3272	26	127
BLWP2 33LHE ADP LP835	3388	26	131
BLWP2 33LHE ADP LP840	3442	26	133
BLWP2 33LHE ADP LP850	3540	26	137
BLWP2 40LHE ADP LP830	3991	32	126
BLWP2 40LHE ADP LP835	4132	32	130
BLWP2 40LHE ADP LP840	4198	32	133
BLWP2 40LHE ADP LP850	4318	32	136
BLWP2 48LHE ADP LP830	4881	39	126
BLWP2 48LHE ADP LP835	5053	39	130
BLWP2 48LHE ADP LP840	5134	39	132
BLWP2 48LHE ADP LP850	5280	39	136
BLWP4 15LHE ADP LP830	1375	11	127
BLWP4 15LHE ADP LP835	1424	11	131
BLWP4 15LHE ADP LP840	1447	11	134
BLWP4 15LHE ADP LP850	1488	11	137
BLWP4 20LHE ADP LP830	1985	16	127
BLWP4 20LHE ADP LP835	2055	16	131
BLWP4 20LHE ADP LP840	2088	16	133
BLWP4 20LHE ADP LP850	2147	16	137
BLWP4 30LHE ADP LP830	3012	24	127
BLWP4 30LHE ADP LP835	3118	24	131
BLWP4 30LHE ADP LP840	3168	24	133
BLWP4 30LHE ADP LP850	3258	24	137
BLWP4 40LHE ADP LP830	4181	33	127
BLWP4 40LHE ADP LP835	4329	33	132
BLWP4 40LHE ADP LP840	4398	33	134
BLWP4 40LHE ADP LP850	4524	33	137
BLWP4 48LHE ADP LP830	5033	39	130
BLWP4 48LHE ADP LP835	5211	39	135
BLWP4 48LHE ADP LP840	5294	39	137
BLWP4 48LHE ADP LP850	5445	39	141
BLWP4 60LHE ADP LP830	6280	47	133
BLWP4 60LHE ADP LP835	6502	47	137
BLWP4 60LHE ADP LP840	6606	47	140
BLWP4 60LHE ADP LP850	6795	47	144
BLWP4 72LHE ADP LP830	7303	56	129
BLWP4 72LHE ADP LP835	7561	56	134
BLWP4 72LHE ADP LP840	7682	56	136
BLWP4 72LHE ADP LP850	7901	56	140
BLWP4 85LHE ADP LP830	8567	69	124
BLWP4 85LHE ADP LP835	8869	69	129
BLWP4 85LHE ADP LP840	9011	69	131
BLWP4 85LHE ADP LP850	9268	69	134
BLWP4 100LHE ADP LP830	9898	80	124
BLWP4 100LHE ADP LP835	10247	80	128
BLWP4 100LHE ADP LP840	10411	80	130
BLWP4 100LHE ADP LP850	10708	80	134

Notes
24 For ADP lens only, for additional lens options refer to photometry on www.acuitybrands.com.

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BLWP8 PERFORMANCE DATA

Lumen Package	Lumens	Input Watts	LPW
BLWP8 40L ADP LP830	3953	30	131
BLWP8 40L ADP LP835	4113	30	136
BLWP8 40L ADP LP840	4107	30	136
BLWP8 40L ADP LP850	4246	30	141
BLWP8 60L ADP LP830	5799	47	122
BLWP8 60L ADP LP835	6034	47	127
BLWP8 60L ADP LP840	6107	47	130
BLWP8 60L ADP LP850	6229	47	132
BLWP8 80L ADP LP830	7643	63	121
BLWP8 80L ADP LP835	7952	63	126
BLWP8 80L ADP LP840	8035	63	127
BLWP8 80L ADP LP850	8210	63	130
BLWP8 100L ADP LP830	9628	82	118
BLWP8 100L ADP LP835	10017	82	123
BLWP8 100L ADP LP840	10133	82	124
BLWP8 100L ADP LP850	10342	82	127
BLWP8 140L ADP LP830	13265	120	111
BLWP8 140L ADP LP835	13802	120	115
BLWP8 140L ADP LP840	13961	120	116
BLWP8 140L ADP LP850	14249	120	119
BLWP8 180L ADP LP830	17781	147	121
BLWP8 180L ADP LP835	18501	147	126
BLWP8 180L ADP LP840	18714	147	127
BLWP8 180L ADP LP850	19101	147	130
BLWP8 200L ADP LP830	18563	156	119
BLWP8 200L ADP LP835	19314	156	124
BLWP8 200L ADP LP840	19537	156	125
BLWP8 200L ADP LP850	19941	156	128

BLWP8 HE PERFORMANCE DATA

Lumen Package	Lumens	Input Watts	LPW
BLWP8 40LHE ADP LP830	3953	30	133
BLWP8 40LHE ADP LP835	4113	30	139
BLWP8 40LHE ADP LP840	4160	30	140
BLWP8 40LHE ADP LP850	4246	30	143
BLWP8 60LHE ADP LP830	5942	46	128
BLWP8 60LHE ADP LP835	6183	46	133
BLWP8 60LHE ADP LP840	6254	46	135
BLWP8 60LHE ADP LP850	6383	46	137
BLWP8 80LHE ADP LP830	7820	59	132
BLWP8 80LHE ADP LP835	8136	59	137
BLWP8 80LHE ADP LP840	8230	59	139
BLWP8 80LHE ADP LP850	8400	59	142
BLWP8 100LHE ADP LP830	9723	74	132
BLWP8 100LHE ADP LP835	10117	74	138
BLWP8 100LHE ADP LP840	10233	74	139
BLWP8 100LHE ADP LP850	10445	74	142
BLWP8 140LHE ADP LP830	13491	104	129
BLWP8 140LHE ADP LP835	14037	104	135
BLWP8 140LHE ADP LP840	14198	104	136
BLWP8 140LHE ADP LP850	14492	104	139
BLWP8 180LHE ADP LP830	17245	130	133
BLWP8 180LHE ADP LP835	17943	130	138
BLWP8 180LHE ADP LP840	18150	130	140
BLWP8 180LHE ADP LP850	18525	130	143
BLWP8 200LHE ADP LP830	19587	144	136
BLWP8 200LHE ADP LP835	20380	144	141
BLWP8 200LHE ADP LP840	20615	144	143
BLWP8 200LHE ADP LP850	21041	144	146

Notes

24 For ADP lens only, for additional lens options refer to photometry on www.acuitybrands.com.

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Catalog Number	
Notes	
Type	



Contractor Select™

XVML

LED Vapor Tight

These fully-gasketed, wet-location, and code-compliant vapor-tights are DLC® listed and IP65 and IP66 rated. They can be surface mounted on the ceiling or wall and are designed for continuous row mounting. The XVML vapor-tights are ideal for outdoor venues, canopies and locker rooms.

FEATURES:

- The fully gasketed, polycarbonate housing with ten polycarbonate captive latches provides a water-tight seal and stands up to dust and dirt with its IP65 and IP66 ratings
- Provides the performance you need with the UV-stabilized, high-impact, frosted polycarbonate lens for uniform light output and high impact-resistance
- Quick and simple to install with the snap-lock tool-less access

UPC	Catalog number	Lumens	Voltage	Color temperature	CRI	Standard pallet qty.
00191723621938	XVML L48 3500LM MVOLT 40K 80CRI	3500LM	MVOLT (120-277)	4000K	80 CRI	144
00191723621945	XVML L48 3500LM MVOLT 50K 80CRI	3500LM	MVOLT (120-277)	5000K	80 CRI	144
00191723621952	XVML L48 5000LM MVOLT 40K 80CRI	5000LM	MVOLT (120-277)	4000K	80 CRI	99
00191723621969	XVML L48 5000LM MVOLT 50K 80CRI	5000LM	MVOLT (120-277)	5000K	80 CRI	99
00191848378595	XVML L48 5000LM 347 40K 80CRI	5000LM	347	4000K	80 CRI	99
00191848378601	XVML L48 5000LM 347 50K 80CRI	5000LM	347	5000K	80 CRI	99

More configurations are available. Click here or visit www.acuitybrands.com and search for XVML.

Accessories: *Order as separate catalog number.*

XVML LATCH STSL	Stainless steel latch kit (Set of 10) [1]
XVMLJSB	Junction box mount [2]
XVMLANGBKT45	Angle mount bracket (Set of 2) [3]

NOTES

1. To deter tampering, stainless steel latches can accommodate #8-32x1/2" tamper resistant fasteners (not provided). Kit includes 10 latches.
2. IP65 rated. Not compatible with angle mount bracket. Required to be used in center of fixture with supplied brackets for additional mounting support.
3. For use with applications where ceiling meets wall at a 90° angle. See drawing on page 3 for more information.

Operational Data

XVML L48 3500LM MVOLT (80CRI)

	Lumens	Wattage	LPW	Comparable Light Source
40K	3,558	33	106.6	2 - 32T8 lamps
50K	3,642		110.4	

XVML L48 5000LM MVOLT (80CRI)

	Lumens	Wattage	LPW	Comparable Light Source
40K	5,365	49	109.6	3-32T8 Lamps, 2-54T5HO lamps
50K	5,534		112.9	

Specifications

INTENDED USE:

Ideal for damp/wet locations such as outdoor venues, canopies and locker rooms. **Certain airborne contaminants may adversely affect the functioning of LEDs and other electronic components, depending on various factors such as concentrations of the contaminants, ventilation, and temperature at the end-user location. Click here for a list of substances that may not be suitable for interaction with LEDs and other electronic components.**

CONSTRUCTION:

Light gray, fully gasketed, polycarbonate housing with ten polycarbonate captive latches provides a watertight seal. The high-impact resistant housing and extruded silicone rubber gasket protects the internal components from the environment, including moisture and dirt. 3/8"" wet location fitting provided on the 3500LM fixture and 1/2"" wet location fitting provided on the 5000LM fixture on one end for use with liquid tight conduit. The housing dimensions vary based on the lumen package selected. Polycarbonate latches (included) deter tampering, by accommodating #6-32x3/8"" tamper resistant fasteners (not provided). Grade 301 stainless steel latches (available separately) deter tampering, by accommodating #8-32x1/2"" tamper resistant fasteners (not provided).

ELECTRICAL:

High-efficiency LEDs. 0-10V dimming standard for a dimming range of 100% to 10%. Luminaire Surge Protection Level: Designed to withstand up to 2.5kV/0.75kA per ANSI C82.77-5-2015.

INSTALLATION:

Mounting hardware for surface mounting to ceiling or wall (horizontally or vertically) included. Mounting hardware kit also includes hooks for suspended mount (chain not included).

Optional 45° corner angle bracket mount and junction mount kit also available. Maximum of 15 units or 6A for through wiring connection or daisy chain type installation. Tool-less access for installation.

LISTINGS:

UL/C-UL listed to US and Canadian Safety Standards. For use in wet locations under covered ceilings. For use in ambient temperatures from -4°F (-20°C) to 104°F (40°C). IP65 and IP66 rated when ceiling, suspended, wall or corner mounted. Junction Box mount rated IP65. This unit meets FCC Non- Consumer Class A (277v) and Consumer Class B (120V) limits.

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY:

5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/resources/terms-and-conditions

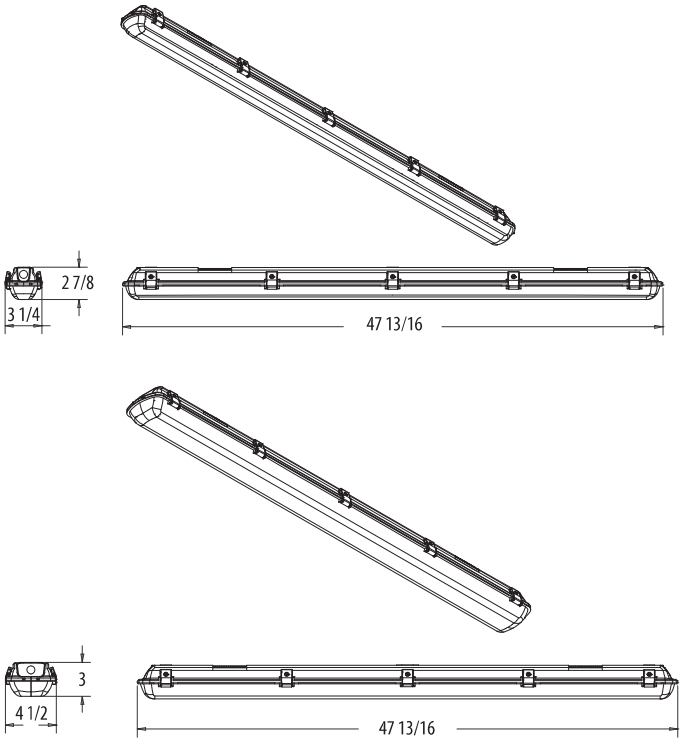
Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Dimensions

Weight and Pallet QUantity

	3500LM	5000LM
Dimensions (in inches)	47 13/16" x 3 ¼" x 2 7/8"	47 13/16" x 4 1/2" x 3"
Weight	4.4 lbs (2.0 kgs)	6.1 lbs (2.8 kgs)
Wet Location Fitting Size (in inches)	3/8"	1/2"
Mounting hole spacing range (in inches)	29-5/8"- 33-1/4"	29-5/8"- 33-1/4"
	Polycarbonate latches (standard latch)	**Stainless Steel (optional accessory)**
Tamper Resistant Fasteners Size needed (not included)	#6 - 32x3/8	#8 - 32x1/2

All dimensions are inches (centimeters) unless otherwise indicated.



2681 LED

STANDARD SPECIFICATIONS

PROJECT:
MODEL #:
FIXTURE TYPE:

HOUSING
Cold rolled 20 GA steel, formed with die punch tooling with no exposed hardware. The pan has three steel brackets which mate with the diffuser.

DIFFUSER
Translucent, UV stabilized, white acrylic. Diffusor is vacuum formed and features a secure "twist lock" tool free installation method.

MOUNTING
Directly to j-box (by others). Mounting hardware included.

FINISH (HOUSING & CANOPY)
The standard finish is a sturdy electroplated brushed nickel. Options include all Brownlee paint finishes. Plated finishes such as Brushed Nickel are suitable for indoor applications only. Installation outdoors voids the Brownlee Limited Warranty.

WARRANTY
5 year limited warranty on this LED product. Consult factory for details.

SUSPENSION SYSTEM
Three stainless steel aircraft cables and a power cord allow mounting at multiple heights from 10" to 25". Both the power cord and aircraft cables are field trimmed for mounting, with additional options for up to 10' and 20' drops.

LED PERFORMANCE - 3500K STANDARD
120-277V - 3500K, 82 CRI - L80 rating - 60,000 hrs - L70 rating (projected) - 100,000 hrs
Amperage rated @ 110V input
Operating ambient temperature: -20°C / -4°F - 40°C / 104°F

Standard 3500K source lumens noted. Consult Brownlee.com for performance of all CCTs.
B06 - 6W nominal, .05 A input - 700 lm (source) - 462 lm (delivered)
B12 - 12W nominal, .10 A input - 1430 lm (source) - 944 lm (delivered)
C09 - 9W nominal, .10 A input - 1200 lm (source) - 792 lm (delivered)
C17 - 17W nominal, .15 A input - 2050 lm (source) - 1353 lm (delivered)
C24 - 24W nominal, .20 A input - 2950 lm (source) - 1947 lm (delivered)
C37 - 37W nominal, .30 A input - 4380 lm (source) - 2891 lm (delivered)
C49 - 49W nominal, .40 A input - 5900 lm (source) - 3894 lm (delivered)



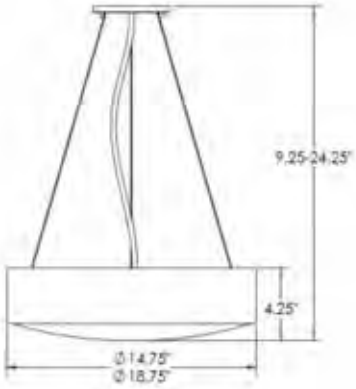
BN finish, RD2 diffuser



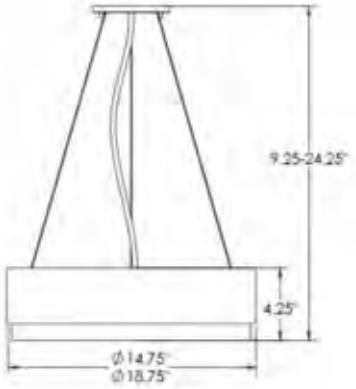
WH finish, FL1 diffuser



BL finish, FL2 diffuser



RD2 diffuser



FL1 diffuser



FL2 diffuser

Specifications and dimensions subject to change without notice.
Consult your Brownlee Lighting representative for availability and ordering information.

BROWNLEE LIGHTING
www.brownlee.com

REVISED 2019.10.04

2681 LED

DAMP

SUPPORTS T24 COMPLIANCE

ORDERING INFORMATION

2681 - _____ - _____ - _____ - _____ - _____ - _____ - _____

Model | 2. | 3. | 4. | 5. | 6. | 7. (if required)

2. SIZE

15	14.75" dia
19	18.75" dia

3. FINISH

STANDARD

BN	Brushed Nickel

OPTIONAL

BL	Black
BZ	Bronze
GM	Gun Metal
MB	Metallic Bronze
MG	Metallic Gold
NT	Nickel Tone
PL	Platinum
WH	White

CUSTOM

Provide color sample or RAL code to match

4. WATTAGE

15 SIZE

B06	6W B Series LED
B12	12W B Series LED
C09	9W C Series LED
C17	16W C Series LED
C24	23W C Series LED

19 SIZE

C17	16W C Series LED
C24	23W C Series LED
C37	35W C Series LED
C49	45W C Series LED

5. DIFFUSER

FL1	Style 1 Flat Diffuser
FL2	Style 2 Flat Diffuser
RD2	Style 2 Round Diffuser

6. COLOR TEMPERATURE

35K	3500K standard color temperature
27K	2700K color temperature
30K	3000K color temperature
40K	4000K color temperature

7. AVAILABLE OPTIONS

90R[0]	90 CRI (3000K only)
BAC[1]	Buy American Compliant
BLD[3]**	Bi-Level Dimming (All except B06)
C10	3' - 10' Cord/Cable Extension
C20	10' - 20' Cord/Cable Extension
DALI	Dali Compatible (0-10V dimming included) (C17, C24, C37 & C49 only)
DIM	Dimming driver (120-277V) (All except B06) (0-10V dimming control required)
DTR[4]	Triac (Line Voltage) Dimming (120V) (All except B06)
ES[6]	ENERGY STAR® (Not available in 90 CRI)
FCL[7]	French Canadian Labels
OCC[8]	Occupancy Sensor
T24[9]	Title 24 Compliant (B12, C24 & C49 in 3000K only)

Notes: Refer to model 2081 for coordinating flush mount.

Notes: (0) 90R - cannot be combined with ES or T24 **(1) BAC -** cannot be combined with FCL **(2) BBI/BBS/BBC -** cannot be combined with DTR, ECW, EXT, or T24 **(3) BLD -** cannot be combined with DTR, OCC, or T24 **(4) DTR -** cannot be combined with BBI, BBC, BBS, BLD or T24 **(5) ECW -** cannot be combined with BBI, BBC, or DTR **(6) ES -** cannot be combined with 90R, DTR, FCL, or T24 **(7) FCL -** cannot be combined with BAC, ES, or T24 **(8) OCC -** cannot be combined with BLD **(9) T24 -** cannot be combined with 90R, BBI, BBC, BBS, BLD, DTR, ES, or FCL **(10) BBS -** cannot be combined with BLD, DTR, ECW, EXT, OCC, or T24 **(11) PCH/PC4 -** cannot be combined with BLD or OCC

Add'l Notes: *BBI/BBS/BBC - standard BBI (and BBS) option has a minimum operating temperature of 10C/50F. BBC option has a minimum operating temperature of -20C/-4F. ****BLD -** Bi-Level Dimming is field adjustable from 100% to a dimmed light level of 10, 20, 30, or 50%. All units are factory set at 50%.

Specifications and dimensions subject to change without notice.

Consult your Brownlee Lighting representative for availability and ordering information.

BROWNLEE LIGHTING
www.brownlee.com

REVISED 2019.05.28

Value, style and performance.

Surface-mounted SKEET® XL looks great and delivers smooth, dimmable light.





ENERGY STAR

RAB® LIGHTING

RABWEB.COM • 888 722-1000

SKEET® XL

- Surface mount to ceiling or wall
- Available in four sizes: 8" (10W), 12" (12W), 16" (20W) or 21" (25W)
- Opal lens provides soft, smooth light
- Available with or without decorative silver ring
- Dimmable driver*
- Ideal for hospitality and multi-family residential applications

10W replaces two 9W CFL or a 24W Circline.

12W replaces two 13W CFL or a 24W Circline.

20W replaces two 18W CFL or a 32W Circline.

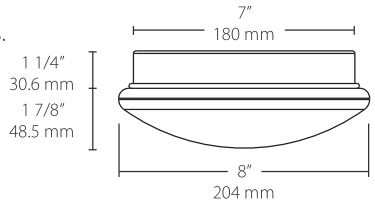
25W replaces two 18W CFL or a 40W Circline.



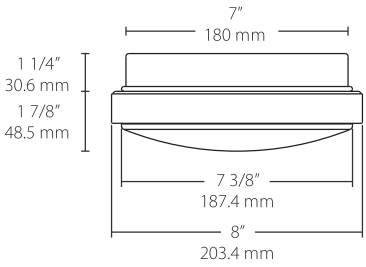
*See dimmer compatibility chart for known compatible dimmers

Dimensions & weights

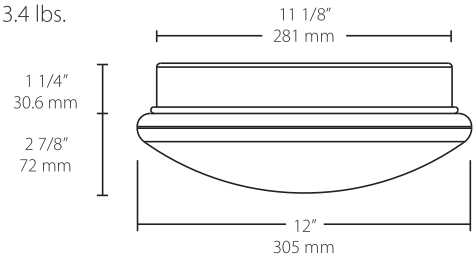
SK8XL - Plain
Weight: 2.2 lbs.



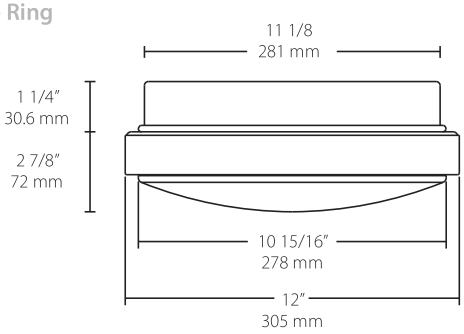
SK8XL - Decorative Ring
Weight: 2.2 lbs.



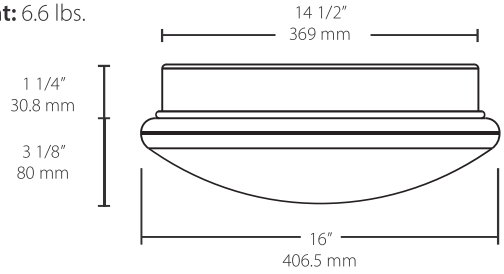
SK12XL - Plain
Weight: 3.4 lbs.



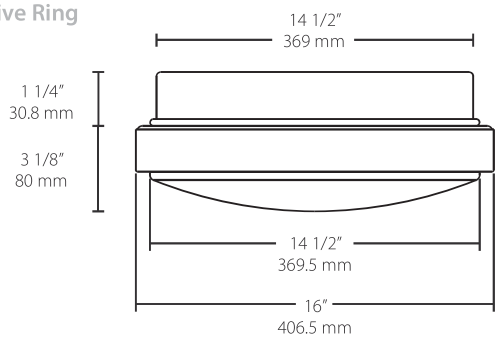
SK12XL - Decorative Ring
Weight: 3.4 lbs.



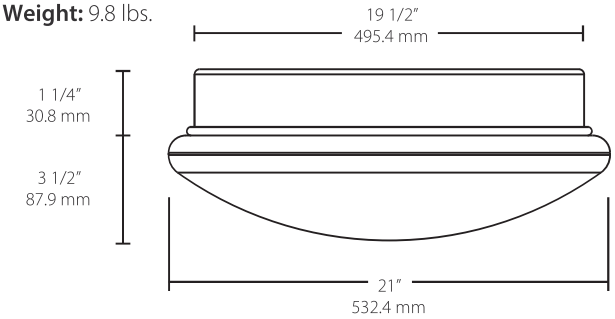
SK16XL - Plain
Weight: 6.6 lbs.



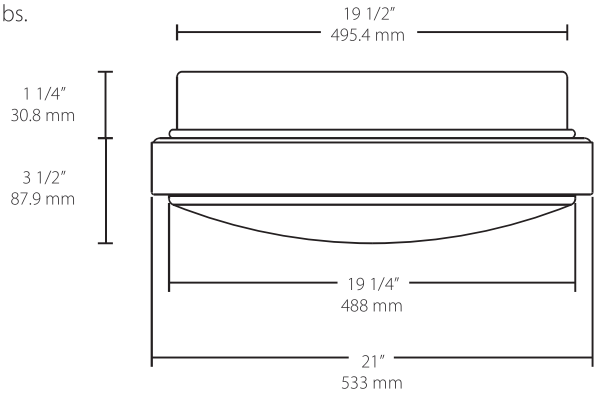
SK16XL - Decorative Ring
Weight: 6.6 lbs.



SK21XL - Plain
Weight: 9.8 lbs.



SK21XL - Decorative Ring
Weight: 9.8 lbs.



Dimmer compatibility

LUTRON	LEVITON	COOPER
RRD-8ANS-WH	Decora 6631-P	TAL06P-C1
Skylark S-600P	Decora IPL06-10Z	DAL06P-C1
Skylark SELV-300P		

This partial list contains a representative selection of known compatible dimming controls.

SKEET® XL Specifications

UL Listing: Suitable for damp locations

LEDs: Long-life, high-efficiency surface mount LEDs

Lifespan: 50,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

Drivers:
10W: 120VAC TRIAC, Constant current, Class 2, 60 Hz, 0.09A

12W: 120VAC TRIAC, Constant current, Class 2, 60 Hz, 0.11A

20W: 120VAC TRIAC, Constant current, Class 2, 60 Hz, 0.17A

25W: 120VAC TRIAC, Constant current, Class 2, 60 Hz, 0.21A

Ambient Temperature: Suitable for use in 40°C ambient temperatures

Housing: Steel sheet metal

Lens: Diffused acrylic

Reflector: White painted, reflective, steel sheet metal

Mounting: Ceiling or wall mount to junction box

IESNA LM-79 & LM-80 Testing: RAB LED luminaires have been tested in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

8" 10W

Color Temperature	4000K	3500K	3000K	2700K
Input Watts	11	11	10	10
Output Lumens*	1,140	1,121	1,017	938
Lumens Per Watt*	108	106	97	91
Color Accuracy (CRI)	82	82	82	82

12" 12W

Color Temperature	4000K	3500K	3000K	2700K
Input Watts	12	12	12	12
Output Lumens*	1,300	1,279	1,160	1,069
Lumens Per Watt*	107	105	96	91
Color Accuracy (CRI)	82	82	82	84

16" 20W

Color Temperature	4000K	3500K	3000K	2700K
Input Watts	21	20	20	20
Output Lumens*	2,096	2,062	1,870	1,724
Lumens Per Watt*	102	101	92	87
Color Accuracy (CRI)	82	82	82	84

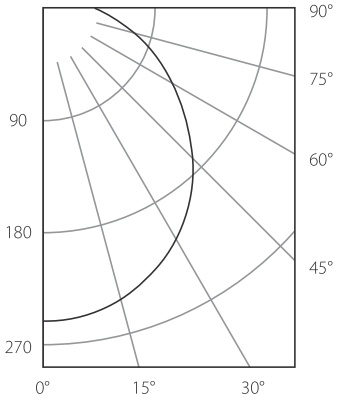
21" 25W

Color Temperature	4000K	3500K	3000K	2700K
Input Watts	25	25	25	24
Output Lumens*	2,482	2,441	2,214	2,041
Lumens Per Watt*	99	98	89	84
Color Accuracy (CRI)	82	82	82	85

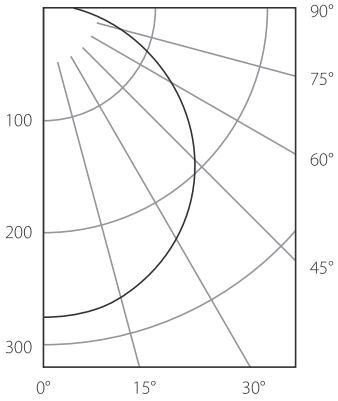
** Performance for plain round models. Visit rabweb.com for information on models with a decorative ring.*

Photometrics

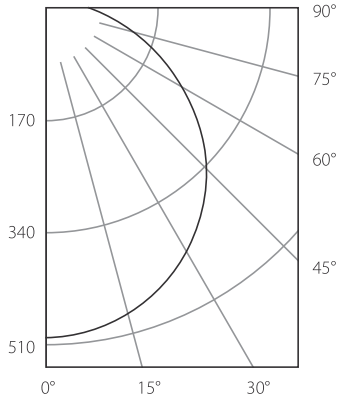
SK8XL - 2700K
Photometric Report #RAB02161



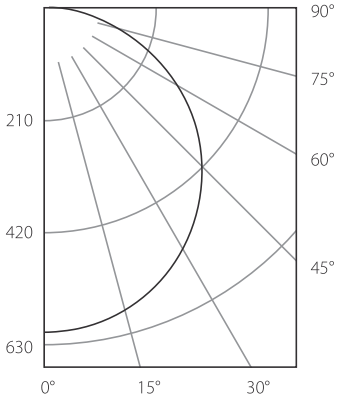
SK12XL - 2700K
Photometric Report #RAB02113



SK16XL
Photometric Report #RAB02175



SK21XL
Photometric Report #RAB02117



For smooth, even light distribution use the following spacing criteria:
1.2 x mounting height

Ordering information

Product Family		Wattage		Style		Color Temp	
SK8XL	8"	**10**	10W (8" only)	**R**	Round Basic	**N**	4000K
SK12XL	12"	**12**	12W (12" only)	**RD**	Round w/Decorative Ring	**YN**	3500K
SK16XL	16"	**20**	20W (16" only)			**Y**	3000K
SK21XL	21"	**25**	25W (21" only)			**YY**	2700K

The versatile, low-cost, low-profile wall pack.

BRISK®— efficient & affordable LED light.



RAB® | Outdoor

RABLIGHTING.COM • 888 722-1000

BRISK® Wall Pack

- Offered in 4 wattages and 2 sizes
- Replaces up to 100W MH or up to 50W HPS
- DLC and DLC Premium listed models
- IP66 Rated
- 60,000-Hour LED lifespan

RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Visit rablighting.com to see which models are DLC or DLC Premium listed.

Specifications

UL Listing: Suitable for wet locations

LEDs: Long-life, high-efficacy, surface-mount LEDs

Driver: Constant Current, 50/60 Hz., 120-277V

5000K				
Wattage	**35W**	**22W**	**14W**	**9W**
Output Lumens	4915	3219	1765	1142
Efficacy (lm/W)	143	144	131	122
Color Accuracy (CRI)	75	75	75	75

4000K				
Wattage	**35W**	**22W**	**14W**	**9W**
Output Lumens	4821	3183	1729	1108
Efficacy (lm/W)	139	140	126	118
Color Accuracy (CRI)	72	72	72	72

3000K				
Wattage	**35W**	**22W**	**14W**	**9W**
Output Lumens	4798	3168	1737	1124
Efficacy (lm/W)	139	140	128	120
Color Accuracy (CRI)	71	71	71	71

Note: Values are typical. +/- 10% tolerance.

Photocell: Optional 120-277V photocell available

Cold Weather Starting: The minimum starting temperature for BRISKM32L is -4° F (-20°C). For all other models it is -22° F (-30°C).

Ambient Temperature: Suitable for use in 104° F (40° C) ambient temperatures

Housing: Precision die-cast aluminum

Reflector: Specular

Lens: Diffused acrylic

Mounting: Heavy-duty, die-cast wiring compartment with four (4) conduit entries (one top, two side, one back).

Gasket: Silicone foam

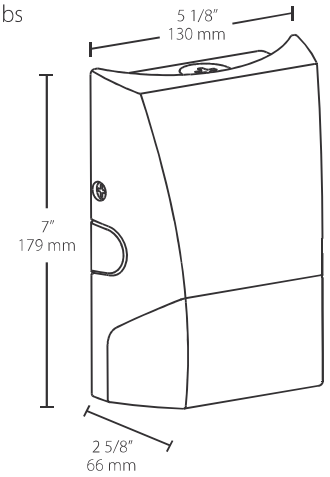
IP Rating: Ingress Protection rating of IP66 for dust and water

Finish: Chip and fade-resistant polyester powder coat finish

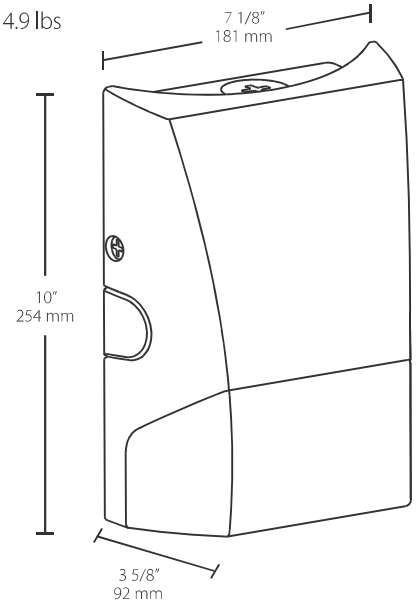
Green Technology: Mercury & UV free

Dimensions and weights

BRISKS
Weight: 2 lbs



BRISKM
Weight: 4.9 lbs



Ordering information

Product Family	Lumen Package/Wattage		CCT/CRI		Finish		Options	
BRISK								
	S11L	1100 lumens* (9W)	**Blank**	5000K / 70CRI	**Blank**	Bronze	**Blank**	No Photocell
	S17L	1700 lumens* (14W)	**740**	4000K / 70CRI	**W**	White	**/PCU**	120-277V Photocell
	M32L	3200 lumens* (22W)	**730**	3000K / 70CRI				
	M48L	4800 lumens* (35W)						

** Lumen outputs are nominal. Tolerance +/-10%. See specification sheet for more info.*

WPLED3T78N

RAB Outdoor



Color: Bronze

Weight: 32.2 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type	Constant Current
120V	0.66A
208V	0.41A
240V	0.35A
277V	0.30A
Input Watts	75.90W
Efficiency	N/A

LED Info

Watts	78.00W
Color Temp	4000K (Neutral)
Color Accuracy	72 CRI
L70 Lifespan	100,000
Lumens	8,941
Efficacy	117.8 LPW

Technical Specifications

Listings

UL Listing:

Suitable for wet locations as a downlight

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities. DLC Product Code: P000017AL

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Six (6) multi-chip, 13W, high-output, long-life LEDs

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5-year period

Color Temperature (Nominal CCT):

4100K

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water

Ambient Temperature:

Suitable For use in 40°C (104°F)

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Housing:

Die cast aluminum housing, lens frame and mounting arm

Reflector:

Specular vacuum-metallized polycarbonate

Gaskets:

High-temperature silicone gaskets

Finish:

Formulated for high durability and long-lasting color

Green Technology:

Mercury and UV free. RoHS-compliant components.

Optical

Specification Grade Optics:

The Type III distribution is ideal for roadway, general parking, and other area lighting applications where a larger pool of lighting is required. It is intended to be located near the side of the area, allowing the light to project outward and fill the area.

BUG Rating:

B1 U0 G2

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Technical Specifications (continued)

Electrical

Driver:

Constant Current, Class 2, 2000mA, 100-277V, 50-60Hz, 1.1A, Power Factor 99%

THD:

5.2% at 120V, 13.6% at 277V

Surge Protection:

6kV

Other

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Patents:

The WPLED design is protected by patents pending in the U.S., Canada, China, Taiwan and Mexico.

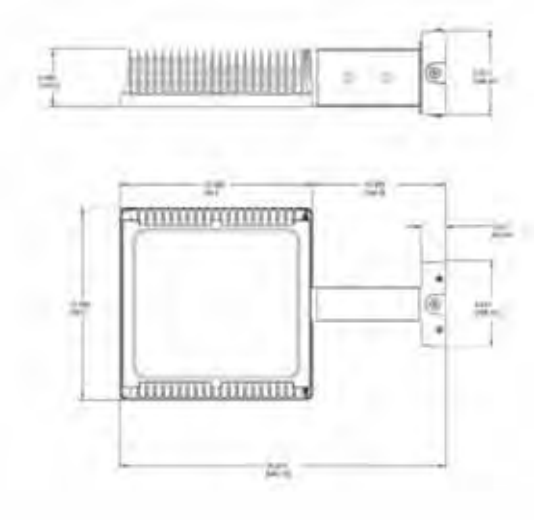
Replacement:

Replaces 400W Metal Halide

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- High performance LED light engine
- Maintains 70% of initial lumens at 100,000-hours
- Weatherproof high temperature silicone gaskets
- Superior heat sinking with die cast aluminum housing and external fins
- Replaces 400W MH
- 100 up to 277 Volts
- 5-Year, No-Compromise Warranty

Ordering Matrix

Family	Optics	Wattage	Color Temp	Mounting	Finish	Driver Options	Other Options
WPLED	3T	78	N				
	4T = Type IV **3T =** Type III **2T =** Type II	**50 =** 50W **78 =** 78W **105 =** 105W **125 =** 125W **150 =** 150W	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**Blank =** Arm **FX =** Flat Mount	**Blank =** Bronze **W =** White	**Blank =** Standard **/480 =** 480V **/BL =** Bi-Level **/D10 =** 0-10V Dimming **/480/D10 =** 480V 0-10V Dimming	**Blank =** Standard **/PC =** 120V Photocell **/PC2 =** 277V Photocell **/PCT =** 120-277V Twistlock Photocell **/PCT4 =** 480V Twistlock Photocell **/PCS =** 120V Swivel Photocell **/PCS2 =** 277V Swivel Photocell **/PCS4 =** 480V Swivel Photocell **/WS =** Multi-Level Motion Sensor **/WS2 =** Multi-Level Motion Sensor (20 ft. mt. ht.) **/WS4 =** Multi-Level Motion Sensor (40 ft. mt. ht.) **/LC =** Lightcloud Controller

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WPLED3T78N

RAB Outdoor



Color: Bronze

Weight: 32.2 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type	Constant Current
120V	0.66A
208V	0.41A
240V	0.35A
277V	0.30A
Input Watts	75.90W
Efficiency	N/A

LED Info

Watts	78.00W
Color Temp	4000K (Neutral)
Color Accuracy	72 CRI
L70 Lifespan	100,000
Lumens	8,941
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LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Six (6) multi-chip, 13W, high-output, long-life LEDs

Color Consistency:

3-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color

Color Stability:

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Color Temperature (Nominal CCT):

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Color Uniformity:

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Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water

Ambient Temperature:

Suitable For use in 40°C (104°F)

Cold Weather Starting:

Minimum starting temperature is -40°C (-40°F)

Housing:

Die cast aluminum housing, lens frame and mounting arm

Reflector:

Specular vacuum-metallized polycarbonate

Gaskets:

High-temperature silicone gaskets

Finish:

Formulated for high durability and long-lasting color

Green Technology:

Mercury and UV free. RoHS-compliant components.

Optical

Specification Grade Optics:

The Type III distribution is ideal for roadway, general parking, and other area lighting applications where a larger pool of lighting is required. It is intended to be located near the side of the area, allowing the light to project outward and fill the area.

BUG Rating:

B1 U0 G2

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Technical Specifications (continued)

Electrical

Driver:

Constant Current, Class 2, 2000mA, 100-277V, 50-60Hz, 1.1A, Power Factor 99%

THD:

5.2% at 120V, 13.6% at 277V

Surge Protection:

6kV

Other

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.

Patents:

The WPLED design is protected by patents pending in the U.S., Canada, China, Taiwan and Mexico.

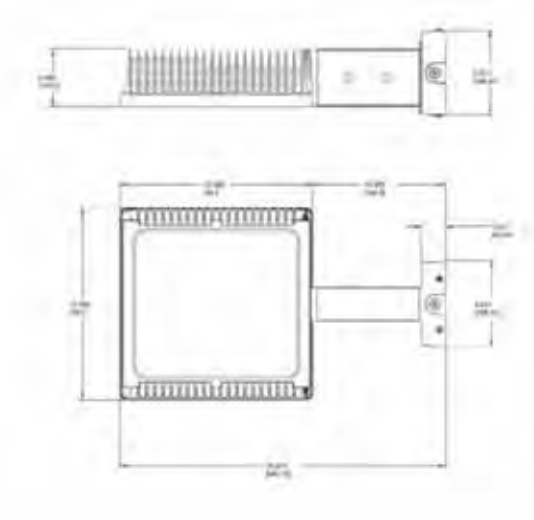
Replacement:

Replaces 400W Metal Halide

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- High performance LED light engine
- Maintains 70% of initial lumens at 100,000-hours
- Weatherproof high temperature silicone gaskets
- Superior heat sinking with die cast aluminum housing and external fins
- Replaces 400W MH
- 100 up to 277 Volts
- 5-Year, No-Compromise Warranty

Ordering Matrix

Family	Optics	Wattage	Color Temp	Mounting	Finish	Driver Options	Other Options
WPLED	3T	78	N				
	4T = Type IV **3T =** Type III **2T =** Type II	**50 =** 50W **78 =** 78W **105 =** 105W **125 =** 125W **150 =** 150W	**Blank =** 5000K (Cool) **N =** 4000K (Neutral) **Y =** 3000K (Warm)	**Blank =** Arm **FX =** Flat Mount	**Blank =** Bronze **W =** White	**Blank =** Standard **/480 =** 480V **/BL =** Bi-Level **/D10 =** 0-10V Dimming **/480/D10 =** 480V 0-10V Dimming	**Blank =** Standard **/PC =** 120V Photocell **/PC2 =** 277V Photocell **/PCT =** 120-277V Twistlock Photocell **/PCT4 =** 480V Twistlock Photocell **/PCS =** 120V Swivel Photocell **/PCS2 =** 277V Swivel Photocell **/PCS4 =** 480V Swivel Photocell **/WS =** Multi-Level Motion Sensor **/WS2 =** Multi-Level Motion Sensor (20 ft. mt. ht.) **/WS4 =** Multi-Level Motion Sensor (40 ft. mt. ht.) **/LC =** Lightcloud Controller

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An LED powerhouse

Leave no corner unlit with over 15,000 lumens.

NEW



WP3LED 110W

DLC QPL LISTED

RAB | Outdoor

WP3LED 110W

- Delivers over 15,000 lumens; replaces 400W MH
- High efficiency with up to 144 lm/W
- Same look as traditional HID wallpacks, and covers most large footprints
- Photocell and motion sensor options available
- 100,000-Hour LED lifespan



Traditional HID wallkpack look, simple installation



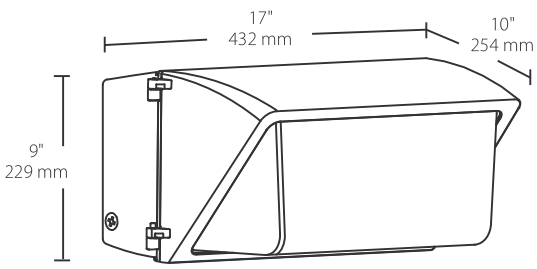
Optional photocell *(button or swivel)* and motion sensor available

480V

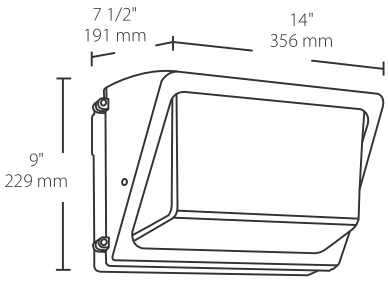
480V models available

Dimensions and weights

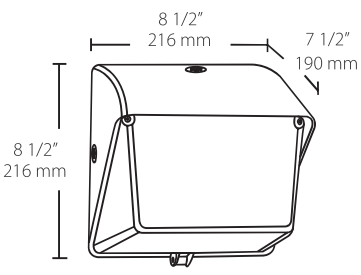
WP3LED
Weight: 23.4 lbs (110W) Weight: 16.8 lbs (82, 65, 55W)



WP2LED
Weight: 9.6 lbs



WP1LED
Weight: 4.4 lbs



Specifications

WP3LED 110W - Replaces up to 400W MH

Color Temperature	5000K	4000K	3000K
Input Watts	107	108	107
Output Lumens	15113	15531	14516
Lumens Per Watt	141	144	136
Color Accuracy (CRI)	79	73	73

WP3LED 82W - Replaces up to 400W MH

Color Temperature	5000K	4000K	3000K
Input Watts	81	79	83
Output Lumens	9280	9347	8496
Lumens Per Watt	114	118	103
Color Accuracy (CRI)	82	83	82

WP3LED 65W - Replaces up to 400W MH

Color Temperature	5000K	4000K	3000K
Input Watts	62	65	63
Output Lumens	7559	7591	7023
Lumens Per Watt	123	126	112
Color Accuracy (CRI)	82	83	82

WP3LED 55W - Replaces up to 400W MH

Color Temperature	5000K	4000K	3000K
Input Watts	57	55	58
Output Lumens	7026	7017	6401
Lumens Per Watt	123	127	110
Color Accuracy (CRI)	82	83	82

WP2LED 37W - Replaces up to 175W MH

Color Temperature	5000K	4000K	3000K
Input Watts	37	37	39
Output Lumens	4387	4365	4207
Lumens Per Watt	118	118	109
Color Accuracy (CRI)	83	84	83

WP2LED 24W - Replaces up to 70W MH

Color Temperature	5000K	4000K	3000K
Input Watts	25	25	25
Output Lumens	2998	2983	2874
Lumens Per Watt	122	122	115
Color Accuracy (CRI)	83	85	83

WP1LED 30W - Replaces up to 100W MH

Color Temperature	5000K	4000K	3000K
Input Watts	31	30	31
Output Lumens	3332	3392	2810
Lumens Per Watt	107	115	91
Color Accuracy (CRI)	86	84	83

UL:
Suitable for wet locations. Wall mount only.

LEDs:
High-output, long-life LEDs

Lifespan:
All have 100,000-hour LED lifespan based on IES LM-80 results & TM-21 calculations except for 65W and 82W WP3LED models which have a 60,000-hour LED lifespan.

Drivers:
Constant Current, Class 2, 50/60 Hz. 100 - 277V in either 480V, 4kV surge protection

Housing:
Precision die-cast aluminum housing

Mounting:
WP1LED: Housing has three (3) conduit entry points and knockout pattern for junction box or direct wall mounting. Hinged door for easy re-assembly;
WP2LED and WP3LED: Die-cast backbox with four (4) conduit entry points and knockout pattern for junction box or direct wall mounting. Hinged door for easy re-assembly.

Lens:
WP1LED: High-impact, prismatic, UV-stabilized polycarbonate refractor lens;
WP2LED and WP3LED: Prismatic, heat-resistant borosilicate glass

Gaskets:
High-temperature silicone

Finish:
Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contain no VOC or toxic heavy metals.

Color Stability:
LED color temperature warrantied not to shift more than 200K in CCT in 5 years

Color Uniformity:
RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

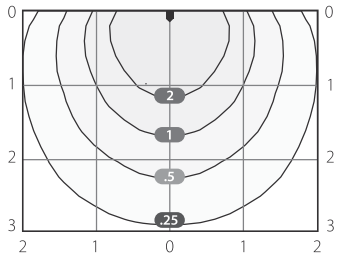
Green Technology:
Mercury and UV free

IESNA LM-79 & LM-80 Testing:
RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

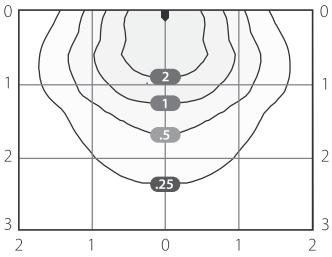
Photometrics

Mounting Height	Multiplier
15	2.8
20	1.6
25	1.0
30	0.7
35	0.5

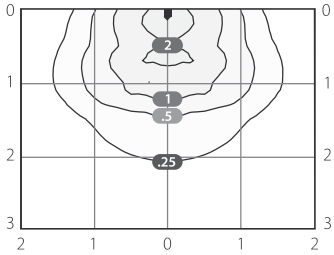
WP3LED 110W - 25' Mounting Height
Photometric Report #RAB03331



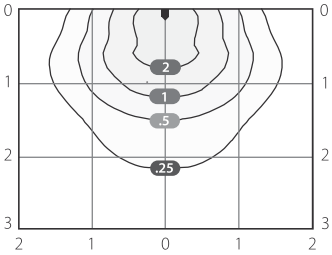
WP3LED 82W - 25' Mounting Height
Photometric Report #RAB01837



WP3LED 55W - 25' Mounting Height
Photometric Report #RAB01024

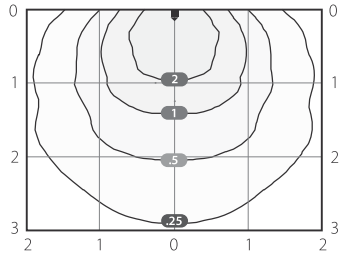


WP3LED 65W - 25' Mounting Height
Photometric Report #RAB01805

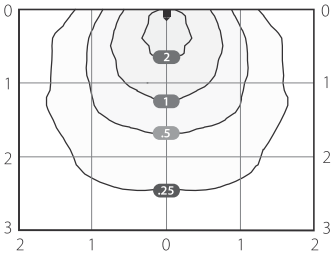


Mounting Height	Multiplier
12	1.8
14	1.3
16	1.0
18	0.8
20	0.6

WP2LED 37W - 16' Mounting Height
Photometric Report #RAB01023

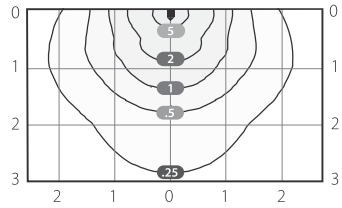


WP2LED 24W - 16' Mounting Height
Photometric Report #RAB01040



Mounting Height	Multiplier
8	2.2
10	1.4
12	1.0
14	0.7
16	0.6

WP1LED 30W - 12' Mounting Height
Photometric Report #RAB01022



Grid Scales: Multiples of Mounting Height
Values Shown in Footcandles

Ordering information

Product Family	Wattage	Color Temperature	Finish	Driver Options	Photocell Options
WP3LED					

Wattage		Color Temperature		Finish		Driver Options		Photocell Options	
110	110W	**Blank**	5000K	**Blank**	Bronze	**Blank**	120/277V	**/PC**	120V Photocell
82	82W	**N**	4000K	**W**	White	**/D10**	0-10V Dimming	**/PC2**	277V Photocell
65	65W	**Y**	3000K			**/480**	480V	**/PCS**	120V Swivel Photocell
55	55W					**/480/D10**	0-10V Dimming, 480V*	**/PCS2**	277V Swivel Photocell
								/PCS4	480V Swivel Photocell

Product Family	Wattage	Color Temperature	Finish	Driver Options	Photocell Options
WP2LED					

Wattage		Color Temperature		Finish		Driver Options		Photocell Options	
37	37W	**Blank**	5000K	**Blank**	Bronze	**Blank**	120/277V	**/PC**	120V Photocell
24	24W	**N**	4000K	**W**	White	**/480**	480V**	**/PC2**	277V Photocell
		Y	3000K					**/PCS**	120V Swivel Photocell
								/PCS2	277V Swivel Photocell
								/PCS4	480V Swivel Photocell**

Product Family	Wattage	Color Temperature	Finish	Driver Options	Photocell Options
WP1LED	30				

Color Temperature		Finish		Driver Options		Photocell Options	
Blank	5000K	**Blank**	Bronze	**Blank**	120/277V	**/PC**	120V Photocell
N	4000K	**W**	White	**/480**	480V	**/PC2**	277V Photocell
Y	3000K					**/PCS**	120V Swivel Photocell
						/PCS2	277V Swivel Photocell
						/PCS4	480V Swivel Photocell

** Not available for 55W*

*** Only available for 37W (WP2LED)*

Affordability. Versatility. Now available in 80W.



5 wattages.
3 beam spreads.
3 mounting options.

1 floodlight family.

DLC QPL LISTED™

DLC QPL LISTED PREMIUM™

RAB® | Outdoor

RABLIGHTING.COM • 888 722-1000

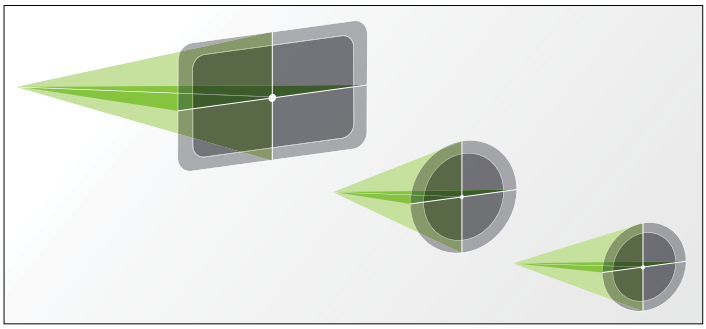
FFLED®

RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty

- Replace 35W to 250W metal halide floods
- Available in 18W, 26W, 39W, 52W and 80W
- NEMA Type 7x6 beam spread (4x4 or 5x5 distributions also available*)
- Ultra efficient: up to 112 lumens per Watt
- Swivel arm, trunnion mount and slipfitter mount options*
- 100,000-Hour LED lifespan



Three mounting options: standard swivel arm, trunnion or slipfitter.*



Three NEMA Types: 7x6, 5x5 and 4x4 for various beam spreads.*



Patent-pending Air-Flow fins keep FFLEDs running cool.

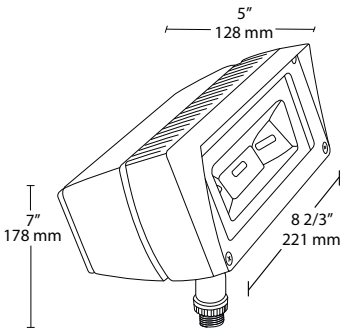


The FFLED family is ultra efficient, performing at up to 112 lm/W.

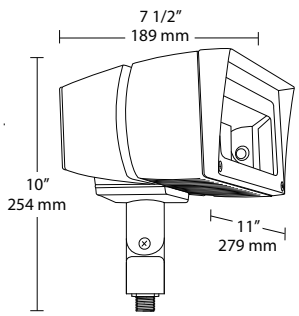
**Not available for 18W models.*

Dimensions and weight

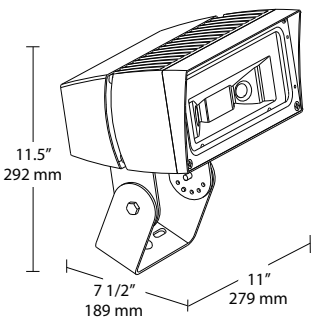
FFLED18
Weight: 4.8 lbs.



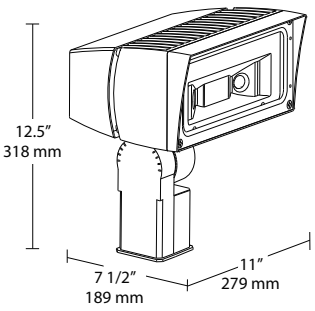
STANDARD SWIVEL ARM
Weight: 12.5 lbs.



OPTIONAL TRUNNION MOUNT
Weight: 14.2 lbs.

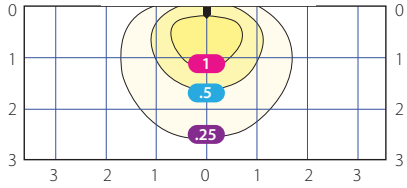


OPTIONAL SLIPFITTER MOUNT
Weight: 14.2 lbs.



Photometrics

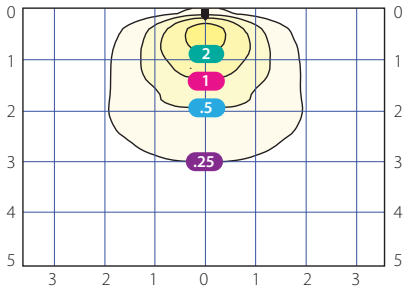
FFLED 18W - 7H x 6V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #RAB01466



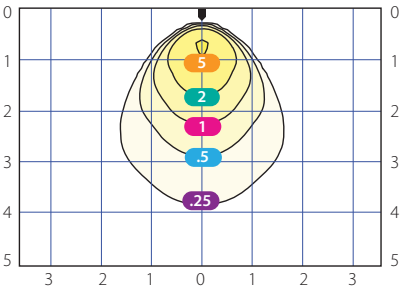
Mounting Height	8	10	12	15	18	20
Multiplier	3.5	2.3	1.6	1.0	0.7	0.6

Grid scales: Multiples of mounting height
Values shown in footcandles

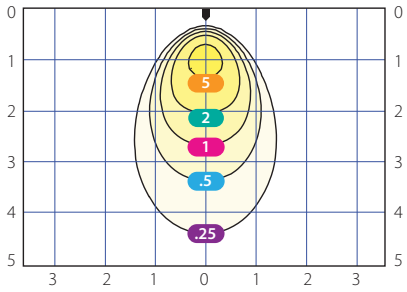
FFLED 26W - 7H x 6V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82112



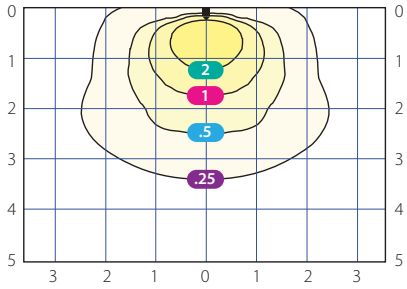
FFLED 26W - 5H x 5V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82214



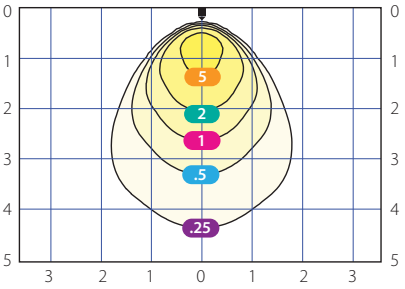
FFLED 26W - 4H x 4V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report # ITL82232



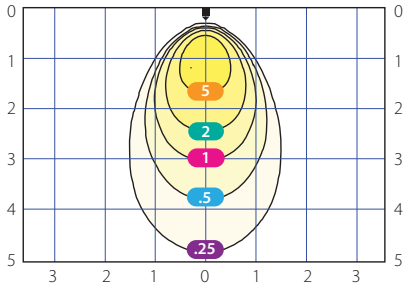
FFLED 39W - 7H x 6V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL79398



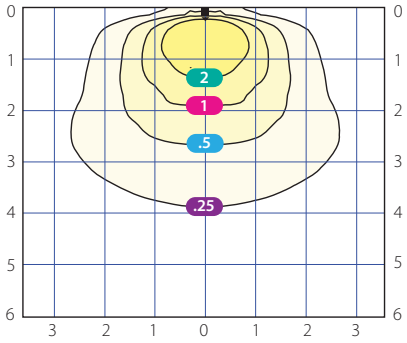
FFLED 39W - 5H x 5V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82217



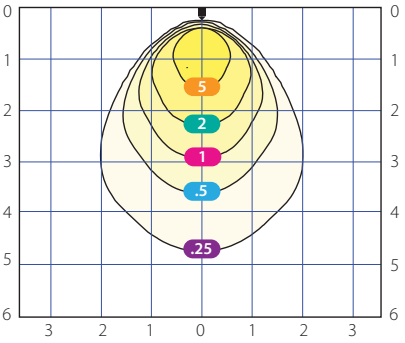
FFLED 39W - 4H x 4V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82235



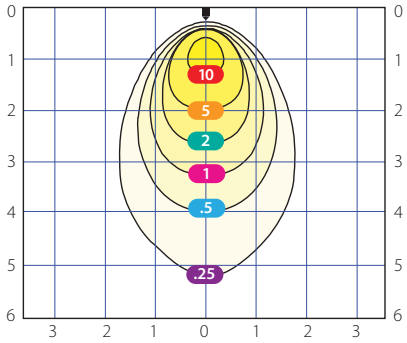
FFLED 52W - 7H x 6V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82115



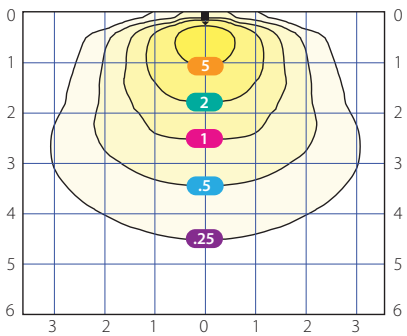
FFLED 52W - 5H x 5V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82220



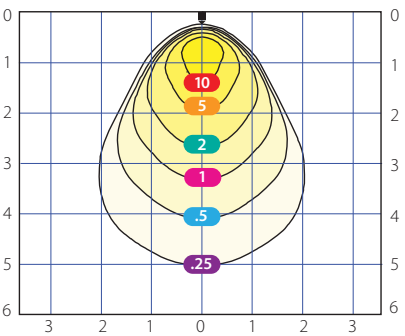
FFLED 52W - 4H x 4V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #ITL82238



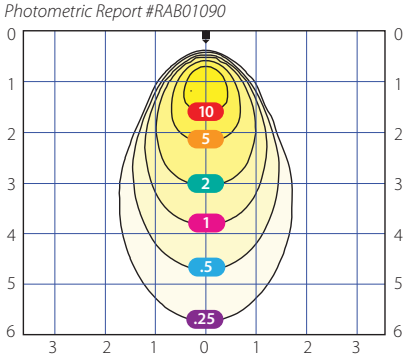
FFLED 80W - 7H x 6V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #RAB01113



FFLED 80W - 5H x 5V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #RAB01092



FFLED 80W - 4H x 4V
15' Mounting Height, Aimed 30° Below Horizon
Photometric Report #RAB01090



FFLED® Specifications

UL Listing: Suitable for wet locations. Suitable for ground mounting.

LED: Multi-chip, high-output, long-life LEDs

Lifespan: 100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

Drivers:

18W: Constant Current, Class 2, 100-277V, 50/60 Hz, 6 kV surge protection, 120V: 0.17 A, 208V: 0.1 A, 240V: 0.09 A, 277V: 0.08 A

26W: Constant Current, Class 2, 100-277V, 50/60 Hz, 6 kV surge protection, 120V: 0.24 A, 208V: 0.15 A, 240V: 0.13 A, 277V: 0.11 A, 480V: 0.06 A

39W: Constant Current, Class 2, 100-277V, 50/60 Hz, 6 kV surge protection, 120V: 0.35 A, 208V: 0.20 A, 240V: 0.18 A, 277V: 0.15 A, 480V: 0.08 A

52W: Constant Current, Class 2, 100-277V, 50/60 Hz, 6 kV surge protection, 120V: 0.45 A, 208V: 0.27 A, 240V: 0.24 A, 277V: 0.21 A, 480V: 0.13 A

80W: Constant Current, Class 2, 100-277V, 50/60 Hz, 6 kV surge protection, 120V: 0.74 A, 208V: 0.48 A, 240V: 0.41 A, 277V: 0.36 A

Equivalencies: 18W replaces 70W MH, 26W replaces 100W MH, 39W replaces 150W MH, 52W replaces 175W MH, 80W replaces 250W MH *(based on 5000K performance)*

5000K Color Temperature

Nominal Watts @120V	18W	26W	39W	52W	80W
Input Watts*	20	29	42	54	89
Output Lumens*	2431	4087	5699	5496	9672
Lumens Per Watt*	123	143	136	102	109
Color Accuracy (CRI)*	71	75	75	67	72

4000K Color Temperature

Nominal Watts @120V	18W	26W	39W	52W	80W
Input Watts*	19	28	42	54	88
Output Lumens*	2111	4043	5641	4536	9157
Lumens Per Watt*	109	143	134	84	104
Color Accuracy (CRI)*	71	75	75	82	72

3000K Color Temperature

Nominal Watts @120V	18W	26W	39W	52W	80W
Input Watts*	19	28	42	54	87
Output Lumens*	2064	3952	5518	4342	8591
Lumens Per Watt*	107	140	132	81	98
Color Accuracy (CRI)*	83	71	70	80	71

** Values shown for 7H x 6V NEMA Type only. Visit rabweb.com for 5H x 5V and 4H x 4V performance.*

Dimming: 18, 26, 39, 52 and 80W: Available as On/Off or with 0-10V dimming.

Cold Weather Starting: The minimum starting temperature is -40°C.

Thermal Management: Superior heat sinking with external Air-Flow fins

Housing: Die-cast aluminum housing, lens frame and mounting arm

Reflector: 18W: Semi-specular anodized aluminum, **26, 39, 52 and 80W:** specular polycarbonate.

NEMA Type: Standard 7H x 6V. 5H x 5V and 4H x 4V available for 26, 39, 52 and 80W models.

Mounting: Heavy-duty mounting arm with "O" ring seal & stainless steel screws. Trunnion and slipfitter mounts also available for 26, 39, 52 and 80W models.

Gaskets: High-temperature silicone gaskets

Finish: Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contain no VOC or toxic heavy metals.

Color Stability: LED color temperature warrantied not to shift more than 200K in CCT in 5 years

Color Uniformity: RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2015.

Green Technology: Mercury and UV free, and RoHS compliant. Polyester powder coat finish formulated without the use of VOC or toxic heavy metals.

IESNA LM-79 & LM-80 Testing: RAB LED luminaires have been tested in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

California Title 24: FFLED18 and FFLED26 equipped with a photocell comply with 2013 California Title 24 building and electrical codes as commercial outdoor non-pole-mounted fixtures <30 Watts. FFLED39, FFLED52 and FFLED80 equipped with a 0-10V driver comply with 2013 California Title 24 building and electrical codes as commercial outdoor non-pole-mounted fixtures >30 Watts mounted up to 24 feet when used with the RAB Stealth Dimmer. Use catalog code STLDIM10 to order a Stealth Dimmer module.

** Values shown for 7H x 6V NEMA Type only. Visit rabweb.com for 5H x 5V and 4H x 4V performance.*

Ordering information

Product Family	Wattage	Color Temp	Finish	Driver	Emergency Options	Photocell Options	Suffix
FFLED	18						
	18 18W	**Blank** 5000K **N** 4000K **Y** 3000K	**Blank** Bronze **W** White	**Blank** 120-277Vac 0-10V Dimming	**Blank** No option **/E*** Emergency Battery 120-277 Vac Only **/EC*** Low Temp Emergency Battery available 120-277 Vac only	**Blank** No option **/PCU** 120-277Vac Button Photocell **/PCS** 120 Vac Swivel Photocell **/PCS2** 277Vac Swivel Photocell **/MS**** Mini Sensor SMS500 **/STL3**** Stealth 360˚ Sensor	**Blank** No option **USA** BAA Compliant

Product Family	Wattage	Mounting	Color Temp	NEMA Type	Finish	Driver Options	Photocell Options
FFLED							
	26 26W **39** 39W **52** 52W **80** 80W	**Blank** Swivel arm **SF** Slipfitter **T** Trunnion	**Blank** 5000K **N** 4000K **Y** 3000K	**Blank** 7H x 6V **B55** 5H x 5V **B44** 4H x 4V	**Blank** Bronze **W** White	**Blank** On/Off **/D10** 0-10V Dimming **/480** 480V On/Off *	**Blank** No Option **/PC** 120V Photocell **/PC2** 277V Photocell **/PCS** 120V Swivel Photocell **/PCS2** 277V Swivel Photocell * **/PCS4** 480V Swivel Photocell

**Available for 18W only.*

***Available for 18W only. Includes mounting plate CU4x CU4A = Bronze, CU4W = White*



OFL Size 2
LED Flood Luminaire

Catalog Number

Notes

Type

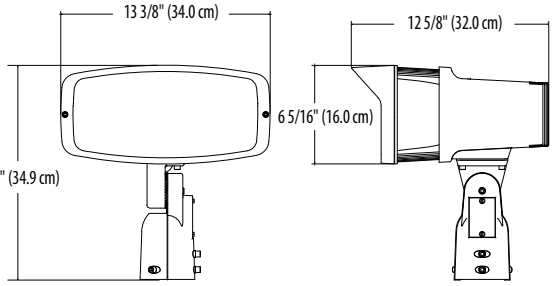
Hit the Tab key or mouse over the page to see all interactive elements.

Introduction

The The OFL Size 2 Floodlight delivers up to 16,900 lumens, with a robust design and several mounting options making it perfect for light commercial applications. It's the ideal long-life replacement for 250-400W metal halide floods, with typical energy savings up to 62% and expected service life of over 50,000 hours.

Specifications

EPA:	0.7 ft² *(.06 m²)*
Depth:	12.6" *(32 cm)*
Width:	13.37" *(34 cm)*
Height:	13.75" *(35 cm)*
Weight:	18 lbs *(8.1 kg)*



Ordering Information

EXAMPLE: OFL2 LED P2 40K MVOLT IS DDBXD

OFL2 LED					
Series	**Performance Package**	**Color Temperature**	**Voltage**	**Mounting**	**Finish** *(required)*
OFL2 LED	P2 P3	40K 4000K 50K 5000K	MVOLT[1] 347	IS Slipfitter YK Yoke	DDBXD Dark bronze

Accessories

Ordered and shipped separately.

OFL2WG	Wire Guard Accessory
DSXF1/2TS DDBXD U	Slipfitter for 1-1/4" to 2-3/8" OD tenons; mates with 1/2" threaded knuckle (specify finish)
FTS CG6 DDBXD U	Slipfitter for 2-3/8" to 2-7/8" OD tenons; mates with yoke mount (specify finish)

NOTES

1 MVOLT driver operates on any line voltage from 120-277V (50/60Hz).

FEATURES & SPECIFICATIONS

INTENDED USE
The traditional and robust design of the OFL2 LED floodlight with energy efficient LEDs, is suitable for replacing up to 400W Metal Halide. It is ideal for landscape, signage, and accent lighting in heavy commercial and residential applications.

CONSTRUCTION
Die-cast aluminum housing has integral heat sink fins to optimize thermal management through conductive and convective cooling. The LED driver is mounted in direct contact with the casting to promote low operating temperature and long life. Housing is completely sealed against moisture and environmental contaminants (IP65). Low EPA (0.7 ft²) for optimized wind loading.

FINISH
Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering.

ELECTRICAL
Light engine(s) consist of chip-on-board (COB) LEDs directly coupled to the housing to maximize heat dissipation and promote long life (50,000 hrs).

INSTALLATION
Integral slipfitter or yoke facilitates quick and easy installation to a variety of mounting accessories.

LISTINGS
UL certified to U.S. and Canadian standards. Luminaire is IP65 rated. Rated for -40°C minimum ambient.
DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

One Lithonia Way • Conyers, Georgia 30012 • Phone: 1-800-705-7378 • www.lithonia.com
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Performance Data

Lumen Output

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Contact factory for performance data on any configurations not shown here.

Performance Package	System Watts	Dist. Type	Field Angle		Beam Angle		40K		50K	
			°H	°V	°H	°V	Lumens	LPW	Lumens	LPW
P2	114W	WFL	106	106	71	72	12,281	108	12,154	107
P3	151W	WFL	106	106	71	72	16,902	112	16,261	107

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Ambient		Lumen Multiplier
0°C	32°F	1.06
10°C	50°F	1.03
20°C	68°F	1.01
25°C	**77°F**	**1.00**
30°C	86°F	0.99
40°C	104°F	0.97

Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the **OFL Flood Size 2** platform based on 9000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Operating Hours	0	25,000	50,000
Lumen Maintenance Factor	1	0.96	0.94

Electrical Load

Light Engines	System Watts	Current (A)				
		120V	208V	240V	277V	347V
1	114W	0.97	0.56	0.49	0.42	0.34
2	151W	1.29	0.75	0.65	0.57	0.45

Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting's OFL Series Flood Size 2 homepage.

Mounting, Options and Accessories



YK- Yoke Mount



IS- Slipfitter Mount
H= 2-1/2" (6.3 cm)
ID= 2-3/8" (6.0 cm)
OD= 3-1/2" (8.8 cm)

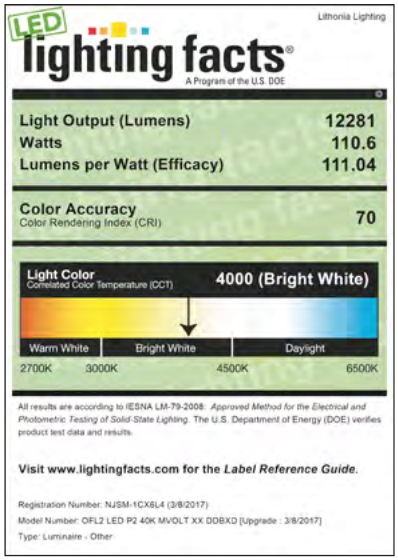


Wire Guard
OFL2WG

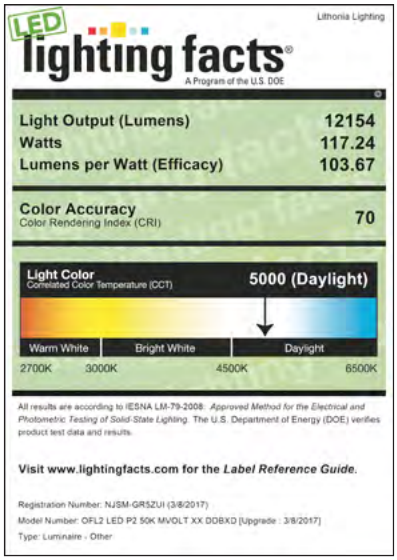
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Lighting Facts Labels

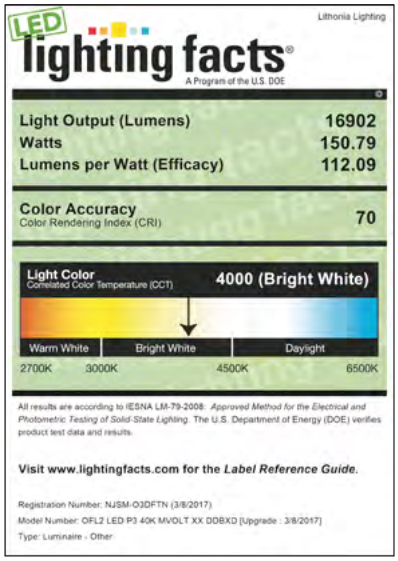
OFL2 LED P2 40K MVOLT XX DDBXD



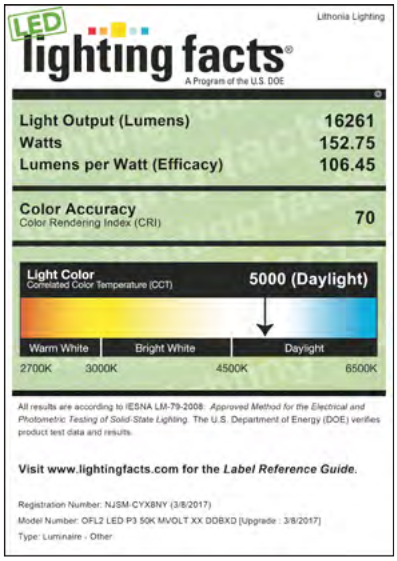
OFL2 LED P2 50K MVOLT XX DDBXD



OFL2 LED P3 40K MVOLT XX DDBXD



OFL2 LED P3 50K MVOLT XX DDBXD



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Replace old canopy fixtures with low-profile, energy-saving LED.

VANLED®



RAB | Outdoor

RABLIGHTING.COM • 888-722-1000

Vandal-resistant canopy light

- 6 power packages with a replacement range of 50W to 200W
- Low-profile design covers traditional canopy footprints
- Ultra-high efficiency up to 150 lm/W
- Available with flat lens or drop lens
- Replace surface or recess-mounted fixtures
- Durable polycarbonate lens is vandal and UV resistant
- IP66 rated against dust and water ingress
- 100,000-Hour LED lifespan

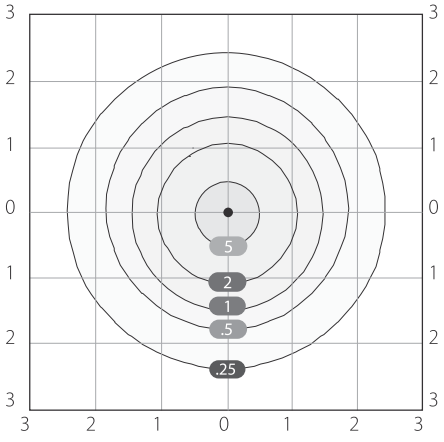
Visit rablighting.com to see which models are DLC listed.

RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty

Photometrics

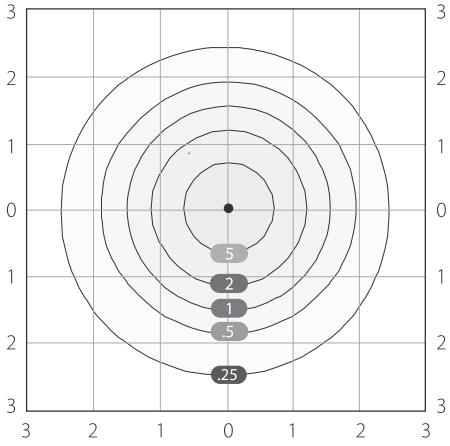
VANLED 10W - 10 ft mounting height

Photometric Report #dlf1808125-2a



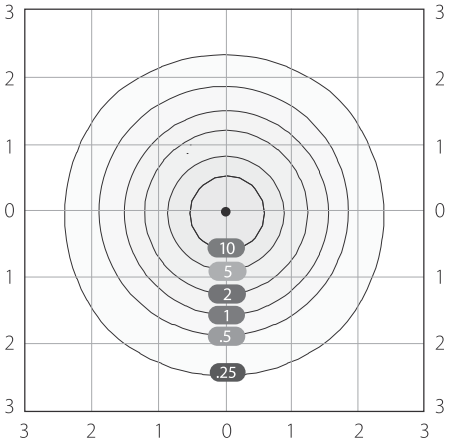
VANLED 20W - 10 ft mounting height

Photometric Report #dlf1808102-2amod50



VANLED 40W - 10 ft mounting height

Photometric Report #dlf1808102-4amod50

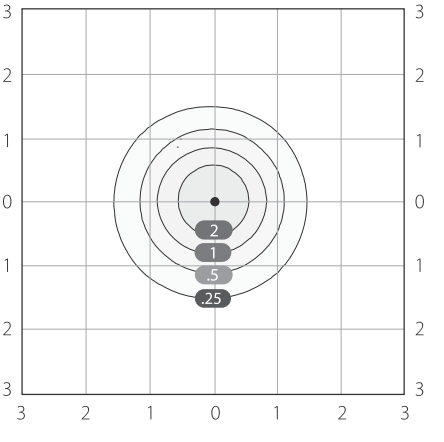


Mounting Height	8	9	10	11	12
Multiplier	1.6	1.2	1.0	0.8	0.7

Grid scales: Multiples of mounting height
Values shown in footcandles

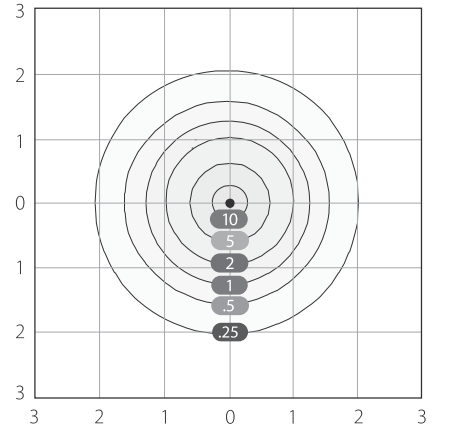
VANLED 52W - 16 ft mounting height

Photometric Report #dlf1808102-5amod50



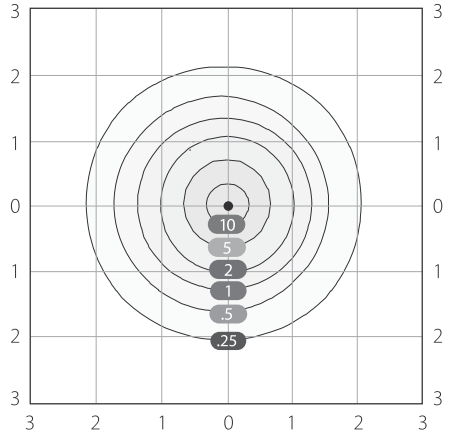
VANLED 65W - 16 ft mounting height

Photometric Report #dlf1808102-6amod50



VANLED 75W - 16 ft mounting height

Photometric Report #dlf1808102-7amod50



Mounting Height	12	14	16	18	20
Multiplier	1.8	1.3	1.0	0.8	0.6

Grid scales: Multiples of mounting height
Values shown in footcandles

Specifications

UL Listing: Suitable for wet locations

LEDs: Long-life, high-efficiency, surface-mount LEDs

Drivers:
10W: Class 2, Constant Current, 100-277V, 50-60Hz, 120V: 0.30A, 208V: 0.20A, 240V: 0.17A, 277V: 0.15A, 280mA
20W: Class 2, Constant Current, 100-277V, 50-60Hz, 120V: 0.30A, 208V: 0.20A, 240V: 0.17A, 277V: 0.15A, 500mA
40W: Class 2, Constant Current, 100-277V and 480V, 50-60Hz, 120V: 0.60A, 208V: 0.19A, 240V: 0.17A, 277V: 0.14A, 1050mA
52W: Class 2, Constant Current, 100-277V and 480V, 50-60Hz, 120V: 0.80A, 208V: 0.26A, 240V: 0.23A, 277V: 0.20A, 1400mA
65W: Class 2, 100-277V, 50-60Hz, 120V: 0.64A, 208V: 0.40A, 240V: 0.35A, 277V: 0.30A1650mA
75W: Class 2, 100-277V, 50-60Hz, 120V: 0.85A, 208V: 0.53A, 240V: 0.46A, 277V: 0.40A, 1980mA

IP Rating: IP66, protected against dust and water ingress

Nominal Watts @120V	10W	20W	40W	52W	65W	75W
Color Temperature (CCT)	5000K	5000K	5000K	5000K	5000K	5000K
Input Watts*	14	22	40	56	68	78
Output Lumens*	1971	2989	5380	6811	8486	9344
HID Replacement*	50W	70W	100W	150W	175W	200W
Lumens Per Watt*	146	137	135	122	124	121
Color Accuracy (CRI)*	78	78	78	78	78	78

Dimming: On/off driver or 0-10V dimming available for 20, 40 and 52W models

Cold Weather Starting: The minimum starting temperature is -40°C.

Housing: Die-cast aluminum housing and lens frame with (4) 1/2" NPS side conduit entries and weatherproof rear wire plug and access plate

Reflector: Semi-specular, vacuum-metalized polycarbonate

Lens: Vandal-resistant polycarbonate textured opaque for low glare; frosted models available.

Mounting: Ceiling mount to recessed junction with knockout template or directly to ceiling surface, utilizing side conduit entry points.

Gaskets: High-temperature silicone gaskets

Finish: Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contain no VOC or toxic heavy metals.

Color Stability: LED color temperature warrantied not to shift more than 200K in CCT in 5 years

Color Uniformity: RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Green Technology: Mercury and UV free. RoHS-compliant components.

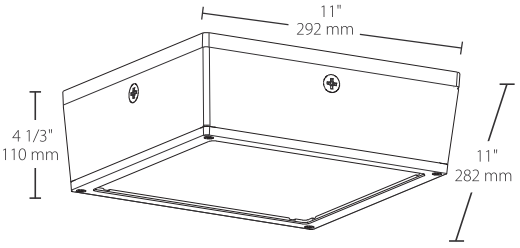
IESNA LM-79 & LM-80 Testing: RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

California Title 24: 10 and 20 Watt VANLED models equipped with a swivel photocell or mini-sensor comply with 2013 California Title 24 building and electrical codes as a commercial outdoor non-pole-mounted fixture <30 Watts.

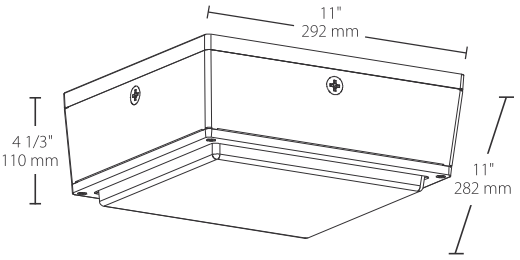
** Values shown for 5000K temperature only, with a clear drop lens. Visit rablighting.com for 4000K and 3000K performance, as well as other lenses.*

Dimensions and Weights

Flat Lens
Weight: 11.8 lbs

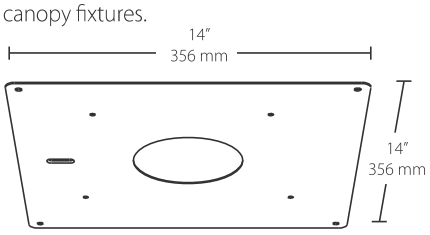


Drop Lens
Weight: 12 lbs



Accessories

VANLED RETROPLATE *(Bronze)*
VANLED RETROPLATEW *(White)*
Mounting plate used to retrofit recessed canopy fixtures.



Ordering Information

Product Family	Wattage	Color Temp	Lens	Finish	Voltage	Option-Motion Sensor	Options- Control	Options
VANLED								
	10 10W	**Blank** 5000K	**Blank** Drop Lens	**Bronze** Blank	**120-277, 0-10V Dim** Blank	**No Option** Standard	**No Option** Blank	**No Option** Standard
	20 20W	**N** 4000K	**F** Flat Lens	**White** W	**480,0-10V Dim** /480[1]	**Microwave Sensor** /MVS[2]	**120V Swivel Photocell** /PCS	**Lightcloud®** /LC
	40 40W	**Y** 3000K	**FR** Frosted Drop Lens			**Wattstopper 8ft** /WS[3]	**277V Swivel Photocell** /PCS2	**Emergency Battery** /E2[4]
	52 52W		**FFR** Frosted Flat Lens			**Wattstopper, 20ft** /WS2[3]	**480V Swivel Photocell** /PCS4	
	65 65W							
	75 75W							

[1] *480V not available for 10W, 20W and 28W*
[2] *Microwave Sensors available only with Drop Lens @120-277V*
[3] *WS = Wattstopper - White - 8ft. WS2 = Wattstopper - White - 20ft. Available for both 120-277 and 480 V*
[4] *120-277V only*

VANLED Canopy Light

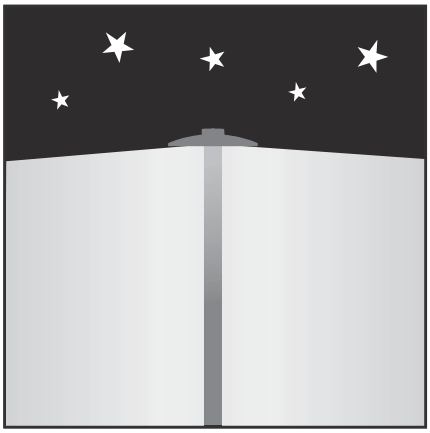



Low profile, low glare.
Edge-lit technology unlike any other.
IVELOT™
RAB® | Outdoor

IVELOT™

- Available in 4,500lm (38W), 7,500lm (67W), 10,000lm (94W) and 13,000lm (117W) models
- Offered with 3 mounting options: universal pole adapter, wall or slipfitter
- Type II, III, IV, VS and Forward Throw distributions
- 0-10V Dimming, standard
- Motion sensor, photocell and Lightcloud® Controller options available
- 100,000-Hour LED lifespan

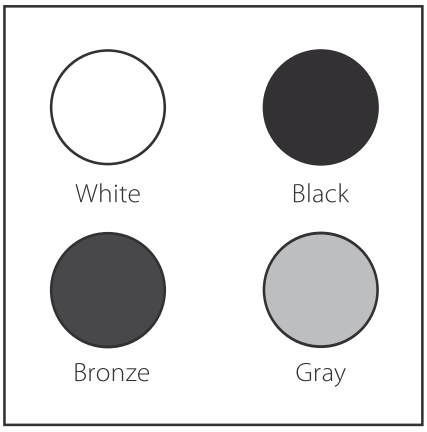
RAB's warranty is subject to all terms and conditions found at rablighting.com/warranty.



The IVELOT is a complete cutoff, fully shielded area light that minimizes glare, while reducing light trespass.



IVELOT offers several mounting options to support a variety of applications. *(Universal Pole Adapter shown)*



Available in four color finishes: bronze, black, white and gray. *(gray has no texture)*



Available with Lightcloud Controller.



Lightweight, low-profile design, and a low EPA help reduce the load on a pole.



Available with an optional, integrated motion sensor or photocell.

Specifications

UL:
Suitable for wet locations

LEDs:
Long-life, high-efficiency, micro-power, surface-mount LEDs

Drivers(s):
Class 2, 50/60Hz. 120 - 277V, 347-480V, 4kV standard, 10kV optional surge protection

Dimming Driver:
Driver includes dimming control wiring for 0-10V dimming systems. Requires separate 0-10V DC dimming circuit. Dims as low as 10%.

Lifespan:
100,000-hour LED lifespan based on IES LM-80 results & TM-21 calculations at 25°C

IP Rating:
Ingress Protection rating of IP66 for dust and water

Color Weather Starting:
Minimum starting temperature is -40°C (-40°F)

Maximum Ambient Temperature:
Suitable for use in 40°C (104°F) temperatures

Housing:
Die-cast aluminum housing

Mounting:
Universal pole adapter, slipfitter or wall mount options available

Lens:
Diffused Polymethyl Methacrylate (PMMA)

Vibration Rating:
3G vibration tested per ANSI C136.31

Effective Projected Area:
EPA = 0.61

Color Stability:
LED color temperature is warrantied to shift no more than 200K in CCT over a 5-year period

Color Uniformity:
RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2017.

Title 24 Compliant:
An IVELOT edge-lit area light can be used with a motion sensor or photocell control option to comply with 2016 Title 24 Part 6 Section 130.2 (a,b,c).

Finish:
Formulated for high durability and long-lasting color

Green Technology:
Mercury and UV free. RoHS-compliant components

IESNA LM-79 Testing:
RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79

Performance

Type II

	IVAT2 - 100L			IVAT2 - 75L			IVAT2 - 45L		
Color Temperature	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**
Input Watts	92	93	93	66	67	67	37	38	38
Output Lumens	10,739	10,095	10,167	7,961	7,484	7,537	4,340	4,080	4,109
Efficacy (lm/W)	117	109	110	120	112	112	117	109	110
Color Accuracy (CRI)	75	73	80	75	73	80	75	73	81
	(Replaces 400W PSMH)			(Replaces 320W PSMH)			(Replaces 175W PSMH)		

Type III

	IVAT3 - 100L			IVAT3 - 75L			IVAT3 - 45L		
Color Temperature	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**
Input Watts	96	96	91	70	70	66	40	40	38
Output Lumens	11,359	9,939	9,588	7,608	6,657	6,422	4,963	4,342	4,189
Efficacy (lm/W)	118	103	105	110	96	98	124	109	111
Color Accuracy (CRI)	75	73	81	75	73	80	75	73	80
	(Replaces 400W PSMH)			(Replaces 320W PSMH)			(Replaces 175W PSMH)		

Type IV

	IVAT4 - 130L			IVAT4 - 100L			IVAT4 - 75L			IVAT4 - 45L		
Color Temperature	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**
Input Watts	117	116	117	95	95	93	66	66	66	37	37	37
Output Lumens	14,322	14,174	13,232	11,361	10,832	10,207	7,429	7,353	6,864	4,906	4,856	4,533
Efficacy (lm/W)	123	122	113	120	115	109	113	112	104	132	131	121
Color Accuracy (CRI)	75	72	80	90	90	90	75	72	80	75	72	80
	(Replaces 450W PSMH)			(Replaces 400W PSMH)			(Replaces 320W PSMH)			(Replaces 175W PSMH)		

Type VS

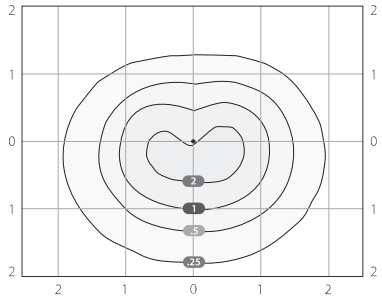
	IVAT5S - 130L			IVAT5S - 100L			IVAT5S - 45L			IVAT5S - 75L		
Color Temperature	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**
Input Watts	118	115	116	97	95	95	38	37	38	66	64	65
Output Lumens	14,494	13,357	12,659	11,577	11,508	10,032	5,210	4,801	4,550	8,434	7,772	7,366
Efficacy (lm/W)	123	116	109	119	122	106	136	128	120	129	122	114
Color Accuracy (CRI)	74	72	80	90	90	90	74	72	80	74	72	80
	(Replaces 450W PSMH)			(Replaces 400W PSMH)			(Replaces 320W PSMH)			(Replaces 300W PSMH)		

Type FT (Forward Throw)

	IVAFT - 100L			IVAFT - 75L			Type FT - 45L		
Color Temperature	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**	**5000K**	**4000K**	**3000K**
Input Watts	95	91	93	68	65	67	39	37	38
Output Lumens	10,594	9,999	9,970	7,927	7,482	7,460	4,928	4,651	4,638
Efficacy (lm/W)	111	110	108	116	115	112	127	125	122
Color Accuracy (CRI)	75	73	80	74	72	80	74	72	80
	(Replaces 400W PSMH)			(Replaces 320W PSMH)			(Replaces 175W PSMH)		

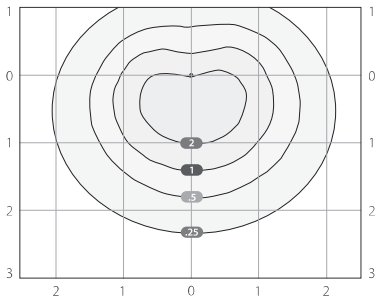
Photometrics

IVAT2-100L
(Type II)
25' Mounting Ht.
Photometric Report
#DLF1810114-11A.IES



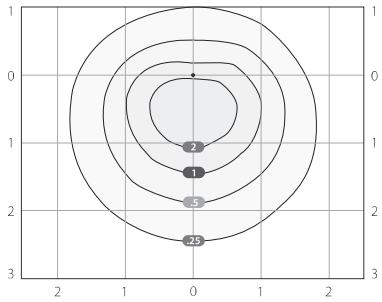
Mounting Height	15	20	25	30	35
Multiplier	2.8	1.6	1.0	0.7	0.5

IVAT3-100L
(Type III)
25' Mounting Ht.
Photometric Report
#DLF1810114-14A.IES



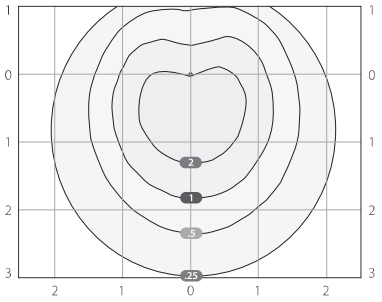
Mounting Height	15	20	25	30	35
Multiplier	2.8	1.6	1.0	0.7	0.5

IVAFT-100L
(Forward Throw)
25' Mounting Ht.
Photometric Report
#DLF1810114-17A.IES



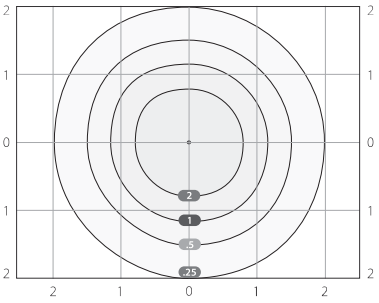
Mounting Height	15	20	25	30	35
Multiplier	2.8	1.6	1.0	0.7	0.5

IVAT4-130L
(Type IV)
25' Mounting Ht.
Photometric Report
#DLF1810114-20A.IES



Mounting Height	15	20	25	35	30
Multiplier	2.8	1.6	1.0	0.5	0.7

IVAT5S-130L
(Type V Square)
25' Mounting Ht.
Photometric Report
#DLF1810114-23A.IES



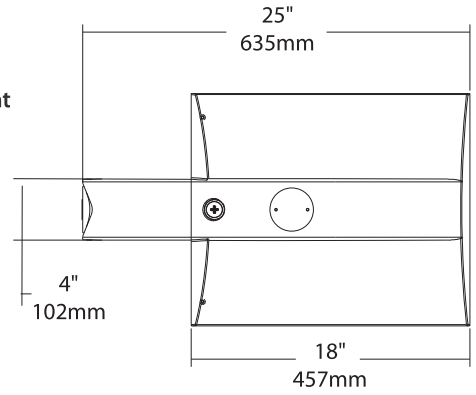
Mounting Height	15	20	25	35	30
Multiplier	2.8	1.6	1.0	0.5	0.7

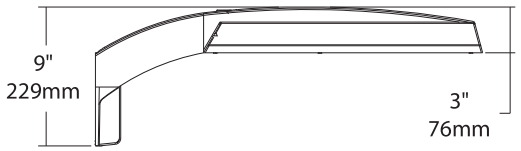
Grid Scales: Multiples of Mounting Height Values Shown in Footcandles

Watts	Lumens Based on 5000K CCT @ 120Vac					Avg Lumens Across All Dist Types
	Type II	Type III	Type IV	Type VS	Forward Throw	
38W	4,340	4,963	4,906	5,210	4,928	4,869
67W	7,961	7,608	7,429	8,434	7,927	7,872
94W	10,739	11,359	10,832	11,577	10,594	10,897
117W	n/a	n/a	14,322	14,494	n/a	14,408

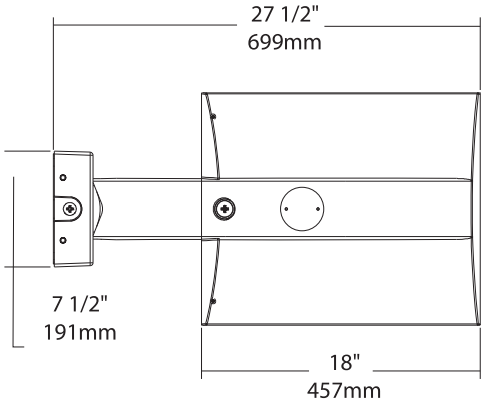
Mountings, Dimensions & Weights

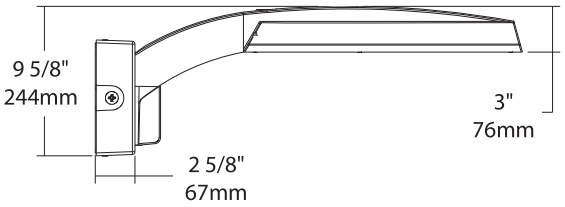
PA - Universal Pole Mount
Weight: 15.0 lbs (7kg)



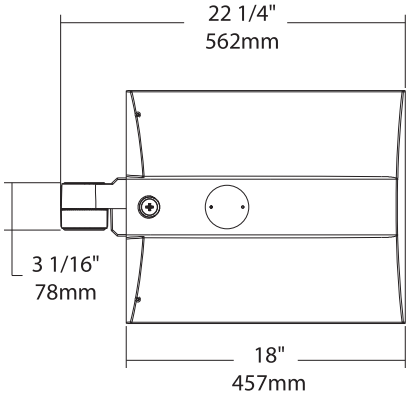


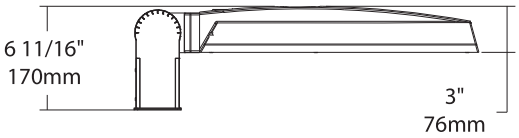
WM - Wall Mount
Weight: 20.0 lbs (9kg)





SF - Slipfitter Mount
Weight: 13.5 lbs (6kg)





Ordering information

Product Family	Optics /Distribution		Lumen Output		Mounting		CCT/CRI		Finish		Voltage/Driver		Sensor Options		Lightcloud Option	
IVA																
T2	Type II	**45L**	4500 lumens (38W)	**PA**	Universal Pole Adapter	**750**	5000K (Cool), 70 CRI	**Z**	Bronze	**U**	120-277V, 0-10V Dimming	**Blank**	No Sensor	**Blank**	No Lightcloud
T3	Type III	**75L**	7500 lumens (67W)	**WM**	Wall Mount	**740**	4000K (Neutral), 70 CRI	**W**	White	**H**	347-480V, 0-10V Dimming	**/WS**	Multi-Level Motion Sensor, 8ft mounting	**/LC**	Lightcloud Controller[2]
T4	Type IV	**130L**	13000 lumens (117W)[1]	**SF**	Slipfitter	**730**	3000K (Warm), 70 CRI	**G**	Roadway Gray			**/WS2**	Multi-Level Motion Sensor, 20ft mounting		
T5S	Type V Sq							**K**	Black			**/WS4**	Multi-Level Motion Sensor, 40ft mounting		
FT	Forward Throw											**/7PR**	7Pin Receptacle		

ACCESSORIES (SOLD SEPARATELY)

IVA-SF	Single Fuse (120V, 277V)
IVA-DF	Double Fuse (208V, 240V, 480V)
RSP10GI-277	10kV Surge Protector (120V & 277V)
RSP10GI-480	10kV Surge Protector (480V)

1. Applies to TYPE IV, V Square | 2.Applies to 120-277V

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

QUANTUM®
Thermoplastic Exits

LHQM LED

LED Lamp Head
Nickel-Cadmium Battery





HO RO



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for applications requiring both exit sign and unit equipment. Attractive, 8" tall, streamlined design is great for above-the-door applications and other tight fits. Optional high-output version with remote lamps are ideal for emergency egress lighting. **Certain airborne contaminants can diminish integrity of acrylic and/or polycarbonate.** **Click here for Acrylic- Polycarbonate Compatibility table for suitable uses.**

CONSTRUCTION — Engineering-grade thermoplastic housing is impact-resistant, scratch-resistant and corrosion-proof. UL94V-0 flame rating. UV-stable resin resists discoloration from natural and man-made light sources.

Rugged unibody housing snaps together with no additional fasteners. Faceplate and back cover are interchangeable on housing. Positive snap-fit tabs hold faceplate securely, yet are easily removable for lamp compartment access. Universal, directional chevron inserts are easily removed and reinserted.

Uniform graphics illumination without shadows or hot spots. Letters are 6" high with 3/4" stroke, with 100 ft. viewing distance rating based upon UL924 standard.

LEDs mounted on primary circuit boards for sign illumination. Low-energy LED lamp in sign operates in normal (AC input) and emergency (DC input) modes.

Low-profile, integrated test switch/pilot light. Easily viewed bright red status indicator.

Unique track-and-swivel arrangement permits full range of direction of lamp head adjustment. Universal J-box mounting pattern. Tool-less access for maintenance. Conduit entry position on top of unit.

U.S. Patent No. 6,848,798; 6,499,866; 6,142,648; 5,797,673; D379,373; 5,526,251; D484,272; D473,672; 5,611,163; 5,646,502.

OPTICS — Twin LED lamp heads operate in emergency (DC input) mode with 12 series-parallel white LEDs in each head. Provides redundant light sources to ensure emergency lighting performance. The typical life of the exit LED lamp is 10 years.

ELECTRICAL — Dual-voltage input capability (120/277V). Edge connector on printed circuit board ensures long-term durability.

Current-limiting charger maximizes battery life and minimizes energy consumption. Provides low operating costs.

Short-circuit protection — current-limiting charger circuitry protects printed circuit board from shorts.

Thermal compensation adjusts charger output to provide optimum charge voltage relative to ambient temperature.

Regulated charge voltage maintains constant-charge voltage over a wide range of line voltages. Prevents over/undercharging that shortens battery life and reduces capacity.

Filtered charger input minimizes charge voltage ripple and extends battery life.

AC/LVD reset allows battery connection before AC power is applied and prevents battery damage from deep discharge.

Single multi-color LED indicator to display two-state charging, test activation and three-state diagnostic test. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection. Self-diagnostic testing for 30 seconds every 30 days, 30 minutes at 180-day interval, and 90 minutes annually. Diagnostic evaluation of LED light source, AC-to-DC transfer, charging and battery condition.

Battery: Sealed, maintenance-free nickel-cadmium battery delivers 90-minute capacity to emergency lamps. Two-state contstant-current charge maximizes battery life and automatically recharges after battery discharge. Low-voltage disconnect prevents excessively deep discharge that can permanently damage the battery. Optional high-output battery to power both local and optional LED remote lamp heads simultaneously.

INSTALLATION — Top, end or back mounting. Housing snaps to canopy with positive-locking tabs. Cam locking pin secures housing to canopy.

Easily removed mounting knockouts. Conduit entry knockout for 1/2" flexible conduit. J-box pattern on back panel.

LISTINGS — UL damp location listed standard 50°-104°F (10°-40°C). Meets UL 924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards.

WARRANTY — 5-year limited warranty. (Battery is prorated). Complete warranty terms located at www.AcuityBrands.com/CustomerResources/Terms_and_Conditions.aspx.

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LHQM LED G

LHQM		LED							
Family		**Lamp type**		**Housing color**		**Letter color**		**Options**	
LHQM	Stencil face, single face plate with extra face plate	LED	Two 1.5W/9.6V white LED	(blank)	White	R	Red	HO	High-output Ni-cad battery
				B	Black	G	Green	HO RO	High-output option, less lamp heads
								SD	Self-diagnostics
								NOM	Meets Mexican standards[1]
								NOM SALIDA	Salida signage (non-UL)[2]

Accessories: *Order as separate catalog number.*

ELA Q L0309 SD	Single, LED indoor remote head, white, self-diagnostics [3,4,5]	ELA WG3	Wireguard, 30"W x 13-1/2"H x 6"D[6]
ELA T Q L0309 SD	Twin, LED indoor remote head, white, self-diagnostics [3,4,5]	ELA WG2M	Wireguard, 21-1/4"W x 15"H x 12"D[6]
ELA QWP L0309 SD	Single, LED weather-proof remote head, gray, self-diagnostics [3,4,5]	ELA LQMUS12	12" white stem kit[7]
		ERE W SGL SQ M12	Single, LED indoor remote head, square, ivory white, .75W, 3.6V-12V voltage sensing[8,9]
ELA T QWP L0309 SD	Twin, LED weather-proof remote head, gray, self-diagnostics [3,4,5]	ERE W T SQ M12	Twin, LED indoor remote head, square, ivory white, 1.5W, 3.6V-12V voltage sensing[8,9]
ELA Q L0309	Single, LED indoor remote head, white[4,5]	ERE GY SGL WP SQ M12	Single, LED weather-proof remote head, square, gray, 1W, 3.6V-12V voltage sensing[8,9]
ELA T Q L0309	Twin, LED indoor remote head, white[4,5]	ERE GY T WP SQ M12	Twin, LED weather-proof remote head, square, gray, 2W, 3.6V-12V voltage sensing[8,9]
ELA QWP L0309	Single, LED weather-proof remote head, gray[4,5]		
ELA T QWP L0309	Twin, LED weather-proof remote head, gray[4,5]		

Notes

1. Available in black or white. Consult factory for options.
2. Only available in white. NOM standard.
3. Only compatible with self-diagnostic option. (ex: HO SD)
4. Also available in black. Add "B" after ELA to order black finish. Example: ELA B Q L0309.
5. Only compatible with HO option . See spec sheet ELA-Q-LED.
6. See spec sheet ELA-WG.
7. See spec sheet ELA-Stemkits.
8. See spec sheet ERE.
9. Not available with SD. Only compatible with HO option.

LHQM LED QUANTUM® Exit/Unit Combo

SPECIFICATIONS

Electrical Primary Circuit				
	Typical LED life[1]	Supply voltage	Max amps	Max watts
Red and green LED	10 years	120	.05	4.3
		277	.03	4.3

BATTERY

Ni-Cad				
Voltage	Typical Shelf life[2]	Typical life[2]	Maintenance[3]	Temperature range[4]
9.6	3 years	7-9 years	none	50-104°F (10-40°C)

1 Based on continuous operation.

2 At 77°F (25°C).

3 All life safety equipment, including emergency lighting path of egress, must be maintained, serviced and tested in accordance with all National Fire Protection Association and local codes. Failure to perform the required maintenance, service or testing could jeopardize the safety of occupants and will void all warranties.

4 Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

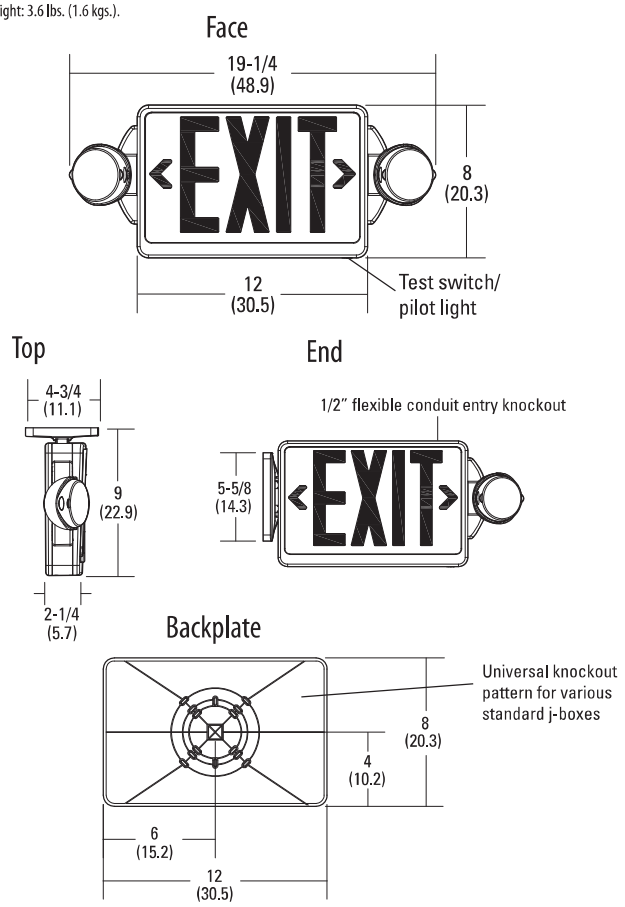
5. Battery life is negatively impacted by many variables including temperature, charging rates, number of cycles and deep discharges due to long periods of time without AC power.

Remote Output Capacity			
Standard unit	Combo	Combo/high-output battery(HO)	Combo/high-output (HO) and no heads (RO)
NA	NA	3W	6W

MOUNTING

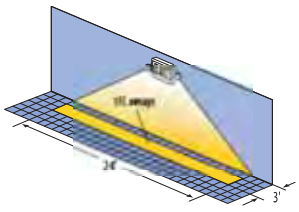
All dimensions are inches (centimeters).

Shipping weight: 3.6 lbs. (1.6 kgs.).

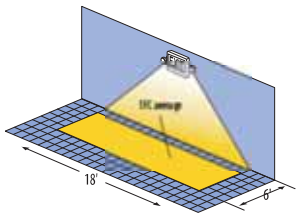


LAMP PHOTOMETRICS

QUANTUM LED SERIES – SINGLE COVERAGE
3W Total White LEDs
Using a single unit at a typical 7.5' mounting height delivers an average illuminance of 1.0 FC over a distance of 24' on a 3' path of egress and 18' on a 6' path of egress.

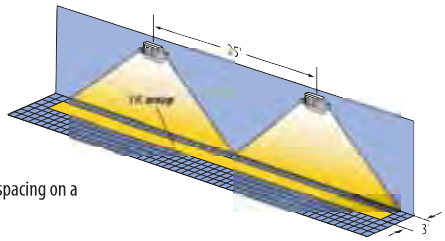


Example of single LHQM LED exit illuminating a 3' path of egress

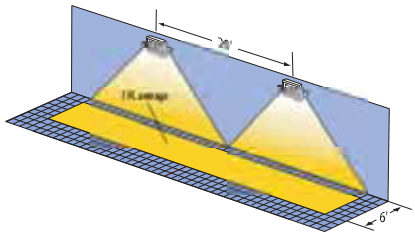


Example of single LHQM LED exit illuminating a 6' path of egress

QUANTUM LED SERIES – MULTIPLE COVERAGE
3W Total White LEDs
Using multiple units at a typical 7.5' mounting height delivers 25' center-to-center spacing on a 3' path of egress and 20' center-to-center spacing on a 6' path of egress.



Example of multiple LHQM LED exits illuminating a 3' path of egress



Example of multiple LHQM LED exits illuminating a 6' path of egress

EXTENDED RUN-TIME FOR HIGH-OUTPUT EXITS

Product	Run time
LHQM LED HO (no remotes)	3.8 hours
LHQM LED HO RO (no remotes)	7.5 hours

EMERGENCY: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com techsupport-emergency@acuitybrands.com © 2012-2019 Acuity Brands Lighting, Inc. All rights reserved. Rev. 07/31/19

Specification Sheet: G2 Line-Voltage LED Battery Backup Kit

The LED Battery-Backup Solution

When your power goes out, Revolution Lighting's G2 Line-Voltage LED Battery Backup Kit is the ideal accessory to have. The kit is UL-listed as field-installable, rated for damp locations, and complies with UL-924 emergency-lighting standards. Designed with single-end-power LED tube lights in mind, the battery backup also can power any 120VAC line-voltage LED lighting system up to 25W at full power for 90 minutes or more during an outage. * And when the power is on, the battery draws only 8W max from any 120-277VAC supply circuit while charging. **

This lithium-ion-powered battery backup is surface-mounted, completely enclosed, and includes mounting hardware, 18 in. of ½-in. flexible conduit, wire nuts, and a manual test switch.

* Caution: Do not power any lighting system over 25W or the battery could overheat and be damaged. Not for use with higher-wattage LED high bays, wall packs, etc.

** Note: Not for use with fixtures controlled by Triac dimmers.

GENERAL SPECIFICATIONS

- 120-277VAC input charging voltage
- 170VDC output voltage (compatible with 120VAC LED driver inputs
- 25W power output
- At least 90 minutes of backup time at rated wattages
- 8W max power draw when charging

PRODUCT BENEFITS

- UL Listed for field installation
- Universal line input voltage (120-277VAC)
- Perfect battery backup for UL Type-B line-voltage LEDs up to 25W max
- Provides full-power backup up to 25W for 90 minutes or more
- Works with any Revolution Lighting product requiring 120VAC line voltage (25W max)
- Long-life Li-ion battery in surface-mounted housing with flexible metal conduit
- Damp-location-rated

WARRANTY

5 YEAR WARRANTY

Our Industry-Leading 5-Year Limited Warranty Guarantees Unsurpassed Quality
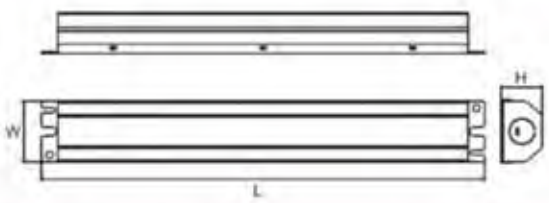
TECHNICAL DATA (Subject to change.)

SKU No.	Input Voltage (VAC)	Output Wattage (W)	Output Voltage (VDC)	Battery Backup Time	Recharge Time (hr)	Charging Wattage (W)	Mounting	Included Hardware	Operating Temp. (°F)
EM-H25170-XX	120-277	25W Max*	170 (120VAC compatible)	≥ 90 min	36	≤ 8	Surface	Test Switch, Mounting Hardware, Wire Nuts, Flexible Conduit	32-122

** Caution: Do not power any lighting system over 25W or the battery could overheat and be damaged.*

PHYSICAL DATA

SKU No.	L = Length (in.)	W = Width (in.)	H = Height (in.)	Weight (lb.)
EM-H25170-XX	17.2	2.2	1.6	3.7



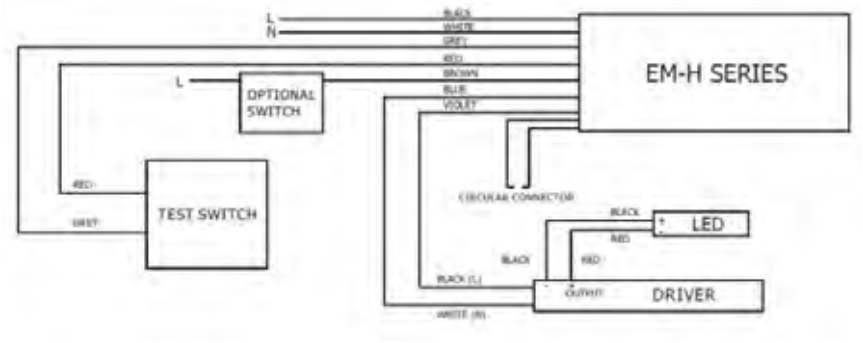


Revolution Lighting Technologies, Inc.
177 Broad Street · 12th Floor · Stamford, CT 06901
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For more information, visit rvltl.com or call 877-578-2538.

Specification Sheet: G2 Line-Voltage LED Battery Backup Kit

WIRING DIAGRAM



WIRING NOTES:

(1.) Do not mate connector until physical installation is complete.

(2.) Do not apply AC power until connector is mated.

(3.) Test accessory leads, observe proper wiring polarity.

(4.) Wall switch controls on and off of the AC driver when the supplied voltage is normal.

(5.) Caution: Do not install this backup kit on any fixture that draws more than 25W.

(6.) Not for use with Triac-dimmed fixtures.

SUGGESTED PRODUCT COMBINATION EXAMPLES (Not Exhaustive)

PRODUCT LINE	SKU	WATTS	Quantity Powered*
 Any Type-B Tube Lamp	Various	8-18	1-3
 G2 Utility Lamp	131232-20X	19	1
 2′ x 2″ Troffer Retrofit Kit	159211-11X	22	1
2′ x 2′ ABS Troffer	152030-11X	22	1

** Note: Quantity assumes a total electrical load of 25W or less.*

AVAILABLE ACCESSORIES



T-Grid Hanger (SKU: TG2)



Example: T-Grid installation of Battery Backup Kit

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Specifications subject to change without notice.

For more information, visit **rvlti.com** or call **877-578-2536.**

Project:

Location:

Product Type:

Contact/Phone:

Model #:

K4500

Shorting Cap, Locking-Type Mounting

The K4500 Shorting Cap features 3-prong locking-type plug connector. It is used with luminaries with a photocontrol receptacle to complete circuit when a photocontrol is not required.

Features

- Designed to meet environmental protection requirements in ANSI C136.10.
- Complete circuit to provide direct connection to luminarie when no photocontrol is connected.



K4500

Ratings

Size:	3" (7.6 cm) High, 3" (7.6 cm) Diameter
Color:	Milky White with Black Imprints
Material:	UV Stabilized Polypropelyne Cap Black Polypropelyne Base Neoprene Blend Gasket Solid Brass Contacts
Electrical Rating:	15 A, 120-488 V
Environmental:	Meets ANSI C136-10 Environmental Requirements
Regulatory Listings:	UL/CSA Listed ANSI C136-10 Compliant
Warranty:	Limited 2-year Manufacturer's Warranty

K4500

Specification

The locking type, shorting plug shall install on a ANSI C136-10 NEMA style 3-pin receptacle to connect load pins to bypass local photocell control. Shorting plug shall have a rating of 15A at 105-488 VAC. The shorting plug shall be constructed with UV stabilized polypropelyne cap, black polypropelyne base and neoprene blended gasket. The shorting plug shall be agency certified and tested accordingly. The shorting plug shall meet all environmental and electrical requirements of ANSI C136.10. The shorting plug shall have a manufactures limited warranty of 2 years minimum. The shorting plug shall be Intermatic model K4500.



Locking-Type Mounting, Thermal Type — K4500 Series

Easy to install; just plug in and twist. This series is equipped with standard 3-prong NEMA locking-type plug connections. Incorporates K4000 style thermal switch for reliable long life performance. Complies with ANSI C136.10.

Size – 3-3/4" (9.5 cm) High, 3" (7.6 cm) Diameter.

Model #	Watts Tungsten	VA Ballast	Amps Tungsten	Amps Ballast	Volts
K4521	1800	1000	15	8.3	120
K4524**	3100	1700	15	8.3	208
K4522	3600	2000	15	8.3	240
K4533**	4100	2300	15	8.3	277
K4535**	7200	4000	15	8.3	480

** Ballast rating meets UL testing at 50% power factor.*
*** Not CSA certified.*

UL773 E59121 | C22.2-177 LR38068 | 3/4 lbs .34 kg | 5 Year Warranty



K4521

Accessories for Locking-Type Controls

Pole Bracket Adapter – Model K122 - 105 to 480 Volts; for use with K1200, K4500 or LC4500 Series locking-type controls. K121 – receptacle only, K121-30 receptacle with 30 inch leads.
Shorting Cap – Model K4500 - 105 to 480 Volts; replaces locking-type photo control to complete circuit.



K122



K4500



K121
K121-30

Low Cost Locking-Type, Thermal Type — LC4500 Series

The LC4500 Series provides low cost reliable control for street lighting and other applications requiring a NEMA twist and lock type plug connection. An integral housing and lens, with UV protection, keeps moisture out and ensures long life. Complies with ANSI C136.10.

Activation – .5 FC minimum "ON"; 15 FC maximum "OFF".
Size – 2-3/4" (7.0 cm) High, 3" (7.6 cm.) Diameter.
Color – Translucent with color coded band for voltage identification.

Model #	Watts Tungsten	VA Ballast	Volts
LC4521C	1000	1000	120
LC4523	1700-2300	1700-2300	208-277
LC4527	5205	2880	347
LC4535**	7200	4000	480
LC4536C	1000-2300	1000-2300	120 or 208-277
LC4521LA	1000	1000	120
LC4523LA	1700-2300	1700-2300	208-277
LC4535LA**	7200	4000	480
LC4536LAC	1000-2300	1000-2300	120 or 208-277

LA Models equipped with 2400 volt open type spark gap arrester.
** Ballast rating meets UL testing at 50% power factor.*
*** Not CSA certified.*

UL773 E59121 | C22.2-55 LR38068 | .2 lbs .09 kg | 3 Year Warranty



LC4521C

armacell®

Tolerances for AP Armaflex® Black Lap Seal*

Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
3/8" Walls												
IPBST05838	1/2" Copper	0.625	0.710	0.750	0.790	0.300	0.363	0.425	1.310	1.475	1.640	2.6
IPBST03438	5/8" Copper	0.750	0.810	0.860	0.910	0.300	0.363	0.425	1.410	1.585	1.760	2.4
IPBST07838	3/4" Copper	0.875	0.940	0.995	1.050	0.300	0.363	0.425	1.540	1.720	1.900	2.4
IPBST11838	1" Copper	1.125	1.200	1.255	1.310	0.300	0.363	0.425	1.800	1.980	2.160	2.3
IPBST13838	1-1/4" Copper	1.375	1.450	1.510	1.570	0.300	0.363	0.425	2.050	2.235	2.420	2.2
IPBST15838	1-1/2" Copper	1.625	1.710	1.770	1.830	0.350	0.413	0.475	2.410	2.595	2.780	2.5
IPBST11038	1 1/2" IPS	1.900	1.970	2.030	2.090	0.350	0.413	0.475	2.670	2.855	3.040	2.4
IPBST21838	2" Copper	2.125	2.220	2.280	2.340	0.350	0.413	0.475	2.920	3.105	3.290	2.4
1/2" Walls												
IPBST03812	1/4" Copper	0.375	0.420	0.460	0.500	0.360	0.423	0.485	1.140	1.305	1.470	3.3
IPBST01212	3/8" Copper	0.500	0.560	0.600	0.640	0.380	0.443	0.505	1.320	1.485	1.650	3.3
IPBST05812	1/2" Copper	0.625	0.710	0.750	0.790	0.400	0.463	0.525	1.510	1.675	1.840	3.4
IPBST03412	5/8" Copper	0.750	0.810	0.860	0.910	0.420	0.483	0.545	1.650	1.825	2.000	3.3
IPBST07812	3/4" Copper	0.875	0.940	0.995	1.050	0.430	0.493	0.555	1.800	1.980	2.160	3.3
IPBST11812	1" Copper	1.125	1.200	1.255	1.310	0.450	0.513	0.575	2.100	2.280	2.460	3.3
IPBST13812	1-1/4" Copper	1.375	1.450	1.510	1.570	0.460	0.523	0.585	2.370	2.555	2.740	3.2
IPBST15812	1-1/2" Copper	1.625	1.710	1.770	1.830	0.470	0.533	0.595	2.650	2.835	3.020	3.2
IPBST11012	1 1/2" IPS	1.900	1.970	2.030	2.090	0.480	0.543	0.605	2.930	3.115	3.300	3.1
IPBST21812	2" Copper	2.125	2.220	2.280	2.340	0.490	0.553	0.615	3.200	3.385	3.570	3.2
IPBST20012	2" IPS	2.375	2.470	2.540	2.610	0.500	0.563	0.625	3.470	3.665	3.860	3.2
IPBST25812	2-1/2" Copper	2.625	2.720	2.800	2.880	0.500	0.563	0.625	3.720	3.925	4.130	3.2
IPBST21012	2-1/2" IPS	2.875	2.980	3.060	3.140	0.500	0.563	0.625	3.980	4.185	4.390	3.2
IPBST31812	3" Copper	3.125	3.230	3.310	3.390	0.500	0.563	0.625	4.230	4.435	4.640	3.2
IPBST30012	3" IPS	3.500	3.610	3.685	3.760	0.500	0.563	0.625	4.610	4.810	5.010	3.1
IPBST35812	3-1/2" Copper	3.625	3.740	3.810	3.880	0.500	0.563	0.625	4.740	4.935	5.130	3.1
IPBST41812	4" Copper	4.125	4.250	4.335	4.420	0.500	0.563	0.625	5.250	5.460	5.670	3.1
IPBST40012	4" IPS	4.500	4.600	4.690	4.780	0.500	0.563	0.625	5.600	5.815	6.030	3.0
3/4" Walls												
IPBST03834	1/4" Copper	0.375	0.420	0.460	0.500	0.620	0.683	0.745	1.660	1.825	1.990	5.9
IPBST01234	3/8" Copper	0.500	0.560	0.600	0.640	0.620	0.683	0.745	1.800	1.965	2.130	5.5
IPBST05834	1/2" Copper	0.625	0.710	0.750	0.790	0.660	0.723	0.785	2.030	2.195	2.360	5.6
IPBST03434	5/8" Copper	0.750	0.810	0.860	0.910	0.680	0.743	0.805	2.170	2.345	2.520	5.5
IPBST07834	3/4" Copper	0.875	0.940	0.995	1.050	0.700	0.763	0.825	2.340	2.520	2.700	5.4
IPBST11834	1" Copper	1.125	1.200	1.255	1.310	0.740	0.803	0.865	2.680	2.860	3.040	5.4
IPBST13834	1-1/4" Copper	1.375	1.450	1.510	1.570	0.750	0.813	0.875	2.950	3.135	3.320	5.3
IPBST15834	1-1/2" Copper	1.625	1.710	1.770	1.830	0.750	0.813	0.875	3.210	3.395	3.580	5.1
IPBST11034	1 1/2" IPS	1.900	1.970	2.030	2.090	0.750	0.813	0.875	3.470	3.655	3.840	4.9
IPBST21834	2" Copper	2.125	2.220	2.280	2.340	0.750	0.813	0.875	3.720	3.905	4.090	4.8
IPBST20034	2" IPS	2.375	2.580	2.680	2.780	0.750	0.813	0.875	4.080	4.305	4.530	5.2
IPBST25834	2-1/2" Copper	2.625	2.720	2.800	2.880	0.750	0.813	0.875	4.220	4.425	4.630	4.7
IPBST21034	2-1/2" IPS	2.875	3.080	3.180	3.280	0.750	0.813	0.875	4.580	4.805	5.030	5.0
IPBST31834	3" Copper	3.125	3.230	3.310	3.390	0.750	0.813	0.875	4.730	4.935	5.140	4.6
IPBST30034	3" IPS	3.500	3.700	3.800	3.900	0.750	0.813	0.875	5.200	5.425	5.650	4.9
IPBST35834	3-1/2" Copper	3.625	3.740	3.810	3.880	0.750	0.813	0.875	5.240	5.435	5.630	4.5
IPBST41834	4" Copper	4.125	4.250	4.335	4.420	0.750	0.813	0.875	5.750	5.960	6.170	4.5
IPBST40034	4" IPS	4.500	4.750	4.850	4.950	0.750	0.813	0.875	6.250	6.475	6.700	4.8

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

1" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03810	1/4" Copper	0.375	0.420	0.460	0.500	0.750	0.813	0.875	1.920	2.085	2.250	7.3
IPBST01210	3/8" Copper	0.500	0.560	0.600	0.640	0.790	0.853	0.915	2.140	2.305	2.470	7.2
IPBST05810	1/2" Copper	0.625	0.710	0.750	0.790	0.830	0.893	0.955	2.370	2.535	2.700	7.2
IPBST03410	5/8" Copper	0.750	0.810	0.860	0.910	0.850	0.913	0.975	2.510	2.685	2.860	7.0
IPBST07810	3/4" Copper	0.875	0.940	0.995	1.050	0.880	0.943	1.005	2.700	2.880	3.060	7.0
IPBST11810	1" Copper	1.125	1.200	1.255	1.310	0.920	1.013	1.105	3.040	3.280	3.520	7.2
IPBST13810	1-1/4" Copper	1.375	1.450	1.510	1.570	0.970	1.063	1.155	3.390	3.635	3.880	7.2
IPBST15810	1-1/2" Copper	1.625	1.710	1.770	1.830	1.000	1.093	1.185	3.710	3.955	4.200	7.2
IPBST11010	1 1/2" IPS	1.900	1.970	2.030	2.090	1.000	1.093	1.185	3.970	4.215	4.460	6.9
IPBST21810	2" Copper	2.125	2.220	2.280	2.340	1.000	1.093	1.185	4.220	4.465	4.710	6.8
IPBST20010	2" IPS	2.375	2.580	2.680	2.780	1.000	1.093	1.185	4.580	4.865	5.150	7.1
IPBST25810	2-1/2" Copper	2.625	2.720	2.800	2.880	1.000	1.093	1.185	4.720	4.985	5.250	6.5
IPBST21010	2-1/2" IPS	2.875	3.080	3.180	3.280	1.000	1.093	1.185	5.080	5.365	5.650	6.8
IPBST31810	3" Copper	3.125	3.230	3.310	3.390	1.000	1.093	1.185	5.230	5.495	5.760	6.3
IPBST30010	3" IPS	3.500	3.700	3.800	3.900	1.000	1.093	1.185	5.700	5.985	6.270	6.6
IPBST35810	3-1/2" Copper	3.625	3.740	3.810	3.880	1.000	1.093	1.185	5.740	5.995	6.250	6.2
IPBST41810	4" Copper	4.125	4.250	4.335	4.420	1.000	1.093	1.185	6.250	6.520	6.790	6.1
IPBST40010	4" IPS	4.500	4.750	4.850	4.950	1.000	1.093	1.185	6.750	7.035	7.320	6.4
IPBST50010	5" IPS	5.563	5.810	5.910	6.010	1.000	1.093	1.185	7.810	8.095	8.380	6.2
IPBST60010	6" IPS	6.625	6.880	6.980	7.080	1.000	1.093	1.185	8.880	9.165	9.450	6.1
1-1/2" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03815	1/4" Copper	0.375	0.420	0.460	0.500	1.408	1.500	1.592	3.236	3.460	3.684	13.7
IPBST01215	3/8" Copper	0.500	0.560	0.600	0.640	1.408	1.500	1.592	3.376	3.600	3.824	12.7
IPBST05815	1/2" Copper	0.625	0.710	0.750	0.790	1.408	1.500	1.592	3.526	3.750	3.974	12.0
IPBST03415	5/8" Copper	0.750	0.810	0.860	0.910	1.408	1.500	1.592	3.626	3.860	4.094	11.3
IPBST07815	3/4" Copper	0.875	0.940	0.995	1.050	1.408	1.500	1.592	3.756	3.995	4.234	10.8
IPBST11815	1" Copper	1.125	1.200	1.255	1.310	1.408	1.500	1.592	4.016	4.255	4.494	10.1
IPBST13815	1-1/4" Copper	1.375	1.450	1.510	1.570	1.408	1.500	1.592	4.266	4.510	4.754	9.6
IPBST15815	1-1/2" Copper	1.625	1.710	1.770	1.830	1.408	1.500	1.592	4.526	4.770	5.014	9.2
IPBST11015	1 1/2" IPS	1.900	1.970	2.030	2.090	1.408	1.500	1.592	4.786	5.030	5.274	8.7
IPBST21815	2" Copper	2.125	2.220	2.280	2.340	1.408	1.500	1.592	5.036	5.280	5.524	8.6
IPBST20015	2" IPS	2.375	2.580	2.680	2.780	1.408	1.500	1.592	5.396	5.680	5.964	8.8
IPBST25815	2-1/2" Copper	2.625	2.720	2.800	2.880	1.408	1.500	1.592	5.536	5.800	6.064	8.2
IPBST21015	2-1/2" IPS	2.875	3.080	3.180	3.280	1.408	1.500	1.592	5.896	6.180	6.464	8.4
IPBST31815	3" Copper	3.125	3.230	3.310	3.390	1.408	1.500	1.592	6.046	6.310	6.574	7.9
IPBST30015	3" IPS	3.500	3.700	3.800	3.900	1.408	1.500	1.592	6.516	6.800	7.084	8.1
IPBST35815	3-1/2" Copper	3.625	3.740	3.810	3.880	1.408	1.500	1.592	6.556	6.810	7.064	7.7
IPBST41815	4" Copper	4.125	4.250	4.335	4.420	1.408	1.500	1.592	7.066	7.335	7.604	7.5
IPBST40015	4" IPS	4.500	4.750	4.850	4.950	1.408	1.500	1.592	7.566	7.850	8.134	7.8
IPBST50015	5" IPS	5.563	5.810	5.910	6.010	1.408	1.500	1.592	8.626	8.910	9.194	7.5
IPBST60015	6" IPS	6.625	6.880	6.980	7.080	1.408	1.500	1.592	9.696	9.980	10.264	7.3
2" Walls												
Item	Nom Pipe Size	Pipe OD	Insulation ID			Insulation Wall			Calculated OD			R Value
			Min	Targ	Max	Min	Targ	Max	Min	Targ	Max	
IPBST03820	1/4" Copper	0.375	0.420	0.460	0.500	1.900	2.000	2.100	4.220	4.460	4.700	19.7
IPBST01220	3/8" Copper	0.500	0.560	0.600	0.640	1.900	2.000	2.100	4.360	4.600	4.840	18.2
IPBST05820	1/2" Copper	0.625	0.710	0.750	0.790	1.900	2.000	2.100	4.510	4.750	4.990	17.2
IPBST03420	5/8" Copper	0.750	0.810	0.860	0.910	1.900	2.000	2.100	4.610	4.860	5.110	16.2
IPBST07820	3/4" Copper	0.875	0.940	0.995	1.050	1.900	2.000	2.100	4.740	4.995	5.250	15.5
IPBST11820	1" Copper	1.125	1.200	1.255	1.310	1.900	2.000	2.100	5.000	5.255	5.510	14.5

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

IPBST13820	1-1/4" Copper	1.375	1.450	1.510	1.570	1.900	2.000	2.100	5.250	5.510	5.770	13.7
IPBST15820	1-1/2" Copper	1.625	1.710	1.770	1.830	1.900	2.000	2.100	5.510	5.770	6.030	13.1
IPBST11020	1 1/2" IPS	1.900	1.970	2.030	2.090	1.900	2.000	2.100	5.770	6.030	6.290	12.4
IPBST21820	2" Copper	2.125	2.220	2.280	2.340	1.900	2.000	2.100	6.020	6.280	6.540	12.2
IPBST20020	2" IPS	2.375	2.580	2.680	2.780	1.900	2.000	2.100	6.380	6.680	6.980	12.3
IPBST25820	2-1/2" Copper	2.625	2.720	2.800	2.880	1.900	2.000	2.100	6.520	6.800	7.080	11.6
IPBST21020	2-1/2" IPS	2.875	3.080	3.180	3.280	1.900	2.000	2.100	6.880	7.180	7.480	11.7
IPBST31820	3" Copper	3.125	3.230	3.310	3.390	1.900	2.000	2.100	7.030	7.310	7.590	11.1
IPBST30020	3" IPS	3.500	3.700	3.800	3.900	1.900	2.000	2.100	7.500	7.800	8.100	11.2
IPBST35820	3-1/2" Copper	3.625	3.740	3.810	3.880	1.900	2.000	2.100	7.540	7.810	8.080	10.7
IPBST41820	4" Copper	4.125	4.250	4.335	4.420	1.900	2.000	2.100	8.050	8.335	8.620	10.5
IPBST40020	4" IPS	4.500	4.750	4.850	4.950	1.900	2.000	2.100	8.550	8.850	9.150	10.7
IPBST50020	5" IPS	5.563	5.810	5.910	6.010	1.900	2.000	2.100	9.610	9.910	10.210	10.2
IPBST60020	6" IPS	6.625	6.880	6.980	7.080	1.900	2.000	2.100	10.680	10.980	11.280	9.9

*These specifications are based on the measurement methods employed by Armacell. Other methods may not result in the same values and cannot be used to determine if the product is within the given tolerance.

Updated2/17/2017

Montclair Public Schools

Mechanical Insulation

Submittal

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Mechanical Insulation-Submittal

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Table A: Minimum Suggested Insulation Requirements

PIPING INSULATION

PIPING	TYPE	PIPE SIZE	TYPE "A" INSULATION THICKNESS	TYPE "B" INSULATION THICKNESS
Interior Domestic Hot Water Supply & Return	A	½" – 1 ¼"	1"	
Interior Domestic Hot Water Supply & Return	A	1 ½" – 10"	1 ½ "	
Interior Heating Hot Water Exposed & Concealed	A	½" – 1 ¼"	1 ½ "	
Interior Heating Hot Water Exposed & Concealed	A	1 ½" – 10"	2"	
Interior Steam Piping Exposed and Concealed	A	½" – 1 ¼"	2 ½"	
Interior Steam Piping Exposed & Concealed	A	1 ½" – 10"	3"	
Interior Steam Condensate/Boiler Feed Exposed & Concealed	A	½" – 1 ¼"	1 ½ "	
Interior Steam Condensate/Boiler Feed Exposed & Concealed	A	1 ½" – 10"	2"	
Chilled Water Piping Exposed & Concealed	A	All	1 ½ "	
Removable blankets on Steam Traps	B	All		See Spec

Insulation Type:

A. Type A: Knauf 1000° Pipe Insulation, ASTM C547, Class 1, k value of 0.23 at 75 degrees F, with All Service Jacketing (ASJ) or equal.

Fittings:

All fittings with Type A Pipe Insulation will be Proto Fitting Covers manufactured from 20-mil thick high-impact, ultra-violet-resistant PVC, or equal.

Jacket:

All type A Pipe insulation includes a Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame retardant kraft paper and aluminum foil – white exterior, Kraft reinforce foil vapor barrier with self-sealing adhesive joints.

Accessories:

All Type A Pipe Insulation terminations will be neatly finished with Childers Vi-Cryl CP-11 Mastic, or equal.

B. Type B: Removable insulation jackets

Insulation:

- High-temperature needled insulation blanket with no binder
- Insulation Moisture Sorption < 3% by weight per ASTM C1104.
- Maximum Use Temperature 1100°F (593°C) per ASTM C411
- Needled Fiber Glass mat, 1" @ 5.0 LB/CF.
- K value .21 @ 75F mean, .42 @ 500F mean.
- Compliance:
  1) ASTM C665 – corrosion resistance
  2) ASTM C553 Type V
  3) ASTM C795
  4) NRC 1.36

Construction:

1. Double sewn lock stitch with a minimum 4 to 6 stitches per inch. Jackets shall be sewn with two (2) parallel rows of stitching using Teflon Coated Fiberglass Thread. The thread must be able to withstand the skin temperatures without degradation.

2. No raw cut jacket edges shall be exposed.

3. Jackets shall be fastened using hook and loop (Velcro) straps and 1” Slide Buckles.

4. All stitching will be done with Teflon Coated Fiberglass Thread.

5. Provide a permanently attached Aluminum or stainless-steel nameplate on each jacket to identify its location, size and tag number.

6. The insulation shall be designed to minimize the convection current in the space between the hot metal surface and the inner layer of insulation. To this end, during jacket fabrication, the layers of insulating mat shall be placed in an overlapping pattern.

7. All jacket pieces which match mating seams must include an extended 2" flap constructed from the exterior fabric and shall be secured using hook & loop closure (i.e. Velcro ^{TM}) parallel to the seam.

8. Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and will not be used.

EQUIPMENT INSULATION

Equipment	Insulation Type	Insulation Thickness
Interior Exposed Above Ambient Temperature Heat Exchangers, Equipment, Tanks, Condensate Receivers	Fiberglass/ w ASJ Jacketing	2”

Insulation Type:

A. Type A: Knauf Fiberglass, Kwikflex Pipe & Tank Insulation, ASTM C 1393, Types I, II, IIIA, IIIB Category 2, ASTM, flame spread rating is <25 and smoke developed rating is <50 as tested by ASTM E84, k value of 0.24 at 75 degrees F, with All Service Jacketing, or equal.

1000° Pipe Insulation

Submittal Date _____

Description

Knauf 1000° Pipe Insulation is a molded, heavy-density, one-piece insulation made from inorganic glass fibers bonded with a thermosetting resin. It is produced in 3' lengths with or without a factory-applied jacket. The jacket is a white-kraft paper bonded to aluminum foil and reinforced with glass fibers, and the longitudinal lap of the jacket is available with or without a self-sealing adhesive. A butt strip is furnished for each section.

Application

Knauf 1000° Pipe Insulation is used in power, process and industrial applications and in commercial and institutional buildings where maximum fire safety, resistance to physical abuse and a finished appearance are desired. Additional weather protection is needed outdoors.

Features & Benefits

Energy Conservation

- Offers excellent resistance to heat loss or gain, which saves energy and lowers operating costs.
- A low thermal conductivity of .23 at 75°F (24°C).

Low-Cost Installation

- Available with a self-sealing lap, which eliminates need for staples, additional material and tools.
- Fast, easy installation reduces labor costs.

Condensation Control

- Installed properly, the foil vapor retarder and pressure-sensitive lap assure a positive vapor seal.

UL Classified

- All Knauf 1000° Pipe Insulation, plain or jacketed, meets the fire and smoke safety requirements of most federal, state and local building codes.

Easy Size Identification

- Pipe size, wall thickness and Proto 25/50 Rated PVC fitting cover size are printed in a repeat pattern along the longitudinal lap.
- Easy identification at job site.
- Simplifies restocking.
- After application, print is covered by the lap for a neat appearance.

Specification Compliance

In U.S.:

- ASTM C 547; Type I
- ASTM C 585
- ASTM C 795
- ASTM C 1136 (jackets); Type I, II, III, IV
- HH-B-100B (jackets); Type I and II
- HH-I-558C; Form D, Type III, Class 12; Class 13 (to 1000°F, 538°C)
- GREENGUARD Certification
- GREENGUARD For Children & Schools™ Certification
- MEA 325-83-M (City of New York Dept. of Buildings)
- MIL-I-22344D
- MIL-I-24244C (ships)
- NFPA 90A and 90B
- NRC Reg. Guide 1.36
- USCG 164.109/4/0 (plain, unjacketed only)

In Canada:

- CAN/ULC S102-M88
- CCG F1-304 (plain only)
- CGSB 51-GP-9M
- CGSB 51-GP-52M (jacket)

Technical Data

Surface Burning Characteristics

- UL Classified.
- Does not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84, CAN/ULC S102-M88, NFPA 255 and UL 723.

Temperature Range

- Pipe operating temperatures from 0°F to 1000°F (-18°C to 538°C).

Water Vapor Transmission (ASTM E 96, Procedure A)

- Jacket has a water vapor permeance of .02 perms or less.

Corrosiveness (ASTM C 665)

- No greater than sterile cotton.

Stress Corrosion

- Complies with ASTM C 795, MIL-I-24244C and NRC 1.36.

Puncture Resistance (TAPPI Test T803) (Beach Units)

- Jacket minimum rating of 50 units.

Alkalinity (ASTM C 871)

- Less than 0.6% as Na_2O.
- pH between 7.5 and 10.0.

Microbial Growth (ASTM C 1338)

- Does not promote microbial growth.

Water Vapor Sorption (ASTM C 1104)

- Less than 0.2% by volume.

Linear Shrinkage (ASTM C 356)

- Negligible.

Product Forms and Sizes

Produced in 3' (914 mm) sections:

- For iron pipe from ½" to 24" nominal pipe size (15 mm to 610 mm).
- For copper tube from ⅝" to 6⅛" (16 mm to 156 mm).
- Wall thicknesses from ½" to 6" (13 mm to 152 mm) in single layer (for most sizes).
- All insulation inner and outer diameters comply with ASTM C 585.

Packaging

- Four convenient carton sizes for easy ordering, inventory tracking and storage.
- Reinforced carton handles for strength and easy lifting.
- Bar-coded cartons for accurate shipments and tracking.
- Full product range stocked at distributors for fast availability.

Precautions

Hot Pipe

- May be installed while the system is in operation, at all temperatures up to 1000°F (538°C).
- Knauf recommends, for insulation thickness greater than 6" (152 mm), the temperature must be increased from 500°F (260°C) to maximum temperature at a rate not exceeding 100°F (56°C) per hour.
- During initial heat-up to operating temperatures above 350°F (177°C), a slight odor and some smoke may be given off as a portion of the bonding material used in the insulation begins to undergo a controlled decomposition.
- If natural convection is not adequate in confined areas, forced ventilation should be provided in order to protect against any harmful fumes and vapors that might be generated.
- Care must also be taken when using sealants, solvents or flammable adhesive during installation.
- A maximum of 6" (152 mm) wall thickness is recommended.

Cold Pipe

- Use a continuous vapor retarder on piping operating below ambient temperatures.
- Seal all joints, surfaces, seams and fittings to prevent condensation.
- On below freezing applications and, in high abuse areas, the ASJ jacket shall be protected with a PVC vapor retarding outer jacket. In addition, exposed ends of insulation shall be sealed with vapor barrier mastic installed per the mastic manufacturer's instructions. Vapor seals at the butt joint shall be applied at every fourth pipe section joint and at each fitting to isolate any water incursion.
- On chilled water systems operating in high humidity conditions, it is recommended that the same guide lines be followed as listed above for below freezing applications.
- Exterior hanger supports are r ecommended.

Outside Application

- Do not expose pipe insulation to weather. It must be covered with appropriate jacketing, mastic or vapor retardant adhesives.
- All exposed surfaces must be protected. Proto® Indoor/Outdoor PVC Jacketing is recommended. See Knauf Guide Specifications for recommended PVC jacketing application guidelines.
- Apply jacketing, mastics or vapor retardant adhesives per manufacturer's instructions. For metallic jackets, factory-applied condensate barriers are recommended.

ASJ-SSL

- Keep adhesive and contact surfaces free from dirt and water, and seal immediately once adhesive is exposed.
- Apply when ambient and insulation temperatures are between 0°F and 130°F (-18°C and 54°C).
- If stored below 0°F or above 130°F, allow insulation cartons to stand within recommended temperature range for 24 hours prior to application.
- Do not store product below -20°F (-29°C) or above 150°F (66°C).
- When using Knauf's SSL closure system, make sure the longitudinal and circumferential joints are properly sealed by rubbing the closure firmly with a squeegee. Use of staples is not recommended.
- When using Knauf SSL Pipe Insulation, the surface temperature of the insulation should be between -20°F and 150°F (-29°C and 66°C) during the life of the insulation.

Fittings and Hangers

- Use Proto 25/50 Rated (ASTM E 84) PVC Fitting Covers, applying PVC fittings per Proto's Data Sheet.
- Fittings should be insulated to same thickness as the adjoining insulation.
- Apply fittings per manufacturer's instructions.
- When required by specification, a hard insert of sufficient length should be used to avoid compression of the insulation.

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1000° Pipe Insulation

Submittal Date _____

Additional Precautions

- Fiber glass may cause temporary skin irritation. Wear long-sleeved, loose-fitting clothing, head covering, gloves and eye protection when handling and applying material.
- Wash with soap and warm water after handling.
- Wash work clothes separately and rinse washer.
- Use a disposable mask/respirator designed for nuisance-type dusts where sensitivity to dust and airborne particles may cause irritation to the nose or throat.

Application Guidelines

Storage

- Protect insulation from water damage or other abuse, welding sparks and open flame.
- Cartons are not designed for outside storage.

Preparation

- Apply only on clean, dry surfaces.
- Pipe or vessel should be tested and released before insulation is applied.

General Guidelines

- All sections should be firmly butted.
- Seal circumferential joint with a minimum 3" (76 mm) wide butt strip.
- Jackets, coating and adhesives should have a comparable F.H.C. rating.
- Factory-applied jacket can be painted with latex or water-based paint. Solvent-based paints should not be used.
- Do not expose factory-applied jacket to chemicals or liquid water.
- All piping should have continuous insulation.
- Position longitudinal lap downward to avoid dirt and moisture infiltration.
- Do not expose pipe insulation to excessive vibration or physical abuse.
- Faced insulation should not have a facing temperature above 150°F (66°C).

Recommended Thicknesses

ASHRAE 90.1-1989

The minimum thicknesses are based on ASHRAE 90.1-1989 standards and do not necessarily represent the Economic Thickness of Insulation or the thickness required for proper condensation control. Rather, they serve as minimum recommendations for commercial applications. For recommended Economic Thickness, install according to Knauf or NAIMA 3E Plus programs or as specified.

Fiber Glass and Mold

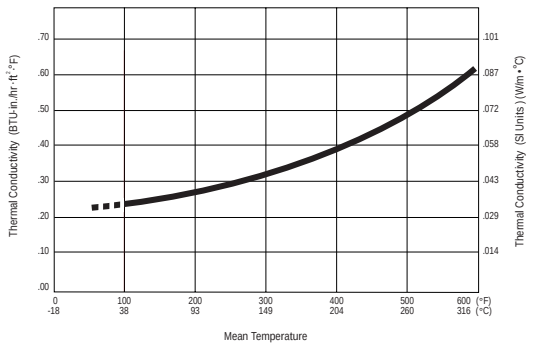
Fiber glass insulation will not sustain mold growth. However, mold can grow on almost any material when it becomes wet and contaminated with organic materials. Carefully inspect any insulation that has been exposed to water. If it shows any sign of mold it must be discarded. If the material is wet but shows no evidence of mold, it should be dried rapidly and thoroughly. If it shows signs of facing degradation from wetting, it should be replaced.

Notes

The chemical and physical properties of Knauf 1000° Pipe Insulation represent typical average values determined in accordance with accepted test methods. The data is subject to normal manufacturing variations. The data is supplied as a technical service and is subject to change without notice. References to numerical flame spread ratings are not intended to reflect hazards presented by these or any other materials under actual fire conditions.

Check with your Knauf sales representative to assure information is current.

Thermal Efficiency (ASTM C 335)



Mean Temperature	k	k (SI)
75°F (24°C)	.23	.033
100°F (38°C)	.24	.035
200°F (93°C)	.28	.040
300°F (149°C)	.34	.049
400°F (204°C)	.42	.061
500°F (260°C)	.51	.074
600°F (316°C)	.62	.089

KNAUF INSULATION
it's time to save energy



Knauf Data Sheet | PE-DS-15e 12-09

KwikFlex™ Pipe & Tank Insulation

with ECOSE® Technology

with ECOSE® TECHNOLOGY

- Knauf KwikFlex offers a unique combination of flexibility and compressive strength in a roll form.

- Tough and durable, yet easy to handle and fabricate.

- Can be used for any curved or irregular surfaces that require the finished characteristics of rigid fiber glass insulation.

- KwikFlex has excellent thermal properties, with temperature rating to 850°F (454°C).

- Wraps tightly around curved and spiral surfaces, making installation quick.



Facts at a glance

- Covers any curved or irregular surface
- No need to stock multiple sizes
- Excellent compressive strength
- Great flexibility provides easier installation
- Low thermal conductivity
- Easy to handle and fabricate

KwikFlex™ Pipe & Tank Insulation *with ECOSE® Technology*

Description

Knauf KwikFlex Pipe and Tank Insulation with ECOSE Technology is a 48" wide semi-rigid fiber glass blanket, 2.5 pcf density, in roll form. It is available plain or faced with a factory-applied ASJ, FSK or PSK vapor retarder jacket. The fiber orientation provides excellent compressive strength while maintaining flexibility for ease of installation.

ECOSE Technology

ECOSE Technology is a revolutionary new binder based on rapidly renewable bio-based materials rather than non-renewable petroleum-based chemicals such as phenol, formaldehyde or acrylics. ECOSE Technology reduces Knauf binder embodied energy and contains no phenol, formaldehyde, acrylics or artificial colors found in traditional fiber glass insulation.

Application

Knauf KwikFlex Pipe and Tank Insulation with ECOSE Technology is typically used on tanks, vessels and large-diameter (greater than 10") pipes. It can be used for any curved or irregular surfaces that require finished characteristics of rigid fiber glass insulation.

Features and Benefits

Excellent Thermal Properties

- Temperature rating to 850°F (454°C).

Low-Cost Installation

- Flexible.
- Easy to handle and fabricate.

Inventory Savings

- No need to stock multiple sizes.
- Various thicknesses available to meet all your pipe and tank insulation needs.

Resists Damage

- Tough and durable.
- Resists damage in shipment and during and after installation.

Resists Microbial Growth

- Does not promote the growth of fungi or bacteria.
- Will not rot.
- Will not sustain vermin.

Corrosiveness (ASTM C 665)

- Does not accelerate corrosion on steel, copper or aluminum.

Corrosion (ASTM C 1617)

- The corrosion rate in mils/yr will not exceed that of the 1 ppm chloride solution.

Specification Compliance

- UL/ULC Classified (FSK, ASJ)
- ASTM C 1393
  Types I, II, IIIA, IIIB Category 2

Technical Data

Temperature Range (ASTM C 411)

- Operating temperature to 850°F (454°C).

Compressive Strength (ASTM C 165)

- Not less than 25 PSF (1.2 kPa) at 10% deformation.

Water Vapor Transmission (ASTM E 96, Procedure A)

- FSK, ASJ and PSK vapor retarders have a maximum rate of .02 perms.

Puncture Resistance (TAPPI Test T803) (Beach Units)

- FSK and PSK facings: 25
- ASJ facing: 50

Surface Burning Characteristics

- UL/ULC Classified (FSK, ASJ)
- Does not exceed 25 Flame Spread, 50 Smoke Developed when tested according to ASTM E 84 and UL 723.

Linear Shrinkage (ASTM C 356)

- Negligible.

Application & Specification Guidelines

Precautions

- ASJ, FSK and PSK jackets should not be used if outer-surface temperature exceeds 150°F (66°C).
- During initial heat-up to operating temperatures above 350°F (177°C), a slight odor and some smoke may be given off as a portion of the bonding material used in the insulation begins to undergo a controlled decomposition.
- If natural convection is not adequate in confined areas, forced ventilation should be provided in order to protect against any harmful fumes and vapors that might be generated.
- Care must also be taken when using sealants, solvents or flammable adhesive during installation.

Storage

- Protect stored insulation from water damage or other abuse.
- Protect from welding sparks and open flame.
- Packages are not designed for outside storage.

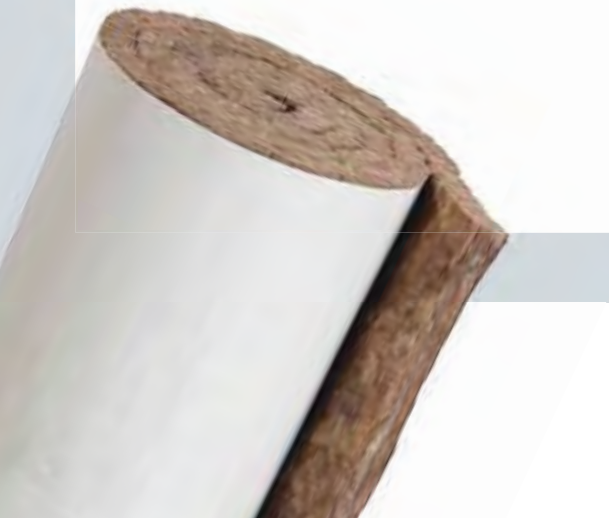
Preparation

- Apply Knauf KwikFlex Pipe and Tank Insulation on clean, dry surfaces.

Application

For easy installation of Knauf KwikFlex Pipe and Tank Insulation simply follow these guidelines.

- Refer to the Stretchout Chart to find the appropriate length to cut for the specific pipe size. Be sure to add an additional 2" (51 mm) to 4" (102 mm) for your staple flap.
- Cut your stretchout length and wrap the material around the iron pipe to ensure the proper fit.
- Staple the lap on 3" (76 mm) centers with outward clinching staples.
- Butt edges shall be firmly secured, and butt strips matching the jacket shall be applied at each joint.

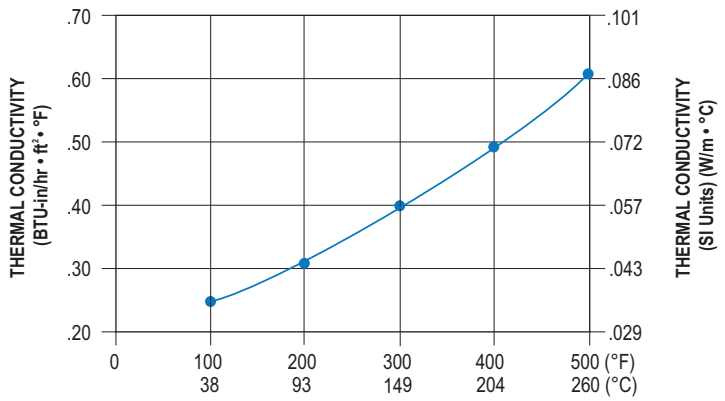


Stretch-Outs*

Nominal Iron Pipe Size		Iron Pipe Outside Diameter		Thickness							
				1" (25 mm)		1 1/2" (38 mm)		2" (51 mm)		3" (76 mm)	
10"	(254 mm)	10 3/4"	(273 mm)	40 1/8"	(1019 mm)	43 1/4"	(1099 mm)	46 3/8"	(1178 mm)	52 5/8"	(1337 mm)
12"	(305 mm)	12 3/4"	(324 mm)	46 3/8"	(1178 mm)	49 1/2"	(1257 mm)	52 3/4"	(1340 mm)	59"	(1499 mm)
14"	(356 mm)	14"	(356 mm)	50 3/8"	(1280 mm)	53 1/2"	(1359 mm)	56 5/8"	(1438 mm)	62 7/8"	(1597 mm)
16"	(406 mm)	16"	(406 mm)	56 5/8"	(1438 mm)	59 3/4"	(1518 mm)	62 7/8"	(1597 mm)	69 1/8"	(1756 mm)
18"	(457 mm)	18"	(457 mm)	62 7/8"	(1597 mm)	66"	(1676 mm)	69 1/4"	(1756 mm)	75 1/2"	(1918 mm)
20"	(508 mm)	20"	(508 mm)	69 1/8"	(1756 mm)	72 3/8"	(1838 mm)	75 1/2"	(1918 mm)	81 3/4"	(2076 mm)
22"	(559 mm)	22"	(559 mm)	75 1/2"	(1918 mm)	78 5/8"	(1997 mm)	81 3/4"	(2076 mm)	88"	(2235 mm)
24"	(610 mm)	24"	(610 mm)	81 3/4"	(2076 mm)	84 7/8"	(2156 mm)	88"	(2235 mm)	94 3/8"	(2397 mm)
26"	(660 mm)	26"	(660 mm)	88"	(2235 mm)	91 1/8"	(2315 mm)	94 3/8"	(2397 mm)	100 5/8"	(2556 mm)
28"	(711 mm)	28"	(711 mm)	94 3/8"	(2397 mm)	97 1/2"	(2477 mm)	100 5/8"	(2556 mm)	106 7/8"	(2715 mm)
30"	(762 mm)	30"	(762 mm)	100 5/8"	(2556 mm)	103 3/4"	(2635 mm)	106 7/8"	(2715 mm)	113 1/8"	(2873 mm)
32"	(813 mm)	32"	(813 mm)	106 7/8"	(2715 mm)	110"	(2794 mm)	113 1/8"	(2873 mm)	119 1/2"	(3035 mm)
34"	(864 mm)	34"	(864 mm)	113 1/8"	(2873 mm)	116 1/4"	(2953 mm)	119 1/2"	(3035 mm)	125 3/4"	(3194 mm)
36"	(914 mm)	36"	(914 mm)	119 1/2"	(3035 mm)	122 5/8"	(3115 mm)	125 3/4"	(3194 mm)	132"	(3353 mm)
38"	(965 mm)	38"	(965 mm)	125 3/4"	(3194 mm)	128 7/8"	(3273 mm)	132"	(3353 mm)	138 1/4"	(3512 mm)
40"	(1016 mm)	40"	(1016 mm)	132"	(3353 mm)	135 1/8"	(3432 mm)	138 1/4"	(3512 mm)	144 5/8"	(3673 mm)
42"	(1067 mm)	42"	(1067 mm)	138 1/4"	(3512 mm)	141 1/2"	(3594 mm)	144 5/8"	(3673 mm)	150 7/8"	(3832 mm)

* Additional 2" (51 mm) to 4" (102 mm) should be added for lap.

Thermal Efficiency (ASTM C 177)



Mean Temperature (Si)	k	k(Si)
75°F (24°C)	0.24	.035
100°F (38°C)	0.25	.036
200°F (93°C)	0.32	.046
300°F (149°C)	0.39	.056
400°F (204°C)	0.49	.070
500°F (260°C)	0.61	.088

Forms Available

Thickness	Width†	Length
1" (25 mm)	48" (1219 mm)	52' (15.85 m)
1½" (38 mm)		30' (9.14 m)
2" (51 mm)		26' (7.92 m)
2½" (64 mm)		21' (6.40 m)
3" (76 mm)		18' (5.48 m)

† Cut-to-length sizes also available.

Caution

Fiber glass may cause temporary skin irritation. Wear long-sleeved, loose-fitting clothing, head covering, gloves and eye protection when handling and applying material. Wash with soap and warm water after handling. Wash work clothes separately and rinse washer. A disposable mask designed for nuisance type dusts should be used where sensitivity to dust and airborne particles may cause irritation to the nose or throat.

Fiber Glass and Mold

Fiber glass insulation is not a food source for mold growth. However, mold can grow on almost any material when it becomes wet and contaminated. Carefully inspect any insulation that has been exposed to water. If it shows any sign of mold growth it must be discarded. If the material is wet but shows no evidence of mold, it should be dried rapidly and thoroughly. If it shows signs of facing degradation from wetting, it should be replaced.

Notes

The chemical and physical properties of Knauf KwikFlex Pipe and Tank Insulation with ECOSE Technology represent typical average values determined in accordance with accepted test methods. The data is subject to normal manufacturing variations. The data is supplied as a technical service and is subject to change without notice. References to numerical flame spread ratings are not intended to reflect hazards presented by these or any other materials under actual fire conditions.

Check with your Knauf Insulation sales representative to assure information is current.

KNAUF INSULATION
it's time to save energy



Knauf Insulation GmbH
One Knauf Drive
Shelbyville, IN 46176

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U.S. GREEN BUILDING COUNCIL MEMBER

LEED Eligible Product
Use of this product may help building projects meet green building standards as set by the Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

MR Credit 4.1 – 4.2
Recycled Content

MR Credit 5.1 – 5.2
Regional Materials

PROTO FITTING COVERS

25/50 RATED
PER ASTM E-84 — LoSMOKE® PVC

PROTO REGULAR PVC
LoSMOKE® PVC JACKETING

SUBMITTAL SHEET

Effective: 05/01/07

Submitted Date: _____

PROTO CORP.
10500 47th Street North
Clearwater, FL 33762-5017
Tel: (727) 573-4665
Fax: (727) 572-6823
Toll Free (800) 875-7768

PVC FITTING COVERS, PRE-MOLDED, INSULATED
WHITE GLOSS FINISH — INDOOR OUTDOOR GRADE

SUBMITTAL SHEET DOES NOT SUPERCEDE WRITTEN SPECIFICATIONS OR OWNER AGREEMENT.

DESCRIPTION

The Proto Fitting Cover System consists of one piece and two piece pre-molded high impact LoSMOKE® PVC fitting covers with fiberglass inserts and accessories, which include elbows, tee/valves, end caps, mechanical line couplings, specialty fittings, white and indoor color jacketing, Protop® Tank End Panels, tack fasteners, tapes and specialty items.

APPLICATIONS

The Proto Fitting Cover System is used to insulate mechanical piping systems at fitting locations and provide a PVC jacketing for straight run piping. Both give a quality appearance and have excellent durability.

FEATURES AND BENEFITS

25/50 Rated. All Proto PVC Fittings are made of LoSMOKE® grade PVC. Roll Jacketing is available in either 25/50 rated or regular PVC Grade (not 25/50 rated). The 25/50 products meet fire and smoke safety requirements of federal, state and local building codes.

Excellent Appearance. Bright high-gloss white coloring adds a distinct quality appearance to the system. The standard line of Proto Fitting Covers are made in LoSMOKE® PVC designed for indoor and outdoor use. Virtually all sizes pass 25/50 when made of LoSMOKE® PVC. Colored PVC is manufactured from a LoSMOKE® formula that is suitable for indoor use only.

Easy To Clean. Due to the smooth, high gloss finish on Proto PVC Fittings, the product cleans easily with soap and water. This makes the system ideal for food and drug facilities.

Low Cost Installation. Significant cost savings vs. conventional cement, molded sections, and mitered sections.

Fast and Easy. At fitting locations, wrap the fiberglass insert around the pipe fitting, apply the Proto PVC Fitting over the insert and tack or tape in place. Do not use tacks where a vapor retarder is applied.

Wide Temperature Range. May be used for mechanical piping systems operating from -20°F to +140°F surface temperature of insulation. Variety: LoSMOKE®, Indoor/Outdoor, Exod®, Exotuff®. Proto products are also available in LoSMOKE® Indoor colors. Exod® is CPVC, GOOD TO 225° F.

Long Lasting. Can be used more than once on retrofit projects, general maintenance.

Excellent Thermal Value. K value of .26 at 75°F (.037 W/m °C at 24°C) of fiberglass insert, mean temperature assures better thermal efficiency than conventional cement fittings.

Resistance To Fungi and Bacteria. (ASTM G 21, ASTM G 22) Does not promote growth of fungi or bacteria.

U.V. Resistant. Can be used on indoor or outdoor applications, for both (White) LoSMOKE® PVC and Regular PVC. Extra thick fitting covers should be used outdoors. (All Std. Proto Fitting covers are made of LoSMOKE® PVC.)

TECHNICAL PHYSICAL PROPERTIES OF PVC LoSMOKE® MATERIALS

Specific Gravity (ASTM D-792) 1.41
Tensile Modulus, PSI (ASTM D-638) ..... 361,000 (25,380 kg/cm²)
Tensile Strength, PSI (ASTM D-638) 6,011
Flexural Strength, PSI (ASTM D-790) 9,396
Izod Impact (1/4") ft. lb./in (ASTM D-256) 3.7
Heat Deflection Temp. (ASTM D-648) ..... 157°F (70°C)
at 264 PSI (8.95 kg/cm²), °F
VICAT Softening Temp. (ASTM D-1525) ..... 198°F (92°C)

Water Vapor Transmission
ASTM E 96-95
70°F & 50% Relative Humidity
.015" thick = .058
.020" thick = .047
.030" thick = .027

Surface Burning Characteristics of All Fitting Covers and Jacketing
LoSMOKE® PVC ..... passes 25/50 ASTM-E 84
Up to .035" Thk.
Puncture Resistance (ASTM D 781) ... .006" thick = 178 Beach Units
.015" thick = 221 Beach Units

FEDERAL SPECIFICATIONS COMPLIANCE— POLY VINYL CHLORIDE — ASTM 1784-92

LP-1035A Type II Grade GU and Type III

LP-535E Type II Grade GU and Type III

United States Department of Agriculture Authorized
Agriculture Canada Authorized
New York City MEA 243-84-M, Chicago, Los Angeles ASTM C-585-76 (sizes)
Canada CAN/CGSB - 51.53-95

TECHNICAL PROPERTIES OF FIBERGLASS INSERT MATERIAL

Thermal Conductivity (ASTM C 177)

Mean Temperature –	°F	"k" — BTU in/hr. Ft.2 °F
HH-I-558 Form B	75° 1(24°C)	.26 (.037 W/m. °C)
Type 1 Class B	150° 1(66°C)	.33 (.048 W/m. °C)
	250° (121°C)	.44 (.063 W/m. °C)

APPLICATION AND SPECIFICATION GUIDELINES

A. STORAGE

Protect cartons from water damage or other abuse. Proto Fitting Cover cartons are not designed for outside storage.

B. PREPARATION

Proto Fitting Covers should be applied on clean, dry surfaces.

C. APPLICATION

1. **General:** The matching fiberglass insert shall be wrapped completely around the metal fitting leaving no voids. Loose wrappings of twine is helpful in shaping difficult surfaces. The Proto Fitting Cover shall then be applied over the fitting and insert, and the throat secured by either tack fastening or taping.

2. **Cold Pipe:** Fitting systems below ambient temperature must have a continuous vapor retarder or vapor retardant mastic as specified by the engineer. When using Proto PVC Tape, a 2" (51mm) minimum downward overlap is recommended for optimum performance. Care should be taken not to stretch the last 2" (51mm) of Proto PVC Tape, to avoid stretching or creeping.

3. **Hot Pipe:** Insulate as per General Instructions given above. Due to PVC softening point at approximately 159°F (70.6°C), care should be taken to ensure sufficient insulation thicknesses are applied.

For hot piping which requires Pipe Insulation over 1 1/2" (38 mm) wall thickness, an extra fiberglass insert shall be applied for each additional inch of pipe insulation wall thickness. Proto recommends the surface temperature of the Pipe Insulation and PVC to be no higher than 125°F (52°C). To complete application of Proto PVC Fittings on hot piping, the throat seam shall be tack fastened or taped. Seal all laps outdoors and in wash down areas.

CAUTION: During initial heat-up to operating temperatures above 350°F, (177°C) an acrid odor and some smoke may be given off as a portion of the bonding material used in the insulation begins to undergo a controlled decomposition. If natural convection is not adequate in confined areas, forced ventilation should be provided in order to protect against any harmful fumes and vapors that might be generated.

4. **Outdoor Pipe:** Insulate as per above instructions.

Minimum Proto PVC Jacketing thickness for outdoor applications should be .030" (.7 mm). Over 15" O.D., .040 is recommended. Under 3 1/8" O.D., .020 is permitted. The PVC Jacketing shall be overlapped a minimum of 2" (51 mm) on the down side so as to shed water. All long and round joints shall be completely weather sealed with caulk adhesive.

On all piping, insulation shall be of sufficient thickness to keep the surface temperature below 125°F (52°C). Additionally, a slip type expansion joint of 8" (202 mm) minimum width shall be applied at least every 25 lineal feet (6.1 lineal meters) and between fittings.

Painting: Painting must be done only after priming the PVC surface with a suitable primer, such as X-1-M 400W Primer, or a similar, approved product.

Outdoor Painting: Only over White Exotuff® 195°F deflection temp. (modified PVC) or EXOD™ 225°F deflection temp. CPVC after X-1-M primer, or a similar, approved product. Use PVC compatible paints without strong solvents. Test paint a section before proceeding.

5. **CAUTION:** Fiberglass may cause temporary skin irritation. Wear long-sleeved, loose-fitting clothing, head covering, gloves and eye protection when handling and applying material. Wash with soap and warm water after handling. Wash work clothes separately and rinse washer. A disposable mask designed for nuisance type dusts should be used where sensitivity to dust and airborne particles may cause irritation to the nose or throat.

D. HEAVY INDUSTRIAL APPLICATIONS OUTDOORS

Use .030" or higher PVC Jacketing. Use "heavy duty" two piece fitting covers made from minimum .030" thick to .050" thick PVC sheet depending on size of fitting cover. Jacketing to be cut and oven precurled

E. FIRE TEST RESULTS: PROTO LoSMOKE® — PVC

USA: E-84 25/50 Rated up to .035" thick (The Best Rated PVC)

CANADA: Conforms to CAN 4-S102.2

LoSMOKE® fitting covers conform to virtually all city, state and federal codes, for use in hotel, commercial and industrial buildings.

LoSMOKE® fitting covers will be labeled on the box "Passes ASTM E-84." Flame spread 25; smoke developed 50".

All E-84 ratings shown here were tested on flat sheets from which fitting covers are made.

Virtually all Proto LoSMOKE® fitting covers will pass E-84 25/50 flame spread and smoke development rating requirements.

SUGGESTIONS

Slide Joints: Do not apply PVC Jacketing too tightly. Slide joints plus PVC thickness must work together to prevent cracks and puckering.

Caulk/Adhesives:
Use: Celulon® (Red Devil Inc.) water base "Ultra Clear".
Service temp. -25°F to +175°F

PVC Cement: Avoid use if possible. Heavy application can cause puckering and cracks. Learn how to use it sparingly.

Vapor Retarder: A vapor retarder is required under all fitting covers for systems operating below ambient temperatures, such as chilled water lines, and is recommended for all outdoor applications. The fitting vapor retarder should provide a continuous seal with the adjacent pipe vapor retarder.

Outdoor Fitting Covers: Use extra thick, plastic heavy duty covers.

Outdoor and Indoor Washdown Areas: Use EXOD™ (CPVC) by Proto, for its higher deflection temperature (225°F). It is light grey.

PVC Outdoor Thickness (Reg. PVC Jacketing): Use .030" thick cut and oven precurled jacketing. Use "heavy duty" plastic fitting covers formed from minimum .030" to .050" thick PVC sheet depending on size of fitting cover. On pipe insulation larger than 15" O.D. use .040" thick PVC.

PVC Indoor Thickness: Use white or indoor color LoSMOKE® on piping. Use .020" thick with standard one piece fitting cover, .030" jacketing can also be used.

Vessels and Tank Tops: Use .050" or .060" thick tank panels for outdoor applications and .030" or .040" for indoor tanks. Use .050" thick Protop® segments for tank heads. (Only Proto Corp. has them.) Made of LoSMOKE® PVC.

Pipe Insulation End Caps: Use on all outdoor, indoor washdown areas, and all vapor sealed systems. End caps will be PVC, metal, or gasket materials appropriate for the metal pipe temperatures. Silicone rubber (500°F) can be applied (min. 1/16" thick) as an end cap outdoors.

Indoor hot piping need not be sealed to the end cap. Cap will be sealed or taped to the jacket.

Two-Ply Waterproofing System: Use .010" thick PVC with self-sealing long lap tape, as the first waterproof layer. Overlap ends 3" and PVC tape over. Caulk all openings with Celulon® or similar, approved product. The finished jacketing material should employ staggered joints with at least a .010 mil thick first layer. Recaulk again over last layer. Install slide joints every 25', caulk shut all other seams, openings, or end overlaps with PVC tape or caulk. Use vapor seal jacketing (instead of .010" thick PVC first layer) where a vapor seal system is required.

CPVC-High Chemical Resistance and High Deflection Temperature: Use "Exod®" CPVC jacketing and fitting covers for 225°F deflection temperature and maximum chemical resistance. Offered only by Proto Corp. as a substitute for stainless steel.

Regular PVC Jacketing Outdoors: Use regular PVC jacketing outdoors. It is less expensive, does the same job as LoSMOKE® PVC. Regular PVC has very good fire (self-extinguishing) properties — not as good as the LoSMOKE® PVC used in confined people areas (buildings), however much better than common plastics used outdoors.

Vessels with ends 24" O.D. or larger: Use .040" thick jacketing up to 48" O.D. On sides of vessels larger than 48" O.D. See Protop® brochure for instructions requiring a suspended band system, to hang panels from, (Gerrard & Company or equal). Use thick PVC panels on Outdoor Tanks not PVC Roll Jacketing. See Tank Tops above for end segments.

PROTO PVC CORP™

10500 47th Street North
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Tel: (727) 573-4665
Fax: (727) 572-6823
Toll Free (800) 875-7768

The physical and chemical properties of Proto Corp. PVC represent typical average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice. Numerical flame spread rating is not intended to reflect hazards presented by this or any other materials under actual fire conditions. Check with Proto Corp. office to assure current information. Purchaser will be responsible to determine suitability of this product for purchaser's use. Proto Corp. liability will be limited to the purchase price of the material. No person is authorized to alter this without a Proto Corp. officer's written approval.

Childers®
Mastics, Coatings, Adhesives, Sealants

VI-CRYL®
CP-10 (Trowel Grade)
CP-11 (Spray/Brush)
Weather Barrier Coatings

DURABLE WATER BASED VINYL-ACRYLIC MASTIC COATING FOR THERMAL INSULATIONS

DESCRIPTION
VI-CRYL® CP-10/11 weather barrier coating is a tough, durable, and fire-resistive water based mastic for most types of thermal insulation and finishing and insulating cements. It is very thixotropic - it looks heavy but spreads easily. It is available in a variety of standard and special fade-resistant colors. It is outdoor rated and U.V. resistant.

USES
VI-CRYL CP-10/11 weather barrier coating is unsurpassed for the mechanical protection and weatherproofing of thermal insulations both outdoors and indoors, in hot, cold, and dual-temperature service. However, since it is a 'breathing' coating (vapors under pressure will pass through it) it should only be used over insulations in low-temperature, or dual-temperature service when the insulations themselves are vapor barriers. VI-CRYL CP-10/11 has also found use throughout the thermal insulation industry as a coating used over closed cell polyethylene and polyurethane foam insulations. Industry experience has demonstrated that all weather barrier coatings may blister when applied over polystyrene board. This effect may be limited by the use of white colored coatings. VI-CRYL CP-10/11 weather barrier coating in its Metallic Gray color is the ideal companion product to Aluminum and Stainless Steel Jacketing.

APPLICATION
VI-CRYL CP-10/11 weather barrier coating is easy to apply by Trowel, Brush or Heavy-Duty Airless Spray. Its thixotropic consistency yields a smooth, attractive finish even over rough substrates; it readily fills gaps and imperfections. VI-CRYL CP-10/11 coating should be applied with glass fiber reinforcing mesh.

ADVANTAGES
- In the wet state, VI-CRYL CP-10/11 weather barrier coatings is non-flammable. It contains no solvents that will attack insulations or facings.
- The cured film is tough, flexible, and resists most common chemicals and many solvents.
- It is fire-resistive: its flame spread index being within the range of acceptance of government and industrial agencies.

CERTIFIED
- Meets NFPA Standard 90-A and 90-B 25/50 requirements.
- This product has been tested according to ASTM E-84 (Surface Burning Characteristics of Building Materials).
- Meets requirements for LEED® IEQ 4.2 Low-Emitting Materials, Paints and Coatings. CP-10 VOC: 45 g/l, less water and exempt solvents, CP-11 VOC: 20 g/l, less water and exempt solvents.

CP-10/11 contains no asbestos, lead, mercury, or mercury compounds.
See other side for specification and application information.
Visit us on the web at www.fosterproducts.com

Childers and the Childers design are trademarks of H.B. Fuller Construction Products Inc.

COLORS	TROWEL	SPRAY/BRUSH
White	*10*	*11*
Metallic Gray	*10-1*	*11-1*
Black	*10-2*	*11-2*

(Other colors are available on special order)

WET WEIGHT
11.3 lbs./U.S. gal. (1.35 kg/liter)

AVERAGE NON-VOLATILE
51% by volume (64% by weight)

SERVICE TEMPERATURE RANGE
(Temperature to which dry coating is subjected.)
-40ºF to 180ºF
(-40ºC to 83ºC)

APPLICATION TEMPERATURE RANGE
40ºF to 100ºF
(4ºC to 38ºC)

DRYING TIME
Touch - 2-4 hours
Through - 24-36 hours
(Drying time will vary depending upon film thickness, temperature and humidity.)

COVERAGE
6 U.S. gal./100 sq. ft. (2.4 l/sq.m)
(Varies with substrate and membrane.)

CLEAN-UP
Warm, soapy water (wet) xylol (dry)

WATER VAPOR PERMEANCE ASTM E-96
Greater than 1.0 perm for 1/16 inch (0.16cm) dry film. (Procedure B)

CLASSIFIED UL

GENERAL PURPOSE COATING
SURFACE BURNING CHARACTERISTICS
282U

Applied to ¼" Inorganic Reinforced Cement Board

Flame Spread:	10
Smoke Developed:	40
Rate per Coat (Sq.ft/gallon):	16.7
Number of Coats	1

Flash point of liquid coating (closed cup): No flash to boiling
R3593

3/11

H.B. Fuller Construction Products Inc.

Customer Service
800-832-9002

1105 South Frontenac Street
Aurora, IL 60504

Fax
800-952-2368

MASTIC FINISH over insulation shall be VI-CRYL CP-10/11 weather barrier coating. It shall be applied in two coats. A tack coat is to be applied at a rate of two gallons per 100 sq. ft. (.81 l/sq. m.). While the tack coat is still wet, a layer of CHIL-GLAS #10 open weave glass fiber reinforcing mesh shall be embedded with all fabric seams overlapped a minimum of 2" (5.08cm). A finish coat at a coverage of four gallons per 100 sq. ft. (1.6 l/sq. m) shall be applied, fully covering the glass fiber reinforcing mesh, so that the minimum dry film thickness is 1/16" (.063") (.16 cm). There shall be no voids or holidays and the mastic shall be trowelled, sprayed or wet-brushed to a smooth even finish.

All adjoining insulated or un-insulated surfaces must be completely waterproofed and flashed. To effectively seal those locations where the VI-CRYL CP-10/11 coating meets adjoining insulated or uninsulated surfaces, or dissimilar weather proofing materials, CP-76 sealant shall be applied as the sealing/flashing material. CP-76 shall be trowelled at 1/8" thickness a minimum of 1" in both directions back onto and over the complete joint interface of the VI-CRYL CP-10/11 coating and the adjoining surface. CHIL-GLAS #10 glass fiber reinforcing mesh is recommended to provide thickness control and strength at the joint interface.

NOTES TO SPECIFYING ENGINEER

1. Synthetic fabrics may be substituted for #10 open weave glass cloth without affecting the application.

2. If Chicken Wire, Hardware Cloth, or other metal reinforcements are to be used in lieu of fabric membranes, contact your representative for suggested procedures.

3. The above specification is for weather proofing and protection of insulation in HOT SERVICE: or for COLD or DUAL TEMPERATURE SERVICE where the insulation and/or the insulation system forms an adequate vapor barrier prior to the application of the VI-CRYL CP-10/11 coating.

Application Guide and Suggested Procedures

1. USE OF MATERIAL

VI-CRYL CP-10/11 weather barrier coating looks much heavier than it is. It is thixotropic. DO NOT THIN. Protect from freezing until dry. Keep stored over long periods of time in a heated area. For spray application VI-CRYL CP-10/11 coating must be kept at a minimum of 50ºF (10ºC) just prior to spraying to achieve optimum results.

2. THE CONDITION OF THE INSULATION TO BE COATED

VI-CRYL CP-10/11 is a "breathing coating", which means that it will allow reasonable amounts of water (in the form of vapor - a gas) to pass through it in a reasonable period of time. However, excessively wet insulation on equipment operating at elevated temperatures will cause excessive water vapor pressure, and therefore blistering of the finish. Make certain the insulation is dry prior to the application of any coating.
To obtain proper bonding, dusty surfaces shall first be primed with Chil-Seal CP-50A MV1 diluted 50% with water.
When applying VI-CRYL CP-10/11 coating over hygroscopic alkaline cements, first prime the surface of the cement with Chil-Seal CP-50A MV1 diluted 50% with water and allow to dry completely before applying the finish coat.
The presence of moisture in systems operating in Cold Service can completely destroy the effectiveness of not only the finish, but the entire insulation system. They MUST BE DRY.
All exterior horizontal surfaces must be sloped at least 1/2 inch per foot (4cm/m) to prevent ponding water.

3. HAND APPLICATION

Large flat areas are best covered by application with trowel or stiff brush. Smaller, irregular surfaces such as fittings are more readily covered by brushing. Airless spray may also be used.

4. SPRAY APPLICATION

VI-CRYL CP-11 coating may be sprayed with many types of equipment, including airless spray. It may also be sprayed with conventional Mastic spray equipment using an external atomizing spray gun. Many manufacturers of spray equipment can make detailed recommendations for any number of types of equipment. The spray equipment and techniques would be similar to those used for applying block fillers. For best results, we suggest the following airless spray equipment.

PUMP	Graco Bulldog Hydramastic, 40:1 ratio (model 204-925) air regulator with inductor plate (207-039).
COMPRESSOR	Capable of 75 CFM and maintaining 100 PSIG.
FLUID HOSE	High pressure capable of 4,000 PSI One inch up to 150 feet. 3/4 inch after the first 150 feet. Use 8' (2.4 m) 1/2" I.D. hose for coupling to the gun.
GUN	Graco Hydra-Mastic #207-300 with Reverse-A-Clean 205-614.
TIP SIZES	635 to 655.

5. DRYING AND RECOATING

A finish coat of VI-CRYL CP-10/11 weather barrier coating should be applied immediately after the tack coat and membrane application for maximum bond.

CUSTOMER SERVICE: 800-832-9002

IMPORTANT: H.B. Fuller Construction Products Inc. warrants that each of its products will be manufactured in accordance with the specifications in effect on the date of manufacture. WE MAKE NO OTHER WARRANTIES AND EXPRESSLY DISCLAIM ANY WARRANTIES OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. If a product fails to meet this limited warranty, purchaser's sole and exclusive remedy is replacement of the product or, at our option, refund of the purchase price. OUR ACCEPTANCE OF ANY ORDERS FOR THE PRODUCT IS EXPRESSLY CONDITIONAL UPON PURCHASER'S ASSENT TO THE TERMS ON THE APPLICABLE INVOICE.

ADEQUATE TESTS: The information contained herein we believe is correct to the best of our knowledge and tests. The recommendations and suggestions herein are made without guarantee or representation as to results. We recommend that adequate tests be performed by you to determine if this product meets all of your requirements. The warranted shelf life of our products is six months from date of shipment to the original purchaser.

For professional use only. Keep out of reach of children.
Consult Material Safety Data Sheet and container label for further information.

Product Data Sheet



Description

Owens Corning® UtiliCore® Insulation products are flexible white blankets designed for high temperature commercial and industrial applications. The pliable, lightweight insulation offers outstanding thermal performance, making it an excellent choice as core insulation for removable and reusable industrial pipe covers, and other industrial pads and blankets.

Thermal Conductivity[1]

	UtiliCore® Insulation					
	L1	L1.3	L1.8	L2.5	L3.7	HP5 Mat
Thickness[2] (inches)	1.0	1.0	1.0	1.0	1.0	1.0
Density (pcf)	1.0	1.3	1.8	2.5	3.7	5.0
Nominal "k" BTU•in/hr•ft.²•°F (R-value = Thickness/K)						
75°F	0.26	0.24	0.23	0.22	0.21	0.21
300°F	0.51	0.46	0.39	0.35	0.31	0.30
500°F	0.85	0.75	0.62	0.52	0.44	0.42
Nominal "k" W/mK						
23°C	0.037	0.035	0.033	0.032	0.031	0.031
149°C	0.074	0.066	0.056	0.050	0.045	0.044
260°C	0.123	0.108	0.089	0.075	0.063	0.060

1. Thermal Conductivity on core insulation only.
2. Thickness value is nominal. Product control is on thermal conductivity.

Sound Absorption Coefficient, ASTM C423—Type A Mounting[3]

		Octave Band Center Frequencies, Hz.							
Product	Thickness (Inches)	125	250	500	1000	2000	4000	NRC	SAA
L1	1.0	0.09	0.31	0.65	0.85	0.90	0.90	0.70	0.68
L1.3	1.0	0.17	0.45	0.84	0.94	0.96	0.93	0.80	0.80
L1.8	1.0	0.13	0.39	0.77	0.94	1.01	0.99	0.80	0.78
L2.5	1.0	0.08	0.34	0.81	0.98	1.03	1.03	0.80	0.79
L3.7	1.0	0.10	0.57	1.09	1.17	1.12	1.17	1.00	0.99
HP5 Mat	1.0	0.13	0.43	0.84	1.05	1.02	0.94	0.85	0.83

3. Nominal samples were measured in accordance with ASTM C 423. These measured absorption coefficients were adjusted to values representative of the product with mean specification properties. While these values are an accurate representation of our product, they are for design approximations only. Production, testing, and application variabilities will alter results. Specific designs should be evaluated in end-use configurations.

Key Features

- L series products are low-binder blankets, while HP5 Mat is a needled blanket with no binder
- User friendly fibers result in less itch and irritation for installers
- HP5 Mat can be used in applications up to 1100°F, L Series, up to 1000°F
- Flexible, lightweight material that makes it easier to install and wrap around curved surfaces
- Easier and cleaner to work with than most competitive mats on the market
- Stitches can be sewn directly through material
- Low water absorption
- Lightweight insulation provides for easy cutting both in shop and in the field

Product Applications

Owens Corning® UtiliCore® insulation products offer outstanding dimensional stability allowing ease of handling in fabrication, assembly and installation of removable and reusable industrial pipe covers.

- Core Insulation Used in:
  - o Industrial Piping System Insulation Covers
  - o Valve Insulation Covers
  - o Flange Insulation Covers
  - o Exchanger Insulation Covers
  - o Filter Insulation Covers
  - o Flow Meter Insulation Covers
  - o Strainer Insulation Covers

Availability

- UtiliCore® L Series Insulation 1" and 2" thicknesses
- UtiliCore® HP5 Mat Insulation 1" thickness
- Other thicknesses may be available upon request. Contact your Area Sales Rep for availability

Standards, Codes Compliance

- ASTM C553, Mineral Fiber Blanket Thermal Insulation, Type V - All UtiliCore®
- ASTM C1139 Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Applications
- ASTM C795, Thermal Insulation for Use in Contact with Austenitic Stainless Steel[4]
- Nuclear Regulatory Commission Guide 1.36, Non-Metallic Thermal Insulation[4]
- MIL-I-22023D Insulation Felt, Thermal and Sound Absorbing Felt, Fibrous Glass, Flexible. See MIL-I-22023D Compliance and Variances
- MIL-DTL-I-24244D (Ships) Insulation Material with Special Corrosion, Chloride, and Fluoride Requirements[4]; Type XVI
- U.S. Coast Guard Approval No. 164.109, Noncombustible Materials

  NOTE: All UtiliCore® products comply to the Noncombustible requirements of IMO FTP Code
- ASTM E136, Behavior of Materials in a Vertical Tube Furnace at 750°C (Noncombustible rating)
- Doesn't contain the fire retardant decabrominated diphenyl ether (decaBDE)

Certifications and Sustainable Features of Owens Corning® UtiliCore® Insulation Products[5]

- Certified by SCS Global Services to contain a minimum of 53% recycled glass content, 31% pre-consumer and 22% post-consumer.
- Certified to meet indoor air quality standards under the stringent GREENGUARD Certification Program, and the GREENGUARD Gold Certification.

Environmental and Sustainability

Owens Corning is a worldwide leader in building material systems, insulation and composite solutions, delivering a broad range of high-quality products and services. Owens Corning is committed to driving sustainability by delivering solutions, transforming markets and enhancing lives. More information can be found at http://sustainability.owenscorning.com.

Physical Property Data

Property	Test Method	Value
Operating Temperature Range	ASTM C411	L Series: up to 1000°F (538°C) HP5 Mat: up to 1100°F (593°C)
Corrosion Resistance	ASTM C665	Meets requirement
Fungi Resistance	ASTM C1338	Meets requirements
Odor	ASTM C1304	No objectionable odor
Moisture Sorption	ASTM C1104	< 3% by weight
Composite Surface Burning Characteristics[6]	ASTM E84, UL 723, and CAN/ULC-S102	
Flame Spread		< 25
Smoke Developed		< 50

6. The surface burning characteristics of these products have been determined in accordance with ASTM E84, UL 723, and CAN/ULC-S102. These standards should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment, which takes into account all of the factors, which are pertinent to an assessment of the fire hazard of a particular end use. Values are reported to the nearest 5 rating.

MIL-I-22023D Compliance and Variances

Density Variance

UtiliCore® complies to MIL-I-22023D, with the exception of Section 1.2 Classification; Table 1 Nominal Density; Type I and Type II, for Class 4 and Class 6, which are slightly below the -10% allowance, but complies to all properties required for these Classes. Table 1 below aligns the UtiliCore® product for Type i and Type II Classes.

Table 1:	Density Required pcf (lb/ft³)	UtiliCore® Product	Product Density pcf (lb/ft³)	Density Compliance
Class 3	1.0	L1	1.0	Yes
Class 4	1.5	L1.3	1.3	0.05 pcf below tolerance
Class 5	2.0	L1.8	1.8	Yes
Class 6	3.0	L2.5	2.5	0.2 pcf below tolerance

3. UtiliCore® offers no Class 2 product.

4. Preproduction qualification testing complete and on file. Chemical analysis of each production lot required for total conformance.
5. Results representative of core insulation only.

Disclaimer of Liability

Technical information contained herein is furnished without charge or obligation and is given and accepted at recipient's sole risk. Because conditions of use may vary and are beyond our control, Owens Corning makes no representation about, and is not responsible or liable for the accuracy or reliability of data associated with particular uses of any product described herein. Nothing contained in this bulletin shall be considered a recommendation.

SCS Global Services provides independent verification of recycled content in building materials and verifies recycled content claims made by manufacturers.
For more information, visit www.SCSglobalservices.com.

GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage. For more information, visit ul.com/gg.







AVERAGE 53% RECYCLED CONTENT
31% PRE-CONSUMER
22% POST-CONSUMER

OWENS CORNING INSULATING SYSTEMS, LLC
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659

1-800-GET-PINK®
www.owenscorning.com

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SILICONE IMPREGNATED FIBERGLASS CLOTH
STYLE 750

Style 750 is designed for preparing high temperature removable pads, flange and valve covers. Style 750 is a fiberglass fabric impregnated with a high temperature, flame retardant, silicone rubber which provides greater life and improved resistance to abrasion, flexing, tear and puncture. The base fabric meets MIL-C-20079.

BASE FABRIC

Weight, oz./sq. yd.	12.6 ± .4
Gauge	.0135 ± .002
Count W & F	4 Harness Satin
Width	60”

STYLE 750 SPECIFICATIONS

Weight, oz./sq. yd.	17.0 oz/sq yd nominal
Thickness	.018” nominal
Tensile Strength	350 lb./in. avg. warp 300 lb./in. avg. fill
Trapezoidal Tear Strength	Too high to measure
Upper use temperature	500°F
Color	Silver Aluminum
Width	60” nominal

All statements herein are expressions of opinion which we believe to be accurate and reliable but are not intended as recommendations for their use in the infringement of any patent. No patent warranty of any kind, express or implied is made or intended.



Controlling Energy Costs With Best Energy Reduction Tools (BERT)

Executive Summary:

As companies, consumers and the country look for ways to save energy and reduce pollution, increased attention will be focused on new ways of controlling the energy use of the legion of smaller electrical loads which now represent the major source of growth in total energy use. While energy managers have been quick to identify and automate large sources of energy use (like HVAC), controlling many smaller devices spread throughout a building is difficult to do. The promotion of 'good habits' like turning off lights and computers may have short term impacts, but sustaining these types of activities over time has proven to be difficult. This paper describes a new approach to facility energy management that leverages a building's existing WiFi network to control end uses throughout a building. By connecting 'smart plugs' to a web-based software interface, energy managers can program schedules by end-use that control energy consumption during times when facilities are not being used. Case studies of university, office, restaurant and residential applications illustrate a range of ways in which the technology can be used. The end uses described in these cases average a 6 month payback. If widely adopted, the control of 'small use' devices could save approximately 461 million kWh and 632 million pounds of carbon annually.

Section 1: Introduction

As energy prices increase and companies and organizations place increased focus on the environment, facility energy managers are challenged to find ways of controlling the energy use of an ever-widening variety of electronic devices. While most managers have made significant strides increasing the efficiency and control of major end uses like HVAC, a large portion of each facility's bill is spent on 'the little stuff'—computers, lights, and other relatively new electronic devices. This paper describes and documents a new patented technology that utilizes the existing WiFi infrastructure to control devices throughout a facility. Section 2 describes the explosion of electronic devices, which represents both a significant growth area for energy demand as well as a new, untapped opportunity for savings. Section

3 provides an overview of past attempts to control diffuse devices over networks, and provides a glimpse into the future of 'smart' appliances. Section 4 describes a new technology called "BERT", for Best Energy Reduction Technologies. Particular focus is placed on how the software interface allows for the individual control of virtually any device. Section 5 describes how the technology can operate within a university, office, restaurants and in residential applications. Section 6 concludes by documenting the savings potential of the technology in several key sectors, and illustrates the potential for this type of technology to transform how energy use is managed in homes and businesses.

Section 2: The Electronics Explosion: Growth and Savings Opportunity

Despite the increased efficiency of a wide variety of many electronic devices, efficiency gains for many facilities have been countered by a proliferation of new devices. Spending on PCs continues to be strong, growing 22.7% in 2010 according to iSuppli, a company that tracks technology sales. According to the Department of Energy's Building Data Book, total energy use for computers rose 43% between 2006 and 2010. Even more startling is the growth in uncategorized uses, which jumped 663% during the period[1]. The increasing number of peripheral devices, from iPhones, to video conferencing equipment and large format LED and plasma displays all add up. Energy use at work is clearly on the rise, despite the increased efficiency of new equipment. Similar growth is taking place residentially. According to the Nielsen Television Audience Report[2], the number of TV's per household is now 2.86, jumping 43% since 1990. In addition, 88% of homes have a DVD, over 80% of homes have a computer, and of those homes 92% had internet access[3].

A byproduct of the proliferation of devices is phantom load. Phantom load refers to energy that is used when a device is off. This includes energy used by TV's when they're in standby mode (i.e. when they can be turned on with a remote), and energy used by chargers or a laptop's AC adapter. Studies estimate that phantom load now accounts for 6% of all energy use.

This increase in energy consumption has been made worse by increases in price. Recent data from the Department of Energy shows that average electricity prices have increased in all three sectors (commercial, residential, industrial) between 2009-2010[4]. The lifting of rate caps in many states has already lead to dramatic price increases. Electricity rates have already increased 39% in Maryland, 21% in Illinois, and are projected to increase 40-70% in Pennsylvania.

With the increasing number of devices, many facilities managers must rely on people to remember to turn out the lights, or unplug their printers when not in use. However this is easier said than done. A

[1] http://buildingsdatabook.eren.doe.gov/docs/DataBooks/2009_BEDB_Updated.pdf

[2] http://blog.nielsen.com/nielsenwire/wp-content/uploads/2009/07/tva_2008_071709.pdf

[3] http://blog.nielsen.com/nielsenwire/online_mobile/home-internet-access-continuing-to-grow-but-big-differences-among-demographics/

[4] http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html

study conducted by the Alliance for Efficiency found that the impact of behaviorally-based conservation programs wanes within a year, even when education campaigns are ongoing[5].

Section 3: The Device Control Industry: Past, Present and Future

Home automation and control technologies have been around for years, and have the potential to reduce the energy used by a wide variety of devices. Pioneers such as X10 created a communications protocol that used in-home electric wiring to transmit commands to compatible devices. These technologies have advanced over the years to utilize wireless transmission (for example, X10 now uses 310 MHz radio frequency to transmit commands to specially equipped devices within the home.) While significant effort has been put behind these technologies a host of problems have hindered widespread adoption, including unreliability due to wiring impedance, slow response time, and interference with/from other household appliances and devices. Despite the apparent allure of ubiquitous electrical wiring, X10 lacked the ease, reliability and security needed for the product segment to grow.

Individual manufacturers, such as Lutron, have created proprietary high-end home control products intended to provide high levels of control, allowing the programming of lighting 'schemes', and the integrated control of equipment throughout the home. These high cost end-to-end solutions provide an interesting niche product for high end or specialty customers, but do not appeal to the mass market. At the other end of the market, products like Belkin's Conserve[6] Surge With Timer builds a timer into standard surge strip allowing an individual user to set the strip to turn off during select hours.

More recently, the Zigbee suite of proprietary communications protocols has made an appearance in the home control market. Under the Smart Energy 2.0 initiative, Zigbee proponents have created a data standard that they hope will be adopted by a potentially large AMI and Smart Metering industry. While the potential of this utility-driven segment is large, its success will rely on the installations of millions of Zigbee enabled electric meters and related devices.

Section 4: What Makes BERT different?

BERT provides a deceptively simple solution to the device control dilemma. First, BERT was built on a large, reliable, existing networking technology- WIFI. Building the control platform on the existing network has several key benefits:

1. Ubiquity: Virtually all homes and businesses are wifi-enabled. This means that any building that has wi-fi can easily utilize a "Plug and Play" BERT device.

[5] http://www.allianceforwaterefficiency.org/public_education.aspx
[6] http://www.belkin.com/energy/conserve/default.aspx

2. Reliability: WiFi networks have achieved an amazingly high degree of reliability and security. This reliability meaning that the problems of cross-device interference and the lack of security are no longer issues.

3. Cost: Because the wifi network already exists, no special equipment needs to be purchased as would be with proprietary or other standards such as ZigBee. This allows for the lowest total cost solution in the marketplace.

4. Ease of installation and use: The computer-based control software allows devices to be easily programmed or controlled through any computer-enabled device. BERT does not rely on proprietary physical control panels, or specially-wired consoles. Instead BERT takes commands through common MAC, PC or Smart Phone devices consumers and businesses already use.

Figure 4-1 shows how the BERT device works. The Enterprise Application Program (EAP) is installed on one computer on the network, and is used to set schedules, group devices, and monitor activity. On/Off requests are sent through the existing network router using WiFi. Each BERT plug contains a microchip and antenna that communicates with the EAP on a periodic basis. The BERT EAP uses SNMP (Simple Network Management Protocol) to monitor the activity of connected devices (plugs). When a BERT plug receives an "off" command, the module turns off all power supplied to the plug.

Figure 4-1: BERT System Schematic



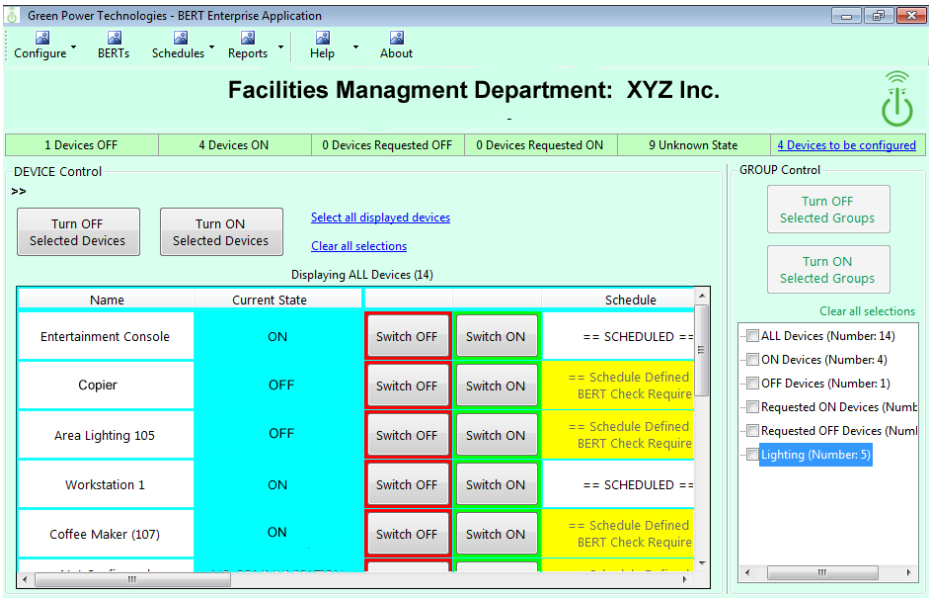
The BERT EAP provides a set of tools to configure, schedule and monitor connected BERT devices. The windows based program is installed on a computer within the network (e.g. a facilities manager's workstation). BERT plug contains a microchip and obtains an IP address from your network. Each BERT device appears on the interface, and individual schedules can be set with multiple on/off periods over a seven day schedule. For example, hallway TV monitors can be programmed to go off at midnight, and

on again at 6 am. Multiple TV's can be grouped together to make control and reporting easier. The EAP tracks and reports the status of all devices on the system.

The energy use of each device can also be programmed into the EAP. For example, if the LCD hallway monitor consumes 225 watts of power, then BERT can use this information to track cumulative energy and dollar savings. The BERT reporting interface allows reports for individual devices, groups, or the entire portfolio of devices.

When deviations from standard building schedules occur, devices can be activated in several ways. Most simply, users approaching a BERT device that is it's off state can press a button on the side of the BERT plug and power will be restored to the device. This change of state will be recognized and recorded by the EAP. The device will remain on until the next programmed schedule change. If there are temporary schedule changes for multiple devices, for example if a building is open late for a special event, the facilities manager can turn on/off individual or groups of units remotely. The manager simply selects the designated groups, like Hallway LCD Monitors, and clicks on "Turn On Selected Groups".

Figure 4-2: The BERT EAP Interface



The microprocessors embedded in each BERT plug provide unique protection in the event of a WiFi outage, the shutdown of the management computer, or other interruption. Each BERT unit contains the programmed weekly schedule within the microchip, so if the plug loses contact with the EAP control software it will simply continue to execute its standard schedule.

Section 5: Sample Applications

BERT units can work in a wide variety of applications. This section describes how BERT can operate in university, office, restaurant and residential applications.

University Building:

Temple University's Speakman Hall is an academic building in the middle of campus, and contains a mix of classrooms, public spaces, study areas, and administrative services. The building includes a wide variety of devices that are on 24x7, including hallway announcement TVs, cooled water fountains, office equipment, vending machines, and computer monitors. The building is WiFi enabled. While the University prides itself on having a wide variety of amenities available for students, it also recognizes that many of these amenities use energy round the clock, even when the building is closed during nighttime hours.

Table 5-1: Sample BERT Installation in a University Building

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh per year)*
Computer Monitors	65	8	30	5,694
Vending Machine	400	8	2	2,336
Water fountain (cooled)	60	8	24	4,205
Copier	5.26	10	2	38
LCD TV	225	10	12	9,855

Table 5-1 shows modeled energy savings for 70 BERT plugs installed in a single academic building over a 1 year period of time. This application saves 22,128 kWh and $3,983 per year.

Office

An office has 30 workstations (each with a computer, monitor, printer and cell phone charger), a water cooler, copier, and a TV screen in the company lobby. The office manager installs a BERT plug at each workstation, and various other devices. The manager schedules the BERT devices to go off for 12 hours each night, when the office is closed.

Table 5-2: Sample BERT Savings In A Small Office

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Workstation	48.51	12	30	6,374

Water cooler	60	12	1	263
Copier	9.63	10	1	35
LCD TV	225	10	1	821

Table 5-2 shows modeled energy savings for 33 BERT plugs installed in a single office over a 1 year period of time. This application saves 7.493 kWh and $1,349 per year.

Restaurant:

A sports bar features a large number of flat screen TVs so that patrons can view their favorite sporting events from virtually any seat. The restaurant owner configures BERT so that the closing manager can turn off all BERT devices as part of the nightly shut down procedure. BERTS return to service when the opening manager returns in the morning.

Table 5-3: Sample BERT Applications In A Restaurant

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Register Stations	48.51	14	3	744
Bar lighting	65	14	5	1,661
Vending Machines	400	14	4	8,176
LCD TV	225	14	20	22,995

Table 5-3 shows modeled energy savings for 33 BERT plugs installed in a single restaurant over a 1 year period of time. This application saves 33,882 kWh and $6,099 per year in energy.

Residential:

A homeowner buys four BERTS to control a computer workstation, entertainment center, area lighting, and kitchen appliances. The homeowner programs BERTS to be on during the times when family members are typically using the equipment; the coffee maker goes on in the morning, while the computer station is active in both morning and evening hours.

Table 5-4: Sample BERT Residential Application

Item Description	Watt Savings	Hours off per day	Number of devices	*Potential energy savings (kWh)*
Light	60	14	1	307
Entertainment Center	75	16	1	438
Workstation	48	14	1	245
Kitchen	8	20	1	58

Table 5-4 shows modeled energy savings for 4 BERT plugs installed in a single home over a 1 year period of time. This application saves 1,084 kWh and $189 per year in energy.

Section 6: Global Impacts:

The global impacts of the adoption of BERT plugs is significant. For example, one million plugs deployed in applications similar to the ones described above saves 461 million kilowatt hours and over 632 million pounds of carbon per year.

Table 6-1: Potential Energy and Environmental Savings

Number of plugs	1,000,000
Average KWH Savings	461.34
Total KWH Savings	461,335,714
Total Dollar savings	$ 83,040,428
Annual Carbon Savings:	632,029,928 pounds per year

In contrast to existing and emerging technologies described in Section 3, WiFi based devices like BERT provide an immediate opportunity to leverage an enormous existing technology infrastructure to save money, energy and the environment by turning off devices on a controlled, scheduled basis while they are not in use.

SeamlesSEAL ULTRA
SILICONE COATING ROOFING SYSTEMS

SeamlesSEAL™ ULTRA HS

Silicone Coating

Overview

SeamlesSEAL ULTRA HS is a single-component, moisture-cured, high-solids, fluid-applied silicone coating. Once cured, the silicone coating membrane offers excellent resistance to water intrusion, UV exposure, and natural weathering. This product is designed to provide protection for a wide range of building surfaces. It is excellent for waterproofing and restoring existing roof systems, as well as for weather protection of SPF roofing systems.

Features and Benefits

- Superior leak protection
- Easy to apply and wide application window
- Weatherability
- Long-lasting
- Resistance to ponding water

Coverage Rate

SeamlesSEAL ULTRA HS Silicone Coating is 96% solids by volume so that a typical application rate of 1.0-1.5 gallons per 100 square feet should yield a dry film thickness of approximately 15 mils in one coat. Waste, wind loss, and other variables will affect the actual dry film thickness.

Installation

1. All surfaces to be coated must be clean, dry, and paintable. It may be necessary to power wash and/or prime to enhance adhesion.
2. No thinning or reducing is recommended. Mix well before using. For drums: use a ¾ hp air-powered mixer with a 6" blade and shaft that will create a good vortex. For pails: use at least a 3" blade or a suitable hand mix paddle. Mixed materials should be used immediately to avoid curing in the container with small amounts of atmospheric moisture.
3. It is not recommended that this product be applied at temperatures below 40°F (4°C) or if inclement weather is expected within 1 hour of application.
4. This product is suitable for application through airless spray equipment or with a roller, squeegee, or brush. Utilize a pump with a minimum output of 3 gallons per minute and 3,500 psi fluid pressure capability, fed with a 5:1 transfer pump and ½" and ¾" ID hose. Always use components rated for the pump maximum pressure. Use a 30-mesh screen or larger. Use a spray tip with a minimum orifice of .30" and 50 degree fan angle. Medium to heavy nap roller pads are recommended. Use hoses dedicated for silicone coatings.
5. This coating can be installed in one or multiple coats.
6. SPF should be coated within 24 hours of application. Subsequent coats should be applied within 24 hours of prior applications to ensure full and uniform adhesion. Coating must be evenly applied and pinhole free. The coating will cure in 2 to 8 hours, dependent on weather conditions such as temperature and humidity. Do not install additional coats until coating is fully cured.
7. Approved roofing granules may be installed in the topcoat to improve aesthetics, traffic resistance, and impact resistance.
8. See listing at www.nsf.org for application and cure instructions for rainwater catchment use.
9. Cleanup of spray equipment containing uncured material may be accomplished by flushing with VM&P Naphtha or Rule 66 mineral spirits. SeamlesSEAL ULTRA HS cures by reacting with moisture and should not be left in spray guns, pump equipment, or hoses for prolonged periods unless equipment contains moisture lock hoses, fittings, and seals. Equipment without these components will transmit sufficient moisture vapor to gradually form cured material on hose walls and at unsealed connections.

Review Carlisle Roof Foam and Coatings' specifications and details for complete installation information. Please contact CRFC for more information.

Precautions

- Not recommended for continuous immersion service, for use in cold storage applications without a vapor retarder, or directly over asphaltic surfaces without a sealer.
- Silicone coatings are slippery when wet. Exercise caution when walking on a roof under these conditions.
- Avoid breathing silicone vapors or spray mists. Use an appropriate MESA/NIOSH approved respirator when exposure can exceed recommended PEL. This product is not recommended for interior use. Additional care must be taken to prevent rooftop HVAC equipment from introducing silicone vapors into interior areas during application. Building occupants should be warned of spray operations in process.
- Keep cleaning solvents away from all sources of heat, sparks, flame, lighted smoking materials, or any other ignition source. Pumping equipment should be grounded to avoid accidental ignition due to static sparks.
- It is not recommended to store this product at temperatures exceeding 100°F (38°C). For maximum shelf life, store between 40°F and 70°F (4°C and 21°C). Higher temperatures will reduce shelf life.
- Remove any skin prior to mixing the material. Once container is opened, all product should be used. Container cannot be resealed without product skinning or curing inside container. Always keep covered and protected from the elements. When transporting this product, ensure lid is tight and container secured.
- See Safety Data Sheet (SDS) for complete safety information.

Ratings and Approvals

Underwriters Laboratories	File R26705
Evaluation Report	UL EX R26705
Factory Mutual Global	Approved
NSF Protocol	P151 (white only)
Miami-Dade County Product Control Approved	No. 18-0308.06
Florida Approval	FL#13816R2
CRRC Listed (white)	
Energy Star (white)	
Title 24	Compliant
ASTM C 1305 Crack Bridging Ability	Passed
Meets Requirements of ASTM D6694 Standard Specification for Liquid-Applied Silicone Coating	

Typical Properties and Characteristics

Property	Test Method	SeamlesSEAL ULTRA HS
Tensile Strength	ASTM D2370	307 psi @ 73°F (23°C)
		484 psi @ 0°F (-18°C)
Elongation	ASTM D2370	205% @ 73°F (23°C)
		307% @ 0°F (-18°C)
Tear Resistance	ASTM D624	26 lbf/in @ 73°F (23°C)
Permeance	ASTM E96 Procedure B	9.3 perms
Reflectivity	ASTM C1549	.87 initial/.70 3-year aged (white)
Emissivity	ASTM C1371	.89 initial/ .90 3-year aged (white)
Solar Reflectance Index	ASTM E1980	SRI - White: 110
Water Absorption	ASTM D471	0.1 % @ 73°F (23°C)
Low Temp. Flexibility	ASTM D522 Procedure B	Pass @ -15°F (-26°C)
Weathering	ASTM G53	No degradation after 8,760 hours
Hardness	ASTM D2240	50 Shore A
Max. Service Temp.		185°F (85°C)
Solids by Volume	ASTM D2697	96% +/- 2
Solids by Weight	ASTM D1644	95% +/- 2
Flash Point	ASTM D93	>105°F (40°C)
Cure Time		Min 2 Hrs @ 100°F (38°C) & 90% RH Max 8-12 Hrs @ 40°F (4°C) & 20% RH
VOC	EPA Method 24	<250 grams/L
Color		White, Light Gray, Dark Gray, Tan

Special colors are available at an additional charge with minimum order.

Typical properties and characteristics are based on samples tested and are not guaranteed for all samples of this product. This data and information is intended as a guide and does not reflect the specification range for any particular property of this product.

Shipping Information

Container Size	Gross Weight	Class
5-gallon pail (18.9 L)	60.5 lbs. (23 Kg)	55
50-gallon drum (189.3 L)		55
D.O.T. Classification: BC - Roof Coating, Non-Regulated	Protect from freezing (32°F/0°C) during shipping and storage	

CARLISLE ROOF FOAM AND COATINGS

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Product Guide

Spray Polyurethane Foam (SPF)

New Product		Replaced Product
PremiSEAL™ 40	Nominal 40 Compressive Strength, UL Listings	PremiSeal 250 PremiSeal 255
PremiSEAL 60	Nominal 60 Compressive Strength, UL Listings, FM, Miami Dade, FL Product Approval, UL EX Evaluation Report, TX Windstorm Approvals	PremiSeal 280 PremiSeal 285 BaySeal 2.7
PremiSEAL 70	Nominal 70 Compressive Strength, UL Listings, FM, FL Product Approval, UL EX Evaluation Report, TX Windstorm Approvals	PremiSeal 300 PremiSeal 305 BaySeal 3.0
PremiSEAL 80	Nominal 80 Compressive Strength, UL Listings	PremiSeal 350
PremiR+™ 40	Nominal 40 Compressive Strength, UL Listings Low Global Warming Potential, Higher Yield	New Product
PremiR+ 60	Nominal 60 Compressive Strength, UL Listings Low Global Warming Potential, Higher Yield	New Product

Available in reactivities of very slow (VS), slow (S), regular (R), fast (F), and very fast (VF).

Acrylic Coating

New Product		Replaced Product
SeamlesSEAL™	White, Tan, Light Gray, Dark Gray 55%, Solids by Volume, UL Listed, Miami Dade, FL Product Approval, CRRC, Meets ASTM D6083	Acry-Tek 4200 BayBlock II Premicote 1400
SeamlesSEAL QS	Skins Quicker, White, Tan, Light Gray, Dark Gray, 55% Solids by Volume, UL Listed, CRRC, Meets ASTM D6083	BayBlock QS PremiCote 1400 QS
SeamlesSEAL HT	Premium High Tensile, White, Tan, Light Gray, Dark Gray, 55% Solids by Volume, UL Listed, FM, Miami Dade, CRRC, UL Evaluation Report, Meets ASTM D6083	BayBlock HT PremiCote 1500 Acry-Tek 9000
SeamlesSEAL BB	Base Coat used over Substrate to Block Bleed Through (Asphalt/Plasticizers)	PremiCote 1650
SeamlesSEAL FR	Premium, More Fire Retardant, Higher Roof Slope Ratings, UL Listed, Meets ASTM D6083	BayBlock FR
SeamlesSEAL Clear Coat	Translucent, used for Restoring, Protecting Plastic and Fiberglass Skylights	Acry-Tek 6000

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Silicone Coating

New Product		Replaced Product
SeamlesSEAL ULTRA LS	69% Solids by Volume, UL Listed, FM, Miami Dade, FL Product Approval, CRRC, NSF, Meets ASTM D6694	Poly-Sil 2200
SeamlesSEAL ULTRA HS	96% Solids by Volume, UL Listed, FM, Miami Dade, FL Product Approval, CRRC, NSF, Meets ASTM D6694	Poly-Sil 2500
SeamlesSEAL ULTRA HSLV	93% Solids by Volume, Low VOC Compliant (California), UL Listed, NSF	Poly-Sil 2500-CA

Primers

New Product		Replaced Product
Prime-Tek Epoxy	Two Component Epoxy, Existing Roof Substrates, Roof Restoration, SPF Applications, FM, Miami Dade	Prime-Tek 11 BayBlock Prime EW
Prime-Tek General Purpose	Black Acrylic, Single Component, used for SPF, Wood, Concrete, Masonry, BUR, Roof Restoration, SPF Applications	Prime-Tek 7500 BayBlock Prime NS
Prime-Tek Bleed Block	Single Component, Red Water Based, used for Metal, Asphaltic Substrates, Roof Restoration, SPF Applications	Prime-Tek 7900 BayBlock Prime RI
Prime-Tek Membrane Cleaner	EPDM Cleaner, Prep Roof Restoration, SPF Applications, FM, Miami Dade	Prep-Tek 500 BayBlock Prep
Prime-Tek Tie-in	Rejuvenate and Promote Adhesion to Urethanes and Polyureas	Prime-Tek 1007
Prime-Tek TPO	Primer for Thermoplastic Single Ply, Other Substrates, Roof Restorations	Prime-Tek 12

Other Coatings

New Product		Replaced Product
HailCoat	Two Component Fast Cure Tough Polyurea Basecoat, High Impact Resistance	HailCoat PL
UreCoat	Single Component Aliphatic Urethane Topcoat	PremiCote 3010

Accessories and Sealants

New Product		Replaced Product
Seal-Tek Acrylic Mastic	Single Component Acrylic Mastic	Seal-Tek 800
Seal-Tek Silicone Mastic	Single Component, 100% Silicone Mastic	Seal-Tek 1100
Seal-Tek Micro Fibers	Fiber Additive to Silicone and Acrylic Coatings to Thicken, Reinforce, and Create Sealing and Patching Material	Seal-Tek MF 20/20
Seal-Tek Reinforcing Fabric	Rolls of Fabric in 4, 6, 12 and 40 Inch Wide for Embedment into Coating Systems for Reinforcement	Seal-Tek SF200
Seal-Tek Silicone Sealant	Silicone Sealant in Tubes, 24 to a Case	CWS Silicone Caulk Seal-Tek SS 1000

Please contact Carlisle Roof Foam and Coatings for questions and further information.

SeamlesSEAL ACRYLIC COATING ROOFING SYSTEMS

SeamlesSEAL ULTRA SILICONE COATING ROOFING SYSTEMS

PremiSEAL PREMIUM ROOFING SPRAY FOAM

PremiR+ HIGH R-VALUE ROOFING SPRAY FOAM

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TECHNICAL GUIDE
R-410A
ZH/ZJ/ZR SERIES
3 - 12.5 TON
60 Hertz



ZH/ZJ/ZR 3 THROUGH 10 TON



ZH/ZJ/ZR 12.5 TON

Description

ASHRAE 90.1 COMPLIANT

YORK® Predator® units are convertible single packages with a common footprint cabinet and common roof curb for all 3 through 12.5 ton models. All 6.5 through 12.5 ton units have two compressors with independent refrigeration circuits to provide 2 stages of cooling. The units were designed for light commercial applications and can be easily installed on a roof curb, slab, or frame.

All Predator® units are self-contained and assembled on rigid full perimeter base rails allowing for 3-way forklift access and overhead rigging. Every unit is completely charged, wired, piped, and tested at the factory to provide a quick and easy field installation.

Predator® units in all tonnage sizes are convertible between side airflow and down airflow, with corresponding economizer if economizer option is desired.

Predator® units are available in the following configurations: cooling only, cooling with electric heat, cooling with gas heat, reheat only, reheat with electric heat and reheat with gas heat. Electric heaters are available as factory-installed options or field-installed accessories.

All units provide constant supply air volume. A variable air volume (VAV) option, which features a variable frequency drive (VFD), is available on 6.5 through 12.5 ton ZH/ZJ models only.

Tested in accordance with:

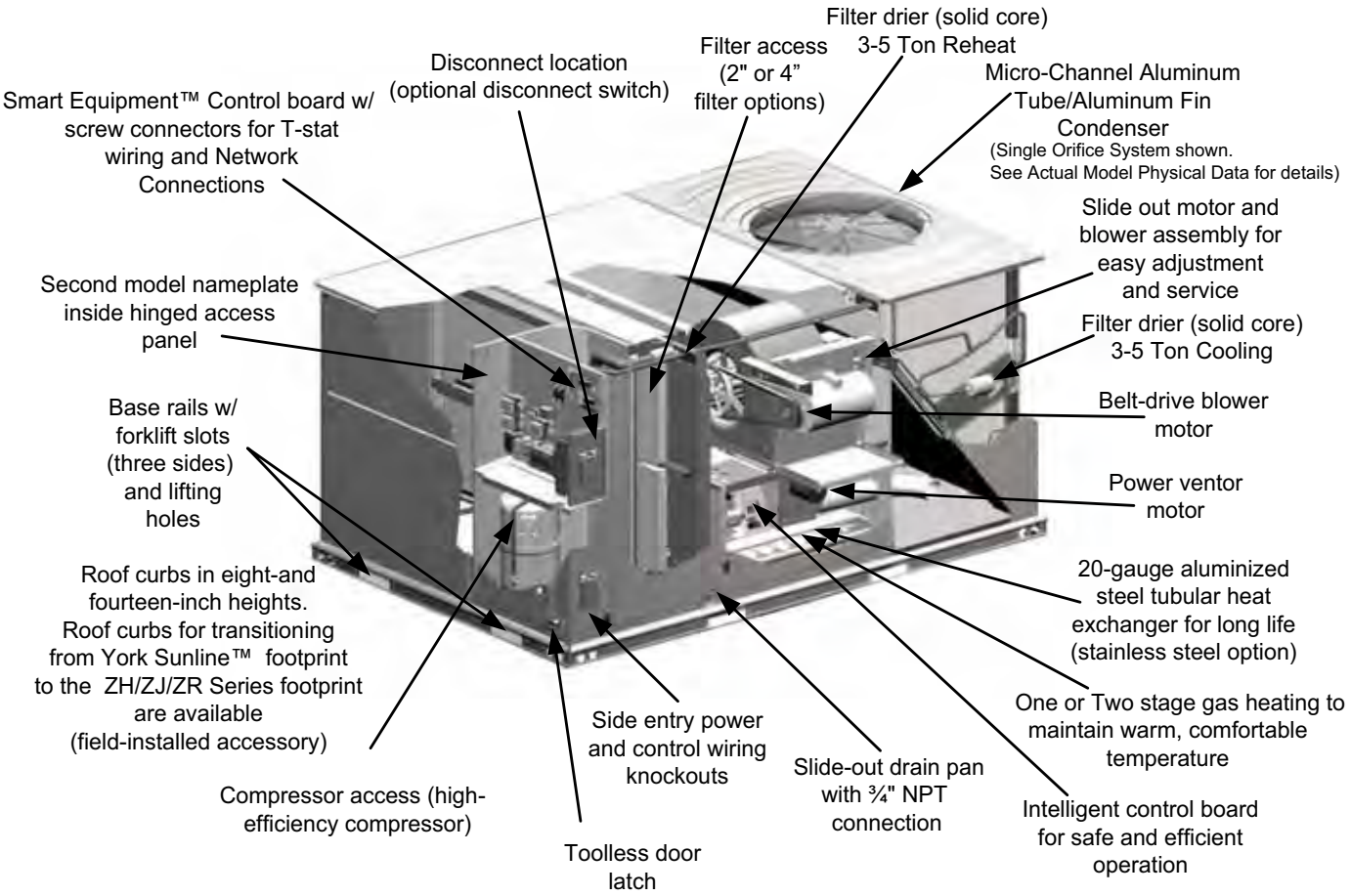
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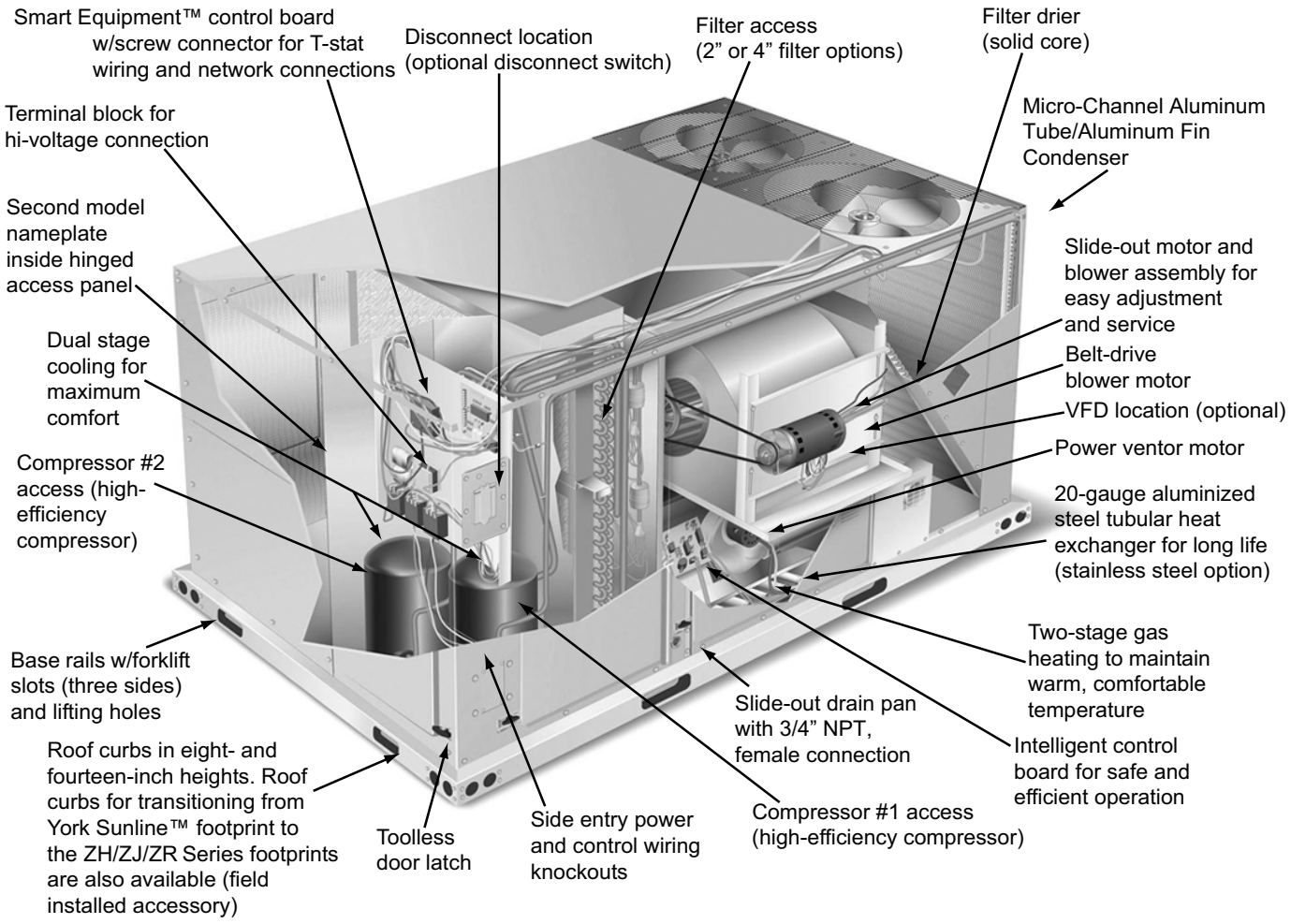
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Component Location

Cooling With Gas Heat (3 Through 5 Ton)



Cooling With Gas Heat (6.5 Through 10 Tons)



Nomenclature

3-12.5 Ton York® Model Number Nomenclature

Z	H	090	C	00	A	2	A	1	A	A	A	1	A	1

Product Category
Z = A/C, Single Pkg., R-410A

Product Identifier
H = Pkg AC Mid Eff
J = Pkg AC High Eff
R = Pkg AC Reheat

Nominal Cooling Capacity
037 = 3 Ton
049 = 4 Ton
061 = 5 Ton
078 = 6.5 Ton
090 = 7.5 Ton
102 = 8.5 Ton
120 = 10.0 Ton
150 = 12.5 Ton

Heat Type
C = Cooling Only
E = Electric Heat

Single Stage Natural Gas Heat Options
H = 1 Stage Gas Aluminized Steel
J = 1 Stage Gas Stainless Steel
K = 1 Stage Low Nox Gas Aluminized Steel
L = 1 Stage Low Nox Gas Stainless Steel

Two Stage Natural Gas Heat Options
N = 2 Stage Gas Aluminized Steel
S = 2 Stage Gas Stainless Steel
P = 2 Stage Low Nox Gas Aluminized Steel
Q = 2 Stage Low Nox Gas Stainless Steel

Heat Capacity
00 = Cooling Only

Gas MBH Input (Unit Size Allowed)
06 = 60 MBH Input (037, 049)
08 = 80 MBH Input (037, 049, 061)
12 = 120 MBH Input (037, 049, 061, 078, 090, 102)
16 = 160 MBH Input (061)
18 = 180 MBH Input (078,090,102,120,150)
24 = 240 MBH Input (120,150)

Electric Heat (Unit Size Allowed)
03 = 3 KW (037)
06 = 6 KW (037,049,061)
09 = 9 KW (037,049,061,078,090,102)
15 = 15KW (037,049,061)
18 = 18 KW (078,090,102,120,150)
20 = 20 KW (049,061)
24 = 24 KW (061, 078,090,102,120,150)
36 = 36 KW (078,090,102,120,150)
54 = 54 KW (120,150)

Blower Option
B = Standard Static
D = High Static
E = VFD/VAV Std Static
G = VFD/VAV High Static
H = VFD/VAV w/Bypass Std Static
K = VFD/VAV w/Bypass High Static
L = VFD/VAV Customer Std Static
N = VFD/VAV Customer High Static
P = VFD IntelliSpeed Std Static
R = VFD IntelliSpeed High Static
S = VFD w/Byp IntelliSp Std Static
U = VFD w/Byp IntelliSp Hi Static
V = VFD Cust IntelliSp Std Static
X = VFD Cust IntelliSp Hi Static

Voltage
2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Outdoor Air Option
A = No Economizer
B = Economizer w/Barometric RLF
D = Economizer w/Power EXH
H = Motorized Damper

Service Options
1 = No Service Options
2 = DSC (Disconnect Switch)
3 = NCO (Non-PWR Conv. Outlet)
4 = PCO (Powered Conv. Outlet)
5 = DSC,NCO
6 = DSC,PCO

Sensors
A = No Sensors
B = PHM (Phase Monitor)
C = DFS (Dirty Filter Switch)
D = SSD (Supply Air Smoke DET)
E = RSD (Return Air Smoke DET)
F = PHM,DFS
G = PHM,SSD
H = PHM,RSD
J = DFS,SSD
K = DFS,RSD
L = SSD,RSD
M = PHM,DFS,SSD
N = PHM,DFS,RSD
P = PHM,SSD,RSD
Q = DFS,SSD,RSD
R = PHM,DFS,SSD,RSD

Controls Option
A = Stand Alone Smart Equipment™
C = BACnet MSTP,Mdbs,N2 COM Card
D = CPC Control, DFS, APS
F = Fault Detection Diagnostics
G = Novar UCM Ctrl, DFS, APS
H = Hnywll Excel 10 CTRL,DFS,APS
M = Verasys Single Zone
N = Verasys Change Over Bypass
P = Verasys VAV
Q = Verasys Single Zone W/FDD
R = Verasys COBP W/FDD
T = Verasys VAV W/FDD

Refrigeration
A = Standard Refrigeration
B = ECC (E-Coat Cond Coil)
C = EEC (E-Coat Evap Coil)
D = HGBP (Hot Gas Bypass)
F = ECC,EEC
G = ECC,EEC,HGBP
J = ECC,HGBP
M = EEC,HGBP

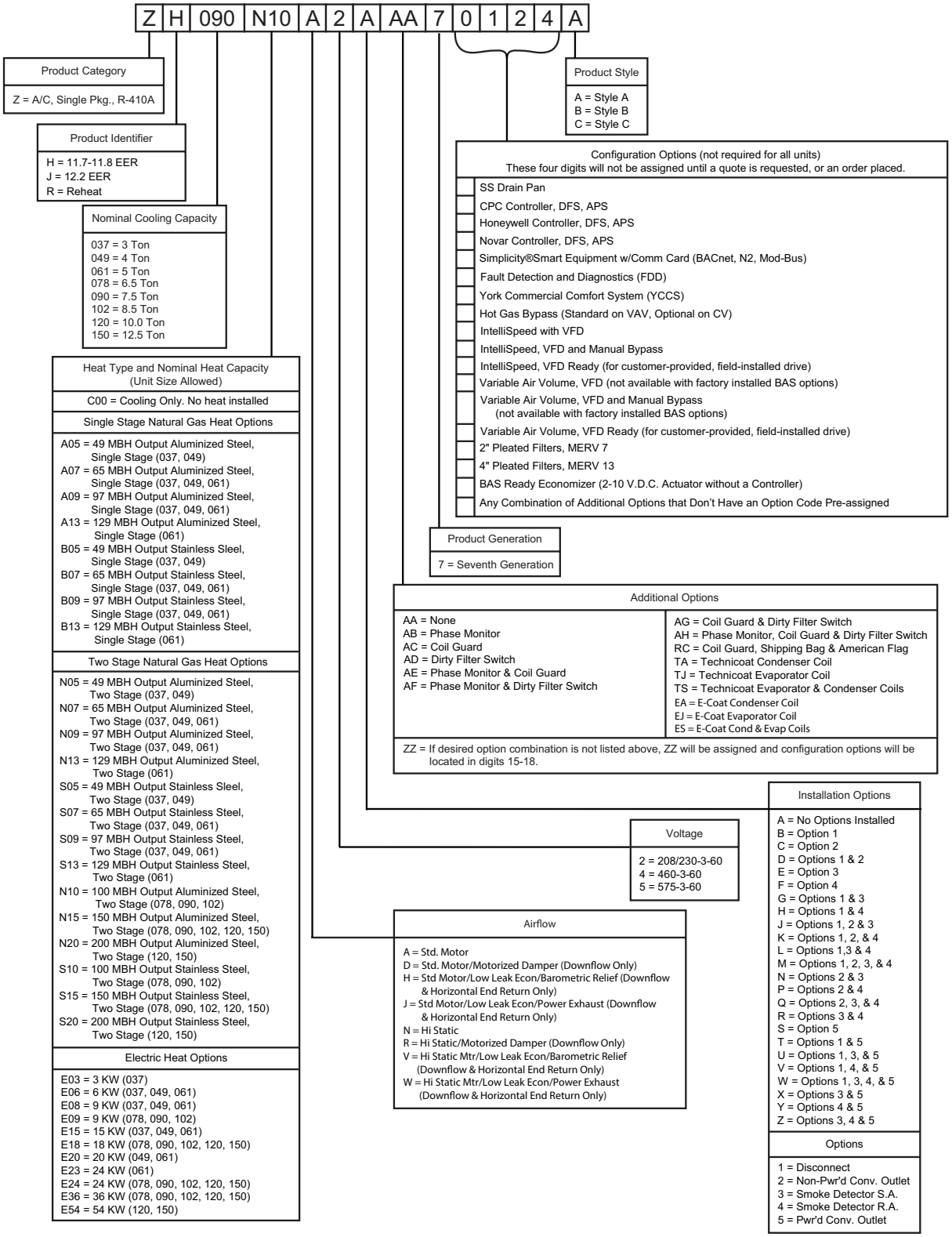
Additional Options
1 = STD Throwaway Filter
2 = 2" Pleated Filters (Merv 8)
3 = 4" Pleated Filters (Merv 13)
4 = Coil Guard (CG), STD Filter
5 = 2" Pleated Filter,CG
6 = 4" Pleated Filter,CG

Cabinet Options
A = Std Cabinet
E = SSD (SST Drain Pan)
R = Reverse Drain Pan

Product Generation
1 = First Generation

Prior Nomenclature

3-12.5 Ton York® Model Number Nomenclature
For Units Produced Before 2-01-2016



Features and Benefits

Standard Features

- **Service Friendly** - The Predator® incorporates a number of key features for ease of serviceability.

  The motor and blower slide out of the unit as a common assembly. This facilitates greater access to all the indoor airflow components, thus simplifying maintenance and adjustment.

  Service time is reduced through the use of hinged, toolless panels. Such panels provide access to frequently inspected components and areas, including the control box, compressors, filters, indoor motor & blower, and the heating section. The panels are screwed in place at the factory to prevent access by children or other unauthorized persons. It is recommended that the panels be secured with screws once service is complete.

  Service windows have been placed in both condenser section walls. Rotation of the cover allows easy access to the condenser coils for cleaning or inspection.

  The Smart Equipment™ control board provides alarm messages to help quickly identify any faults.

  All units use four filters of the same standard size. This standardization simplifies selections for filter replacement.

  The non-corrosive drain pan slides out of the unit to permit easy cleaning. The drain pan is accessed by removing the drain pan cover plate on the rear of the unit. Once the plate is removed, the drain pan slides out through the rear of the unit.

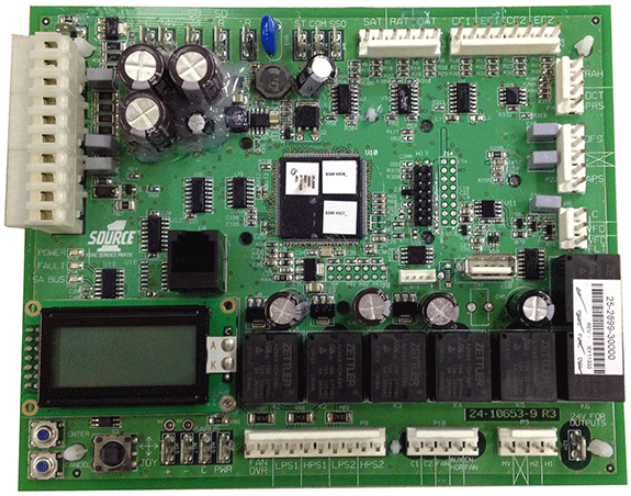
  All Predator® units have a second model nameplate located inside the control access door. This is to prevent deterioration of the nameplate through weathering.
- **Coil Technology** – All ZH/ZJ condensers utilize Micro-Channel “all-aluminum” condensers which provide improved heat transfer capabilities and reduced charge volumes. All evaporators utilize a conventional copper tube/aluminum fin design for proven reliability and performance. ZR037 thru 061 models utilize Micro-Channel condenser coils, ZR078 thru 150 models utilize copper tube/aluminum fin or Micro-Channel condenser coils. For specific unit model information see Physical Data Tables.
- **Environmentally Aware** - For improved Indoor Air Quality, a combination of aluminum foil faced and elastometric rubber insulations are used exclusively throughout the units.
- **Balanced Heating** - The Predator® two stage gas heating offers "Ultimate Heating Comfort" with a balance between 1st and 2nd stage gas heating to provide a well maintained desired temperature.

Unit Tonnage	1st. Stage	2nd. Stage
3-5 Ton	70 to 75% of Heating Capacity	100% of Heating Capacity
6.5 - 12.5 Ton	60% of Heating Capacity	100% of Heating Capacity

- **Convertible Airflow Design** – The side duct openings are covered when they leave the factory. If a side supply/return is desired, the installer simply removes the two side duct covers from the outside of the unit and installs them over the down shot openings. No panel cutting is required. Convertible airflow design allows maximum field flexibility and minimum inventory.
- **System Protection** - Suction line freezestats are supplied on all units to protect against loss of charge and coil frosting when the economizer operates at low outdoor air temperatures while the compressors are running. Every unit has solid-core liquid line filter-driers and high and low-pressure switches. Internal compressor protection is standard on all compressors. Phase Monitors are standard on units with Scroll compressors. This accessory monitors the incoming power to the unit and protects the unit from phase loss and reversed phase rotation.
- **Advanced Controls** - Smart Equipment™ control boards have standardized a number of features previously available only as options or by utilizing additional controls.

⚠ CAUTION

The Smart Equipment™ control board used in this product will effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When applying this product for process cooling applications (computer rooms, switchgear, etc.), please call the applications department for Unitary Products @ 1-877-UPG-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.



- **Units will come with the new state of the art Smart Equipment™ control system.** The new unit control incorporates the best of the already proven unitary controls and creates a more robust, intelligent control. The goal of this control is to utilize cutting edge technology making the equipment easier to install, operate, and service. All units are Factory commissioned, configured, and run tested.
- **Versatile -** The Smart Equipment™ control can be configured to use with a standard thermostat (easy to connect screw terminals), A zone sensor, or can be setup to communicate with multiple BAS communication protocols to integrate with building automation systems.
- **Reduce field installed complexity -** Each unit will comes equipped with factory installed supply air, return air, and outdoor air temperature sensors providing key temperature readings thus reduce field installed complexity.
- **On-board USB Port -** The new control comes with a long list of features including data logging, current and previous system faults and software update capabilities using the on board USB port and common flash drive. Energy use monitoring capabilities allow custom tailoring to allow a system to work more efficiently at all times and occupancy levels. Self test and start-up reports also available from the board VIA the USB port.
- **Embedded LCD Display -** The board has a easy to read, built-in LCD display and easy to use navigation joystick and buttons allowing the user to quickly navigate the menus displaying unit status, options, current function, supply, return and outdoor temperatures, fault codes and other information.
- **Safety Monitoring -** The control monitors the outdoor, supply, and return air temperatures and the high and low pressure switch status on the independent refrigerant circuits. On units with heating the gas valve and high temperature limit switches are monitored on gas and electric heating units. The control also monitors the voltage supplied to the unit and will protect the unit if low voltage due to a brown out, or other electrical issue occurs.
- **Low Ambient -** An integrated low-ambient control allows units to operate in the cooling mode down to 0°F outdoor ambient without additional components or intervention. Optionally, the control board can be programmed to lockout the compressors when the outdoor air temperature is low or when free cooling is available.
- **Anti-Short Cycle Protection -** To aid compressor life, an anti- short cycle delay is incorporated into the standard control. Compressor reliability is further ensured by programmable minimum run times. For testing, the anti-short cycle delay can be temporarily overridden with the push of a button.
- **Fan Delays -** Fan on and fan off delays are fully programmable. Furthermore, the heating and cooling fan delay times are independent of one another. All units are programmed with default values based upon their configuration of cooling and/or heating capacity.
- **Nuisance Trip Protection and Three Strikes -** To prevent nuisance calls, the control board uses a three times, you're out philosophy. The high, low-pressure switch, anti-freeze protection, low voltage or heating high limit must trip three times within two hours before the unit control board will lock out the associated compressor.An alarm message will be displayed on the LCD screen.
- **Lead-Lag** - An integrated Lead-Lag option allows equal run time hours on all compressors, thereby extending the life of all compressors. This option is selectable on the unit control board.
- **Low Limit Control (LLC)** - To prevent the supply air from dropping below a specified set point, when there is a demand for cooling during cold outside conditions. (Programmable Set point)
- **Reliable** - From the beginning - All units undergo computer automated testing before they leave the factory. Units are tested for refrigerant charge and pressure, unit amperage, and 100% functionality. For the long term - All units are painted with a long lasting, powder paint that stands up over the life of the unit. The paint used has been proven by a 1000 hour salt spray test.
- **Full Perimeter Base Rails** - The permanently attached base rails provide a solid foundation for the entire unit and protect the unit during shipment. The rails offer rigging holes so that an overhead crane can be used to place the units on a roof.
- **Easy Installation** - Gas and electric utility knockouts are supplied in the unit underside as well as the side of the unit. Utility connections can be made quickly and with a minimum amount of field labor. All units are shipped with 2" throw-away filters installed.
- **Wide Range of Indoor Airflows** - All supply air blowers are equipped with a belt drive that can be adjusted to meet the exact requirements of the job. A high static drive option is available for applications with a higher CFM and/or static pressure requirement.
- **Warranty** - All models include a 1-year limited warranty on the complete unit. Compressors and electric heater

elements each carry a 5-year warranty. Aluminized steel (10 yr.) and stainless steel tubular heat exchangers carry a 15- year warranty.

Factory Installed Options

YORK® offers several equipment options factory installed, for the Predator® line.

- **Optional Factory Installed Economizers** - Predator units offer a variety of optional factory installed economizers with low leak dampers. The outdoor air dry bulb sensor enables economizer operation if the outdoor air temperature is less than the set point of the economizer logic module. See economizer options section to determine the correct economizer for your application.
  - **Down flow / End Return Economizers (with barometric relief and fresh air hood)** - All units offer a variety of optional factory installed down flow economizers that are shipped, installed and wired with low leak dampers designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. Each economizer goes through a rigorous 60,000 cycle test. Dry bulb, single enthalpy, and dual enthalpy (with field installed kit) can be selected. The economizer has spring return, fully modulating damper actuators and is capable of introducing up to 100% outdoor air. As the outdoor air intake dampers open, the return air dampers close. The changeover from mechanical refrigeration to economizer operation is regulated by the outdoor air dry bulb temperature or the outdoor air enthalpy input. The optional (field installed) single or dual enthalpy kits provide additional inputs to monitor outdoor air/ or return air humidity and temperature for true enthalpy control. The installer needs only to assemble the outdoor air hood, attach the enthalpy control the hood and mount the hood to the unit (Hood and control are provided).
- **Power Exhaust** - This factory option allows down flow or horizontal end return economizer operation. **The power exhaust must be removed from the unit and mounted in the horizontal end return duct work when applying the product in the horizontal, end return configuration.**
- **Motorized Outdoor Air Damper** - The motorized outdoor air damper includes a slide-in/plug-in damper assembly with an outdoor air hood and filters. The outdoor air dampers open to the preset position when the indoor fan motor is energized. The damper has a range of 0% to 100% outdoor air entry.
- **Alternate Indoor Blower Motor** - For applications with high static restrictions, units are offered with optional indoor motors that provide higher static output and/or higher airflow, depending upon the installer's needs.
- **Variable Air Volume (VAV; 6.5 through 12.5 ton, only)** - A factory-installed variable frequency drive (VFD), mounted in the Blower Access compartment, is used to control the speed of the indoor blower motor in order to maintain a constant static pressure in the supply duct. A duct pressure transducer is provided with the unit. The drive comes completely wired and pre-programmed from the factory.

  An optional, factory-installed manual bypass switch available with factory-installed VFD can be found in the Blower Motor Access compartment. The switch can be used to either route power to the VFD for modulating control of the blower motor, to bypass the drive and operate the motor at full speed, or to power the drive (and not the motor) for diagnostic purposes.

  VAV is not available with the factory-installed 3rd. party BAS controllers. VAV is only factory installed with the Smart Equipment™ Controller.

  A 'VFD-ready' option provides the provisions for a customer-installed drive. The unit comes with a mounting bracket installed in the Blower Access compartment which may accommodate other vendor's drives depending on their size. In order to utilize the unit's mounting bracket, the maximum recommended drive dimensions are limited to approximately 9" H x 5" W x 7.5" D.

  If the drive will not fit in the allotted space, then it will have to be mounted elsewhere; either within the building on a perpendicular wall which is not subjected to excessive temperature, vibration, humidity, dust, corrosive gas, explosive gas, etc., or within an appropriate enclosure rated for outside installation to safeguard against moisture, dust and excessive heat. A terminal block located in the control box is provided for field connection of the VFD controls.
- ***IntelliSpeed*™ Supply Fan Control Option (ASHRAE 90.1 compliant) -** Units configured with the ***IntelliSpeed*™** Supply Fan Option will contain a VFD for multi-speed supply fan operation. This option allows the supply fan RPM to vary based on the number of compressors or heating stages energized. The economizer's minimum position will also be configurable to vary based on the supply fan VFD frequency output.
- **Aluminized Steel Gas Heat Exchanger** - For applications in non-corrosive environments.
- **Stainless Steel Gas Heat Exchanger** - For applications in corrosive environments, this option provides a full stainless steel heat exchanger assembly.
- **Low NOx Option** - For units with gas furnaces in locations where codes require that the Oxides of Nitrogen emissions from the furnace be below 40 Nano grams per joule.
- **Stainless Steel Drain Pan -** An optional rust-proof stainless steel drain pan is available to provide years of trouble-free operation in corrosive environments.
- **Electric Heaters** - The electric heaters range from 3kW to 54kW and are available in all the voltage options of the base units. All heaters are intended for single point power supply.
- **Disconnect Switch** - For gas heat units and cooling units with electric heat, a HACR breaker sized to the unit is provided. For cooling only units, a switch sized to the largest electric heat available for the particular unit is provided. Factory installed option only.

- **Convenience Outlet - (Non-Powered/Powered)** - This option locates a 120V single-phase GFCI outlet with cover, on the corner of the unit housing adjacent to the compressors. The “Non-powered” option requires the installer to provide the 120V single-phase power source and wiring. The “Powered” option is powered by a stepdown transformer in the unit. Factory installed option only.
- **Smoke Detectors** - The smoke detectors stop operation of the unit and provide a fault message to the control board. Smoke detectors are available for both the supply and/or return air configurations.
- **Filters -** 2” Pleated MERV 8 or 4” Pleated MERV 13 are available to meet LEED requirements. A 2” Throwaway is shipped as standard.

⚠WARNING

Factory-installed smoke detectors may be subjected to extreme temperatures during "off" times due to outside air infiltration. These smoke detectors have an operational limit of -4°F to 158°F. Smoke detectors installed in areas that could be outside this range will have to be relocated to prevent false alarms.

- **Phase Monitors** - Designed to prevent unit damage. The phase monitor will shut the unit down in an out-of phase condition. **(Standard on units with Scroll Compressors.)**
- **Coil Guard** - Customers can purchase a coil guard kit to protect the condenser coil from damage. Additionally, this kit stops animals and foreign objects from entering the space between the inner condenser coil and the main cabinet. This is not a hail guard kit.
- **Dirty Filter Switch** - This kit includes a differential pressure switch that energizes the fault light on the unit thermostat, indicating that there is an abnormally high pressure drop across the filters. Factory installed option or field installed accessory.
- **E-Coat Condenser Coils** - The condenser coils are coated with an epoxy polymer coating to protect against corrosion.
- **E-Coat Evaporator Coils** - The evaporator coils are coated with an epoxy polymer coating to protect against corrosion.
- **Hot Gas Bypass -** Allows operation during low load conditions while avoiding coil frosting and damage to compressor. When suction pressure falls below valve setpoint, the valve modulates hot gas to the inlet of the evaporator. HGBP is standard on all units with VAV and optional with constant-volume units.

Control Options

- **Smart Equipment™ with Communication Option Control** - The York® Smart Equipment™ with Communication Option Control is factory installed. It includes all the features of the Smart Equipment™ control with an additional gateway to BACnet MS/TP (programmable to Modbus or N2 protocols).
- **FDD (Fault Detection and Diagnostics) - Refrigerant side** A factory installed control system option on the commercial equipment that constantly monitors refrigerant circuit pressures, refrigerant circuit temperatures, as well as the environmental temperatures and humidity via multiple sensor inputs.
  - Provides a building owner, technician or contractor with the operational characteristics of the RTUs entire refrigerant circuit to ensure the unit is functioning at its specified performance level.
  - Provides alarms if the unit is not functioning optimally.
  - Remotely accessible via the Mobile Access Portal (MAP) gateway as well as scrolled on the UCB LCD screen.
- **Novar® BAS Control -** The Novar® building automation system controller is factory installed. Includes supply air sensor, return air sensor, dirty filter indicator switch, and air proving switch.
- **CPC BAS Control -** The Computer Process Controls Model 810-3060 ARTC Advanced Rooftop building automation system controller is factory installed. Includes supply air sensor, return air sensor, with optional dirty filter indicator switch and air proving switch.
- **Honeywell BAS Control -** The Honeywell W7750C building automation system controller is factory installed. Includes air supply sensor, return air sensor, with optional dirty filter indicator switch, and air proving switch.
- **Verasys** - Verasys provides a simple user experience with configurable self-recognizing controllers without the need for any additional tools. Verasys creates enhanced integration of HVACR equipment, zoning, and controls. Contractors are able to offer a complete bundled solution of equipment and controls to serve the light commercial market.

Field Installed Accessories

YORK® offers several equipment accessories for field installation, for the Predator® line.

- **Down flow and End Return Economizers (with fresh air hood and barometric relief) -** All units offer a variety of optional factory installed down flow economizers that are shipped, installed and wired with low leak dampers designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. Each economizer goes through a rigorous 60,000 cycle test. Dry bulb, single enthalpy, and dual enthalpy (with field installed kit) can be selected. The economizer has spring return, fully modulating damper actuators and is capable of introducing up to 100% outdoor air. As the outdoor air intake dampers open, the return air dampers close. The changeover from mechanical refrigeration to economizer operation is regulated by the outdoor air dry bulb temperature or the outdoor air enthalpy input. The dual enthalpy kit provides a second input used to monitor the return air (field installed). The installer needs only to assemble the outdoor air hood, attach the enthalpy control

the hood and mount the hood to the unit (Hood and control are provided).

- **Single or Dual Enthalpy Control, Accessories** - These kits contain the required components to convert a dry bulb economizer to a single enthalpy and/or dual enthalpy economizer.
- **Barometric Relief Damper** - Zero to 100% capacity barometric relief dampers for use with horizontal flow, or field installed economizers.
- **Power Exhaust** - This accessory installs in the unit with a down flow or horizontal end return economizer. Power exhaust plugs into the connector in the unit bulkhead. **User must purchase the 1EH0408 barometric relief and hood kit when applying the product in a horizontal flow application. The power exhaust must be mounted in the horizontal end return ductwork.**
- **Manual Outdoor Air Damper** - Like the motorized outdoor air damper, each manual outdoor air damper includes a slide-in damper assembly with an outdoor air hood and filters. Customers have a choice of dampers with ranges of 0% to 100% or 0% to 35% outdoor air entry.
- **Motorized Outdoor Air Damper** - The motorized outdoor air damper includes a slide-in/plug-in damper assembly with an outdoor air hood and filters. The outdoor air dampers open to the preset position when the indoor fan motor is energized. The damper has a range of 0% to 100% outdoor air entry. Factory installed option or field installed accessory.
- **Smoke Detectors** - The smoke detectors stop operation of the unit by interrupting power to the control board if smoke is detected within the air compartment.
- **CO_2 Sensor** - Senses CO_2 levels and automatically overrides the economizer when levels rise above the preset limits.
- **Dirty Filter Switch** - This kit includes a differential pressure switch that energizes the fault light on the unit thermostat, indicating that there is an abnormally high pressure drop across the filters.
- **Coil Guard -** Field installed decorative wire coil guard.
- **Hail Guard** - This kit includes a sloped hood which installs over the outside condenser coil and prevents damage to the coil fins from hail strikes. Field installed accessory only.
- **Flue Exhaust Extension Kit** - In locations with wind or weather conditions which may interfere with proper exhausting of furnace combustion products, this kit can be installed to prevent the flue exhaust from entering nearby fresh air intakes.
- **Gas Heat High Altitude Kit** - This kit converts a gas heat unit to operate at high altitudes, 2,000 to 6,000 feet. Conversion kits are available for natural gas and propane.
- **Low NOx Kit** - For units with gas furnaces in locations where codes require that the Oxides of Nitrogen emissions from the furnace be below 40 Nano grams per joule.
- **Gas Heat Propane Conversion Kit** - This kit converts a gas-fired heater from natural gas to propane. It contains the main burner orifices and gas valve replacement springs.
- **Gas Piping Kit** - Contains pipe nipples, fittings and gas cock required for gas supply connection with external shut off.
- **Electric Heaters** - The electric heaters range from 3kW to 54kW and are available in all the voltage options of the base units. The 54kW/208-240 volt, field-installed heater kit is not available with VAV units due to a lack of space to accommodate the heater's fuse block accessory.

  All heaters are dual staged. Cooling units include an adapter panel for easy installation of the electric heaters. Necessary hardware and connectors are included with the heaters. All heaters are intended for single point power supply.
- **Metal Frame Filter Kit -** Metal frame with polyester filter medium.
- **Permanent Filters** - Permanent filters are available.
- **Roof Curbs** - The roof curbs have insulated decks and are shipped disassembled The roof curbs are available in 8" and 14" heights. For applications with security concerns, burglar bars are available for the duct openings of the roof curbs.
- **Roof Curb Transition -** Single Piece Adapter (10" High) - Roof curbs for transitioning from Sunline™ units to Predator® units. Fits 7.5 to 12.5 Sunline™ roof curbs only.
- **Burglar Bars** - Mount in the supply and return openings to prevent entry into the duct work.
- **Thermostat** - The units are designed to operate with 24-volt electronic and electro-mechanical thermostats. All 6.5 thru 12.5 ton ZH,ZJ units and all 3 thru 12.5 ton ZR units (with or without an economizer) operate with two-stage heat/two-stage cool or two-stage cooling only thermostats, depending upon unit configuration.

Accessories

Field Installed Accessories - Non-Electrical

MODEL	VOLTAGE	DESCRIPTION	WHERE USED
1BD0408	All	Burglar Bars, Downflow	All Cabinets
1CG0419	All	Coil Guard	(Electric / Electric Models), 50” Tall Standard Cabinets
1CG0420	All	Coil Guard	(Gas / Electric Models), 50" Tall Standard Cabinets
1CG0427	All	Coil Guard	(Electric / Electric Models), 42” Tall Cabinets
1CG0428	All	Coil Guard	(Gas / Electric Models), 42" Tall Cabinets
1HG0411	All	Hail Guard Kit	All Tall (50") Standard Cabinets, (Excludes 12.5T "V" cabinets)
1HG0415	All	Hail Guard Kit	All Short (42") Standard Cabinets
1FE0412	All	Flue Exhaust Extension Kit	All Cabinets
1FF0414	All	2" only Metal Filter Frame Kit	All Tall 50" Cabinets
1FF0415	All	2" only Metal Filter Frame Kit	All Tall 42" Cabinets
1FL0402	All	Permanent 2" only Filter Kit Includes (4) Four Filters)	All Tall 50" Cabinets
1FL0423	All	Permanent 2" only Filter Kit (Includes (4) four Filters)	All Tall 42" Cabinets
1GP0405	All	Gas Piping Kit	All Cabinets
1HA0442	All	High Altitude Kit for Natural Gas	All 6 - 12T Cabinets
1HA0450	All	High Altitude Kit for Natural Gas	3 - 5T (80, 120 & 160 MBH Input)
1HA0451	All	High Altitude Kit for Natural Gas	3 - 4T (60 MBH Input)
1HA0443	All	High Altitude Kit for Propane	All 6 - 12T Cabinets
1HA0452	All	High Altitude Kit for Propane	3 - 5T (80, 120 & 160 MBH Input)
1HA0453	All	High Altitude Kit for Propane	3 - 4T (60 MBH Input)
1NP0442	All	Propane Conversion Kit	All 6 - 12T Cabinets
1NP0454	All	Propane Conversion Kit	3 - 5T (80, 120 & 160 MBH Input)
1NP0455	All	Propane Conversion Kit	3 - 4T (60 MBH Input)
1RC0470	All	Roof Curb, 8" Height	All Cabinets
1RC0471	All	Roof Curb, 14" Height	All Cabinets
1RC0472	All	Roof Curb, Transition (7.5 T thru 12.5T Sunline to Predator 3-12T)	All Cabinets
1WC0412	All	Wooden Crate for extra protection during shipping and handling	Standard Cabinets Only (not applicable to units 119" in length)
1LN0407	All	Low NOx Kit	3 - 5T (80, 120 & 160 MBH Input)
1LN0408	All	Low NOx Kit	3 - 5T (60 MBH Input)

Accessories (Continued)

Field Installed Accessories - Electric Heat

MODEL	VOLTAGE	DESCRIPTION	WHERE USED
2TP04520925	230	9kW Electric Heat	All 50" Cabinet 6.5 and 8.5 Ton Models
2TP04520946	460		
2TP04520958	575		
2TP04531825	230	18kW Electric Heat	All 50" Cabinet 6.5, 8.5, 10 and 12.5 Ton Models
2TP04531846	460		
2TP04521858	575		
2TP04532425	230	24kW Electric Heat	All 50" Cabinet 6.5, 8.5, 10 and 12.5 Ton Models
2TP04532446	460		
2TP04522458	575		
2TP04533625	230	36kW Electric Heat	All 50" Cabinet 6.5, 8.5, 10 and 12.5 Ton Models
2TP04533646	460		
2TP04523658	575		
2TP04525425	230	54kW Electric Heat	All 50" 10 and 12.5 Ton Models
2TP04525446	460		
2TP04525458	575		
2TP04540925	230	9kW Electric Heat	All 42" Cabinet 6.5, 7.5 and 8.5 Ton Models
2TP04540946	460		
2TP04540958	575		
2TP04541825	230	18kW Electric Heat	All 42" 6.5, 7.5 and 8.5 Ton Models
2TP04541846	460		
2TP04541858	575		
2TP04542425	230	24kW Electric Heat	All 42" Cabinet 6.5, 7.5 and 8.5 Ton Models
2TP04542446	460		
2TP04542458	575		
2TP04543625	230	36kW Electric Heat	All 42" Cabinet 6.5, 7.5 and 8.5 Ton Models
2TP04543646	460		
2TP04543658	575		
2TP04510325	230	3kW Electric Heat	All 42" Cabinet 3 Ton Models
2TP04510346	460		
2TP04510625	230	6kW Electric Heat	All 42" Cabinet 3, 4 and 5 Ton Models
2TP04510646	460		
2TP04510825	230	9kW Electric Heat	All 42" Cabinet 3, 4 and 5 Ton Models
2TP04510846	460		
2TP04510858	575		
2TP04511525	230	15kW Electric Heat	All 42" Cabinet 3, 4 and 5 Ton Models
2TP04511546	460		
2TP04511558	575		
2TP04512025	230	20kW Electric Heat	All 42" 4 and 5 Ton Models
2TP04512046	460		
2TP04512058	575		
2TP04512325	230	24kW Electric Heat	All 42" Cabinet 5 Ton Models
2TP04512346	460		
2TP04512358	575		

Accessories (Continued)

Field Installed Accessories - Fresh Air

MODEL	VOLTAGE	DESCRIPTION	WHERE USED
1FA0413	All	Manual Outside Air Damper 0-35%, Downflow	All Cabinets
1FA0414	All	Manual Outside Air Damper 0-100%, Downflow	All Cabinets
1EH0408	All	Barometric Relief Kit for Power Exhaust, Horizontal Application	All Cabinets
2EC0401	All	Single Enthalpy Control	All Cabinets
2EC0402	All	Dual Enthalpy Control (Includes 2 Sensors)	All Cabinets
2EE04707624	All	Economizer for Downflow, End Return Horizontal, or ERV Applications. Includes FA Hood, Exhaust Hood w/Baro Relief	All 50" Cabinets
2EE04707424	All	Economizer for Downflow, End Return Horizontal, or ERV Applications. Includes FA Hood, Exhaust Hood w/Baro Relief	All 42" Cabinets
2EE04706924	All	Horizontal Economizer without Barometric Relief	All Cabinets
2MD04703824	All	Motorized Damper, Downflow without Barometric Relief	All Cabinets
2MD04703924	All	Motorized Damper, Horizontal without Barometric Relief	All Cabinets
2PE04704706	230	Power Exhaust 230V Downflow or Horizontal	All Cabinets
2PE04704746	460	Power Exhaust 460V Downflow or Horizontal	All Cabinets
2PE04704758	575	Power Exhaust 575V Downflow or Horizontal	All Cabinets

Field Installed Accessories - Controls

MODEL	VOLTAGE	DESCRIPTION	WHERE USED
2AP0401	All	Air Proving Switch	All Units
2AQ04700324B	All	CO^2 Space Accessory	All Units
2AQ04700424C	All	CO^2 Unit Accessory	All Units
2DF0402	All	Dirty Air Switch	All Units
2SH0401	All	Wall Mounted humidity sensor-For use with MagnaDry Reheat or space humidity input to Smart Equipment™ board.	All Cabinets
2SD04700824	All	Smoke Detector for Supply	All Gen 5 units and greater with 2" & 4" Filters
2SD04700924	All	Smoke Detector for Return	All Gen 5 units and greater with 2" & 4" Filters
2SD04701024	All	Smoke Detector for Supply and Return	All Gen 5 units and greater with 2" & 4" Filters
S1-YK-MAP1810-0P	All	MAP (Mobile Access Portal) Gateway- For use with Smart Equipment™ Control.	All Units
S1-MP-PRTKIT-0P	All	MAP (Mobile Access Portal) Gateway Kit- Replacement MAP gateway protective case, lanyard and communication cable. Use only to replace worn or damaged components.	All Units

Field Installed Accessories - Electrical

MODEL	VOLTAGE	DESCRIPTION	WHERE USED
2LA04704632	All	Low Ambient Kit	All 3 - 10T units (excludes ZT Units)
2LA04704633	All	Low Ambient Kit	All 12.5T cabinets
2LA04704632	All	Low Ambient Kit	All 3 - 5T Reheat Units Only

Guide Specifications

GENERAL

Units shall be manufactured by Unitary Products in an ISO 9001 certified facility. YORK® Predator® units are convertible single packages with a common footprint cabinet and common roof curb for all 3 through 12.5 ton models. All 6.5 through 12.5 ton units have two compressors with independent R-410A refrigeration circuits to provide 2 stages of cooling. The units were designed for light commercial applications and can be easily installed on a roof curb, slab, or frame. All Predator® units are self-contained and assembled on rigid full perimeter base rails allowing for 3-way forklift access and overhead rigging. Every unit is completely charged with R-410A, wired, piped, and tested at the factory to provide a quick and easy field installation. All units are convertible between side and down airflow. Independent economizer designs are used on side and down discharge applications, as well as all tonnage sizes. Predator® units are available in the following configurations: cooling only, cooling with electric heat, cooling with gas heat, reheat only, reheat with electric heat and reheat with gas heat. Electric heaters are available as factory-installed options or field-installed accessories.

DESCRIPTION

Units shall be factory assembled, single package, (Elec/Elec, Gas/Elec), designed for outdoor installation. They shall have built in field convertible duct connections for down discharge supply/return or horizontal discharge supply/return and be available with factory installed options or field installed accessories. The units shall be factory wired, piped and charged with R-410A refrigerant and factory tested prior to shipment. All unit wiring shall be both numbered and color coded. The cooling performance shall be rated in accordance with DOE and AHRI test procedures. Units shall be CSA certified to ANSI Z21.47 and UL 1995/CAN/CSA No. 236-M90 standards.

UNIT CABINET

Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards. Indoor blower sections shall be insulated with up to 1" thick insulation coated on the airside. Either aluminum foil faced or elastometric rubber insulation shall be used in the unit's compartments and be fastened to prevent insulation from entering the air stream. Cabinet doors shall be hinged with toolless access for easy servicing and maintenance. Full perimeter base rails shall be provided to assure reliable transit of equipment, overhead rigging, fork truck access and proper sealing on roof curb applications. Disposable 2" filters shall be furnished as standard and be accessible through hinged access door. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils. Condensate pan shall be slide out design, constructed of a non corrosive material, internally sloped and conforming to ASHRAE 62-B9 standards. Condensate connection shall be a minimum of ¾" I.D. female and be rigid mount connection.

INDOOR (EVAPORATOR) FAN ASSEMBLY

Fan shall be a belt drive assembly and include an adjustable pitch motor pulley. Job site selected brake horsepower shall not exceed the motors nameplate horsepower rating plus the service factor. Units shall be designed to operate within the service factor. Fan wheel shall be double inlet type with forward curve blades, dynamically balanced to operate smoothly throughout the entire range of operation. Airflow design shall be constant volume. Bearings shall be sealed and permanently lubricated for longer life and no maintenance. Entire blower assembly and motor shall be slide out design.

OUTDOOR (CONDENSER) FAN ASSEMBLY

The outdoor fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The outdoor fan motors shall have permanently lubricated bearings internally protected against overload conditions and staged independently. A cleaning window shall be provided on two sides of the units for coil cleaning.

REFRIGERANT COMPONENTS

Compressors:

a. Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction gas cooled and have a voltage range of + or – 10% of the unit nameplate voltage.

b. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.

Coils:

a. Evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option.

b. Evaporator coils shall be of the direct expansion, draw-thru design.

c. Condenser coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins.

d. Condenser coils shall be of the draw-thru design.

Refrigerant Circuit and Refrigerant Safety Components shall include:

a. Independent fixed-orifice or thermally operated expansion devices.

b. Solid core filter drier/strainer to eliminate any moisture or foreign matter.

c. Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.

d. The 6.5 through 12.5 ton unit shall have two independent refrigerant circuits, equally split in 50% capacity increments.

Unit Controls:

a. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.

b. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor.

   1. Loss-of-charge/Low-pressure switch.
   2. High-pressure switch.
   3. Freeze condition sensor on evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.

c. Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.

d. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.

e. Unit control board shall have on-board diagnostics and fault message display.

f. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to a selectable value as low as 0 °F.

g. Control board shall monitor each refrigerant safety switch independently.

GAS HEATING SECTION (IF EQUIPPED)

Heat exchanger and exhaust system shall be constructed of aluminized steel, and be designed with induced draft combustion with post purge logic, energy saving direct spark ignition, and redundant main gas valve. The heat exchanger shall be of the tubular type, constructed of T1-40 aluminized steel for corrosion resistance and allowing minimum mixed air entering temperature of 40 ºF. Burners shall be of the in-shot type, constructed of aluminum-coated steel. All gas piping shall enter the unit cabinet at a single location, through either the side or bottom, without any field modifications. An integrated control board shall provide timed control of evaporator fan functioning and burner ignition. Heating section shall be provided with the following minimum protection:

a. Primary and auxiliary high-temperature limit switches.

b. Induced draft pressure sensor.

c. Flame roll out switch (manual reset).

d. Flame proving controls.

e. All two stage gas units shall have two independent stages of capacity as shown on Page 5.

ELECTRIC HEATING SECTION (IF EQUIPPED)

An electric heating section, with nickel chromium elements, shall be provided in a range of 3 thru 54KW. The heating section shall have a primary limit control(s) (automatic reset) to prevent the heating element system from operating at an excessive temperature. The Heating Section assembly shall slide out of the unit for easy maintenance and service. Units with Electric Heating Sections shall be wired for a single point power supply with branch circuit fusing (where required).

UNIT OPERATING CHARACTERISTICS

Unit shall be capable of starting and running at 125 ºF outdoor temperature, exceeding maximum load criteria of AHRI Standard 340/360. The compressor, with standard controls, shall be capable of operation down to 0 ºF outdoor temperature. Unit shall be provided with fan time delay to prevent cold air delivery before heat exchanger warms up. (Gas heat only)

ELECTRICAL REQUIREMENTS - All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.

STANDARD LIMITED WARRANTIES - Compressor – 5 Years, Heat Exchanger – 10 Years, Elect. Heat Elem. – 5 Years, Parts – 1 Year

OPTIONAL OUTDOOR AIR (Shall be made available by either/or):

- **DRY BULB AUTOMATIC ECONOMIZER -** Outdoor and return air dampers that are interlocked and positioned by a fully-modulating, spring-return damper actuator. The maximum leakage rate for the outdoor air intake dampers shall be designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feeds input into the basic module. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit. Water eliminator/filters shall be provided.

  Simultaneous economizer/compressor operation is also possible. Dampers shall fully close on power loss. Available with barometric relief and power exhaust.
- **MOTORIZED OUTDOOR AIR DAMPERS -** Outdoor and return air dampers that are interlocked and positioned by a 2- position, spring-return damper actuator. A unit-mounted potentiometer shall be provided to adjust the outdoor and return air damper assembly to take in the design CFM of outdoor air to meet the ventilation requirements of the conditioned space during normal operation. Whenever the indoor fan motor is energized, the dampers open up to one of two pre-selected positions - regardless of the outdoor air enthalpy. Dampers return to the fully closed position when the indoor fan motor is de-energized. Dampers shall fully close on power loss.

ADDITIONAL FACTORY INSTALLED OPTIONS

- **ALTERNATE INDOOR BLOWER MOTOR** – For applications with high restrictions, units are available with optional indoor blower motors that provide higher static output and/or higher airflow.
- **VARIABLE AIR VOLUME (VAV)** - The VAV option using a variable frequency drive (VFD) shall be available on 6.5 through 12.5 ton models for applications requiring a constant supply-duct static pressure. Units equipped for VAV shall be controlled by a duct pressure transducer with a 0 - 5" WC pressure range. The pressure transducer shall provide a 0 - 5 VDC output signal to a VAV control board which, in turn shall provide a 2 - 10 VDC speed reference signal to the VFD. The control board shall operate using factory-installed Supply Air, Return Air and Outside Air Temperature Sensors with a nominal resistance of 10,000 Ohms. Units equipped with VFD's shall have factory-installed manual bypass as an option.
- **CONVENIENCE OUTLET (POWERED/NON-POWERED)**– Unit can be provided with an optional 120VAC GFCI outlet with cover on the corner of the unit housing the compressors.
- **ELECTRIC HEAT** - Electric Heaters range from 3kW to 54kW and are available in all the voltage options of the base unit.
- **PHASE MONITOR** - Designed to prevent damage in out-of-phase condition.
- **COIL GUARD** - Designed to prevent condenser coil damage.
- **BAS CONTROLS HARDWARE** - Include supply air sensor, return air sensor, dirty filter indicator and air proving switch.

- **DIRTY FILTER SWITCH** – This kit includes a differential pressure switch that energizes the fault light on the unit thermostat, indicating that there is an abnormally high-pressure drop across the filters.
- **BREAKER** – An HACR breaker can be factory installed on gas heat units or cooling units with electric heat.
- **DISCONNECT SWITCH** - A disconnect can be factory installed on a cooling only units sized for the largest electric heat available.
- **STAINLESS STEEL HEAT EXCHANGER** – For applications in a corrosive environment, this option provides a full stainless steel heat exchanger assembly.
- **SMOKE DETECTOR** – A smoke detector can be factory mounted and wired in the supply and/or return air compartments.

OTHER PRE-ENGINEERED ACCESSORIES AVAILABLE

- **ROOF CURB** - 14” and 8” high, full perimeter knockdown curb, with hinged design for quick assembly.
- **BAROMETRIC RELIEF DAMPER** – (Unit mounted – Downflow, Duct Mounted – Horizontal) – Contains a rain hood, air inlet screen, exhaust damper and mounting hardware. Used to relieve internal air pressure through the unit during economizer operation.
- **PROPANE CONVERSION KIT** – Contains new orifices and gas valve springs to convert from natural to L.P. gas.
- **ECONOMIZER** (Downflow and Horizontal flow)
- **POWER EXHAUST** – (Unit mount – Downflow, Duct mount – Horizontal flow)
- **DUAL ENTHALPY KIT** - Provides a second input to economizer to monitor return air.

Physical Data

ZH037-061 Single Stage Gas Physical Data

Component	Models								
	ZH037			ZH049			ZH061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (MBh)	37000			50000			61000		
AHRI net capacity (MBh)	36000			48000			58000		
EER	11.8			11.8			11.8		
SEER	14			14			14		
CFM	1200			1600			2000		
System power (KW)	3.05			4.07			4.90		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	7-4			6-14			7-12		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	H06	H08	H12	H06	H08	H12	H08	H12	H16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	1	1	1	1	1	1	1	1	1
Temperature Rise Range (ºF)	20-50°F	25-65°F	50-80°F	20-50°F	25-65°F	40-70°F	25-65°F	35-65°F	45-75°F
Gas Limit Setting (ºF)	235°F	200°F	255°F	235°F	200°F	255°F	200°F	245°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	723			763			864		
COMPRESSORS[1]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	11.9			18.5			21.1		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	1/25			.71/18			.71/18		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	8			8			10.6		
Rows	3			3			3		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		

ZH037-061 Single Stage Gas Physical Data (Continued)

Component	Models								
	ZH037			ZH049			ZH061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
CONDENSER FAN DATA									
Quantity of fans	1			1			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			1			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	1			1			1		
RPM	850			850			850		
Total CFM	3300			3700			6700		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VM34		1VL44	1VM34		1VL44	1VL40		1VP56
Blower Sheave	AK69		AK69	AK56		AK56	AK61		AK74
Belt	A47		A47	A47		A47	A47		A51
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[2,3]			4 - (24 x 16 x 2)[2,3]			4 - (24 x 16 x 2)[2,3]		
	4 - (24 x 16 x 4)[4]			4 - (24 x 16 x 4)[4]			4 - (24 x 16 x 4)[4]		

1. ZH037, ZH049 (575V ONLY), ZH061 have crankcase heaters standard.
2. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value).
3. 2 In. Pleated, Optional, MERV 8.
4. 4 In. Pleated, Optional, MERV 13.

ZH037-061 Two Stage Gas Physical Data

Component	Models								
	ZH037			ZH049			ZH061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (MBh)	37000			50000			61000		
AHRI net capacity (MBh)	36000			48000			58000		
EER	11.8			11.8			11.8		
SEER	14			14			14		
CFM	1200			1600			2000		
System power (KW)	3.05			4.07			4.90		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	7-4			6-14			7-12		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	N06	N08	N12	N06	N08	N12	N08	N12	N16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	2[1]	2[2]	2[2]	2[1]	2[2]	2[2]	2[2]	2[2]	2[2]
Temperature Rise Range (ºF)	20-50°F	25-65°F	50-80°F	20-50°F	25-65°F	40-70°F	25-65°F	35-65°F	45-75°F
Gas Limit Setting (ºF)	235°F	200°F	255°F	235°F	200°F	255°F	200°F	245°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	723			763			864		
COMPRESSORS[3]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	11.9			18.5			21.1		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	1/25			.71/18			.71/18		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	8			8			10.6		
Rows	3			3			3		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		

ZH037-061 Two Stage Gas Physical Data (Continued)

Component	Models								
	ZH037			ZH049			ZH061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
CONDENSER FAN DATA									
Quantity of fans	1			1			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			1			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	1			1			1		
RPM	850			850			850		
Total CFM	3300			3700			6700		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VM34		1VL44	1VM34		1VL44	1VL40		1VP56
Blower Sheave	AK69		AK69	AK56		AK56	AK61		AK74
Belt	A47		A47	A47		A47	A47		A51
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[4,5]			4 - (24 x 16 x 2)[4,5]			4 - (24 x 16 x 2)[4,5]		
	4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 4)[6]		

1. 1st Stage Capacity is 75% of Full Capacity.
2. 1st Stage Capacity is 70% of Full Capacity.
3. ZH037, ZH049 (575V ONLY), ZH061 have crankcase heaters standard.
4. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value)
5. 2 In. Pleated, Optional, MERV 8.
6. 4 In. Pleated, Optional, MERV 13.

ZH078-150 Physical Data

Component	Models									
	ZH078		ZH090		ZH102		ZH120		ZH150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
AHRI COOLING PERFORMANCE										
Gross Capacity @ AHRI A point (Btu)	81000		93000		107000		125000		156000	
AHRI net capacity (Btu)	77000		88000		100000		118000		150000	
EER	11.7[1]/11.5[2]		11.7[1]/11.5[2]		11.7[1]/11.5[2]		11.7[1]/11.5[2]		11.7[1]/11.5[2]	
IEER with Constant Volume	12.9[1]/12.7[2]		12.9[1]/12.7[2]		12.9[1]/12.7[2]		-		12.8[1]/12.6[2]	
IEER with Intellispeed	14.8[1]/14.6[2]		14.2[1]/14.0[2]		14.0[1]/13.8[2]		14.8[1]/14.6[2]		14.4[1]/14.2[2]	
IEER with VAV	13.85[1]/13.65[2]		13.2[1]/13.0[2]		13.0[1]/12.8[2]		13.5[1]/13.3[2]		13.4[1]/13.2[2]	
CFM	2600		2700		3400		4000		3750	
System power (KW)	6.69		7.70		9.0		10.40		12.80	
Refrigerant type	R-410A		R-410A		R-410A		R-410A		R-410A	
Refrigerant charge (lb-oz)										
System 1	6-8		6-0		7-6		8-6		8-2	
System 2	5-14		6-0		7-2		7-7		8-2	
AHRI HEATING PERFORMANCE										
Heating model	N12	N18	N12	N18	N12	N18	N18	N24	N18	N24
Heat input (K Btu)	120	180	120	180	120	180	180	240	180	240
Heat output (K Btu)	96	144	96	144	96	144	144	192	144	192
AFUE %	-	-	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80	80	80
No. burners	4	6	4	6	4	6	6	8	6	8
No. stages	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]
Temperature Rise Range (ºF)	20-50	35-65	15-45	30-60	10-40	25-55	20-50	35-65	10-40	25-55
Gas Limit Setting (ºF)	165	165	165	165	215	195	195	160	195	160
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)										
Length	89		89		89		89		119-1/2	
Width	59		59		59		59		59	
Height	42		42		50-3/4		50-3/4		50-3/4	
OPERATING WT. (lbs.)	910		910		1047		1090		1280	
COMPRESSORS[4]										
Type	Recip		Recip		Recip		Scroll		Scroll	
Quantity	2		2		2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA										
Face area (Sq. Ft.)	23.8		23.8		29.0		29.0		47.5	
Rows	1		1		1		1		1	
Fins per inch	23		23		23		23		23	
Tube diameter (in./MM)	1/25		1/25		1/25		1/25		.71/18	
Circuitry Type	2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel	
EVAPORATOR COIL DATA										
Face area (Sq. Ft.)	10.6		10.6		13.2		13.2		13.2	
Rows	3		3		3		4		4	
Fins per inch	15		15		15		15		15	
Tube diameter	0.375		0.375		0.375		0.375		0.375	
Circuitry Type	Intertwined		Intertwined		Intertwined		Intertwined		Intertwined	
Refrigerant control	TXV		TXV		TXV		TXV		TXV	

ZH078-150 Physical Data (Continued)

Component	Models									
	ZH078		ZH090		ZH102		ZH120		ZH150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
CONDENSER FAN DATA										
Quantity of fans	2		2		2		2		4	
Fan diameter (Inch)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
Quantity of motors	2		2		2		2		4	
Motor HP each	1/3		3/4		3/4		3/4		1/3	
No. speeds	1		1		1		1		1	
RPM	850		1110		1110		1110		850	
Total CFM	6700		8600		9400		9400		14000	
BELT DRIVE EVAP FAN DATA										
Quantity	1		1		1		1		1	
Fan Size (Inch)	12 x 12		12 x 12		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor Sheave	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VP56
Blower Sheave	AK74	AK64	AK74	AK61	AK94	AK74	AK84	AK74	AK74	BK77
Belt	A49	A49	A49	A49	A56	A54	A56	A54	A54	BX55
Motor HP each	1-1/2	2	1-1/2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
FILTERS										
Quantity - Size	4 - (24 x 16 x 2)[5,6]		4 - (24 x 16 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]	
	4 - (24 x 16 x 4)[7]		4 - (24 x 16 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]	

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 1st Stage 60% of Full Capacity.
4. ZH120 and ZH150 have crankcase heaters standard.
5. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
6. 2 In. Pleated, Optional, MERV 8.
7. 4 In. Pleated, Optional, MERV 13.

ZJ037-061 Single Stage Gas Heat Physical Data

Component	Models								
	ZJ037			ZJ049			ZJ061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (MBh)	37000			50000			62000		
AHRI net capacity (MBh)	36000			48000			60000		
EER	12.2			12.2			12.2		
SEER	14.5			15			15		
CFM	1300			1600			2000		
System power (KW)	2.95			3.95			4.90		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	6-12			7-8			8-4		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	H06	H08	H12	H06	H08	H12	H08	H12	H16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	1	1	1	1	1	1	1	1	1
Temperature Rise Range (ºF)	20-50°F	25-65°F	50-80°F	20-50°F	25-65°F	40-70°F	25-65°F	35-65°F	45-75°F
Gas Limit Setting (ºF)	235°F	200°F	255°F	235°F	200°F	255°F	200°F	245°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	740			775			770		
COMPRESSORS[1]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	18.5			23.8			23.8		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	.71/18			.71/18			.71/18		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	7.9			10.5			10.5		
Rows	3			3			3		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		

ZJ037-061 Single Stage Gas Heat Physical Data (Continued)

Component	Models								
	ZJ037			ZJ049			ZJ061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
CONDENSER FAN DATA									
Quantity of fans	1			1			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			1			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	1			1			1		
RPM	850			850			850		
Total CFM	3300			3700			6300		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VM34		1VL44	1VM34		1VL44	1VL40		1VP56
Blower Sheave	AK69		AK69	AK56		AK56	AK61		AK74
Belt	A47		A47	A47		A47	A47		A51
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[2,3]			4 - (24 x 16 x 2)[2,3]			4 - (24 x 16 x 2)[2,3]		
	4 - (24 x 16 x 4)[4]			4 - (24 x 16 x 4)[4]			4 - (24 x 16 x 4)[4]		

1. ZJ049 and ZJ061 have crankcase heaters standard.
2. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value)
3. 2 In. Pleated, Optional, MERV 8.
4. 4 In. Pleated, Optional, MERV 13.

ZJ037-061 Two Stage Gas Heat Physical Data

Component	Models								
	ZJ037			ZJ049			ZJ061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (MBh)	37000			50000			62000		
AHRI net capacity (MBh)	36000			48000			60000		
EER	12.2			12.2			12.2		
SEER	14.5			15			15		
CFM	1300			1600			2000		
System power (KW)	2.95			3.95			4.90		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	6-12			7-8			8-4		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	N06	N08	N12	N06	N08	N12	N08	N12	N16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	2[1]	2[2]	2[2]	2[1]	2[2]	2[2]	2[2]	2[2]	2[2]
Temperature Rise Range (ºF)	20-50°F	25-65°F	50-80°F	20-50°F	25-65°F	40-70°F	25-65°F	35-65°F	45-75°F
Gas Limit Setting (ºF)	235°F	200°F	255°F	235°F	200°F	255°F	200°F	245°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	740			775			770		
COMPRESSORS[3]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	18.5			23.8			23.8		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	.71/18			.71/18			.71/18		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	7.9			23.8			10.5		
Rows	3			3			3		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		

ZJ037-061 Two Stage Gas Heat Physical Data (Continued)

Component	Models								
	ZJ037			ZJ049			ZJ061		
Nominal Tonnage	**3.0**			**4.0**			**5.0**		
CONDENSER FAN DATA									
Quantity of fans	1			1			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			1			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	1			1			1		
RPM	850			850			850		
Total CFM	3300			3700			6300		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VM34		1VL44	1VM34		1VL44	1VL40		1VP56
Blower Sheave	AK69		AK69	AK56		AK56	AK61		AK74
Belt	A47		A47	A47		A47	A47		A51
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[4,5] 4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 2)[4,5] 4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 2)[4,5] 4 - (24 x 16 x 4)[6]		

1. 1st Stage Capacity is 75% of Full Capacity.
2. 1st Stage Capacity is 70% of Full Capacity.
3. ZH049 and ZJ061 have crankcase heaters standard.
4. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value)
5. 2 In. Pleated, Optional, MERV 8.
6. 4 In. Pleated, Optional, MERV 13.

ZJ078-150 Physical Data

Component	Models									
	ZJ078		ZJ090		ZJ102		ZJ120		ZJ150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
AHRI COOLING PERFORMANCE										
Gross Capacity @ AHRI A point (Btu)	80000		93000		106000		124000		154000	
AHRI net capacity (Btu)	75000		90000		102000		120000		150000	
EER	12.2[1]/11.8[2]		12.2[1]/12.0[2]		12.2[1]/12.0[2]		12.0		12.1[1]/12[2]	
IEER with Constant Volume	14.0		13.2[1]/13.0[2]		13.0		12.9[1]/12.8[2]		13.7[1]/13.5[2]	
IEER with Intellispeed	14.8[1]/14.6[2]		14.8[1]/14.6[2]		14.0[1]/13.8[2]		14.8[1]/14.6[2]		15.2[1]/15.0[2]	
IEER with VAV	14.1[1]/13.9[2]		13.2[1]/13.0[2]		13.45[1]/13.25[2]		13.85[1]/13.65[2]		13.8[1]/13.6[2]	
CFM	2600		2400		2800		3400		3500	
System power (KW)	6.40		7.38		8.30		9.80		12.50	
Refrigerant type	R-410A		R-410A		R-410A		R-410A		R-410A	
Refrigerant charge (lb-oz)										
System 1	5-10		7-12		8-8		7-14		10-8	
System 2	5-12		7-10		8-12		7-14		9-12	
AHRI HEATING PERFORMANCE										
Heating model	N12	N18	N12	N18	N12	N18	N18	N24	N18	N24
Heat input (K Btu)	120	180	120	180	120	180	180	240	180	240
Heat output (K Btu)	96	144	96	144	96	144	144	192	144	192
AFUE %	-	-	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80	80	80
No. burners	4	6	4	6	4	6	6	8	6	8
No. stages	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]
Temperature Rise Range (ºF)	20-50	35-65	15-45	30-60	10-40	25-55	20-50	35-65	10-40	25-55
Gas Limit Setting (ºF)	165	165	165	165	215	195	195	160	195	160
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)										
Length	89		89		89		89		119-1/2	
Width	59		59		59		59		59	
Height	50-3/4		50-3/4		50-3/4		50-3/4		50-3/4	
OPERATING WT. (lbs.)	1030		1050		1060		1070		1280	
COMPRESSORS[4]										
Type	Recip		Recip		Recip		Scroll		Scroll	
Quantity	2		2		2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA										
Face area (Sq. Ft.)	29.0		23.8		29.0		29.0		47.5	
Rows	1		1		1		1		1	
Fins per inch	23		23		23		23		23	
Tube diameter (in./MM)	.71/18		1/25		1/25		1/25		.71/18	
Circuitry Type	2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel	
EVAPORATOR COIL DATA										
Face area (Sq. Ft.)	13.2		13.2		13.2		13.2		13.2	
Rows	3		4		4		4		4	
Fins per inch	15		15		15		15		15	
Tube diameter	0.375		0.375		0.375		0.375		0.375	
Circuitry Type	Intertwined		Intertwined		Intertwined		Intertwined		Intertwined	
Refrigerant control	TXV		TXV		TXV		TXV		TXV	

ZJ078-150 Physical Data (Continued)

Component	Models									
	ZJ078		ZJ090		ZJ102		ZJ120		ZJ150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
CONDENSER FAN DATA										
Quantity of fans	2		2		2		2		4	
Fan diameter (Inch)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
Quantity of motors	2		2		2		2		4	
Motor HP each	1/3		3/4		3/4		3/4		1/3	
No. speeds	1		1		1		1		1	
RPM	850		1110		1110		1110		850	
Total CFM	7400		8000		9000		9400		14000	
BELT DRIVE EVAP FAN DATA										
Quantity	1		1		1		1		1	
Fan Size (Inch)	15 x 15		15 x 15		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor Sheave	1VL40	1VM50	1VL40	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VP56
Blower Sheave	AK74	AK74	AK69	AK69	AK89	AK74	AK84	AK74	AK74	BK77
Belt	A53	A54	A52	A54	A56	A54	A56	A54	A54	BX56
Motor HP each	1-1/2	2	1-1/2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
FILTERS										
Quantity - Size	4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]	
	4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]	

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 1st Stage 60% of Full Capacity.
4. ZJ90 and ZJ150, have crankcase heaters standard.
5. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
6. 2 In. Pleated, Optional, MERV 8.
7. 4 In. Pleated, Optional, MERV 13.

ZR037-061 Single Stage Gas Heat Physical Data

Component	Models								
	ZR037			ZR049			ZR061		
Nominal Tonnage	**3**			**4**			**5**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (Btu)	36500			49000			62000		
AHRI net capacity (Btu)	35500			46900			58000		
EER	12.2			12.1			12.1		
SEER	14.7			14.5			14.25		
CFM	1200			1600			2000		
System power (KW)	2.88			3.32			4.83		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	11-8			11-0			11-0		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	H06	H08	H12	H06	H08	H12	H08	H12	H16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	1	1	1	1	1	1	1	1	1
Temperature Rise Range (ºF)	20-50°F	25-65°F	50-80°F	20-50°F	25-65°F	40-70°F	25-65°F	35-65°F	45-75°F
Gas Limit Setting (ºF)	235°F	200°F	255°F	235°F	200°F	255°F	200°F	245°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	867			880			867		
COMPRESSORS[1]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	11.9			11.9			11.9		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	.98/25			.98/25			.71/18 -.98/25		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	10.56			10.56			10.56		
Rows	3			3			4		
Fins per inch	15			15			12		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		
REHEAT COIL DATA									
Face area (Sq. Ft.)	8.9			8.9			8.9		
Rows	2			2			2		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	Solenoid			Solenoid			Solenoid		

ZR037-061 Single Stage Gas Heat Physical Data (Continued)

Component	Models								
	ZR037			ZR049			ZR061		
Nominal Tonnage	**3**			**4**			**5**		
CONDENSER FAN DATA									
Quantity of fans	1			2			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			2			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	Var.			Var.			Var.		
RPM (max.)	850			850			850		
Total CFM	3500			7000			7000		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VP34		1VL44	1VP34		1VL44	1VP34		1VL44
Blower Sheave	AK61		AK59	AK61		AK59	AK61		AK59
Belt	A47		A47	A47		A47	A47		A47
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[2, 3] 4 - (24 x 16 x 4) [4]			4 - (24 x 16 x 2) [2,3] 4 - (24 x 16 x 4) [4]			4 - (24 x 16 x 2) [2,3] 4 - (24 x 16 x 4) [4]		

1. ZR049 and ZR061 have crankcase heaters standard.
2. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value).
3. 2 In. Pleated, Optional, MERV 8.
4. 4 In. Pleated, Optional, MERV 13.

ZR037-061 Two Stage Gas Heat Physical Data

Component	Models								
	ZR037			ZR049			ZR061		
Nominal Tonnage	**3**			**4**			**5**		
AHRI COOLING PERFORMANCE									
Gross Capacity @ AHRI A point (Btu)	36500			49000			62000		
AHRI net capacity (Btu)	35600			47000			58000		
EER	12.2			12.1			12.1		
SEER	14.7			14.5			14.25		
CFM	1200			1600			2000		
System power (KW)	2.88			3.32			4.83		
Refrigerant type	R-410A			R-410A			R-410A		
Refrigerant charge (lb-oz)									
System 1	11-8			11-0			11-0		
System 2	-			-			-		
AHRI HEATING PERFORMANCE									
Heating model	N06	N08	N12	N06	N08	N12	N08	N12	N16
Heat input (K Btu)	60	80	120	60	80	120	80	120	160
Heat output (K Btu)	49	65	97	49	65	97	65	97	129
AFUE %	-		-	-		-	-		-
Steady state efficiency (%)	81.5	81	81	81.5	81	81	81	81	80.5
No. burners	4	4	6	4	4	6	4	6	8
No. stages	2^{1}	2^{2}	2^{2}	2^{1}	2^{2}	2^{2}	2^{2}	2^{2}	2^{2}
Temperature Rise Range (ºF)	20-50°F	25-65°F	35-80°F	20-50°F	25-65°F	35-80°F	25-65°F	35-80°F	45-75°F
Gas Limit Setting (ºF)	200°F	235°F	290°F	200°F	235°F	290°F	235°F	290°F	240°F
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)									
Length	89			89			89		
Width	59			59			59		
Height	42			42			42		
OPERATING WT. (lbs.)	867			880			867		
COMPRESSORS[3]									
Type	Recip			Recip			Recip		
Quantity	1			1			1		
Unit Capacity Steps (%)	100			100			100		
CONDENSER COIL DATA									
Face area (Sq. Ft.)	11.9			11.9			11.9		
Rows	1			1			1		
Fins per inch	23			23			23		
Tube diameter (in./MM)	.98/25			.98/25			.71/18 -.98/25		
Circuitry Type	2-pass Microchannel			2-pass Microchannel			2-pass Microchannel		
EVAPORATOR COIL DATA									
Face area (Sq. Ft.)	10.56			10.56			10.56		
Rows	3			3			4		
Fins per inch	15			15			12		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	TXV			TXV			TXV		
REHEAT COIL DATA									
Face area (Sq. Ft.)	8.9			8.9			8.9		
Rows	2			2			2		
Fins per inch	15			15			15		
Tube diameter	0.375			0.375			0.375		
Refrigerant control	Solenoid			Solenoid			Solenoid		

ZR037-061 Two Stage Gas Heat Physical Data (Continued)

Component	Models								
	ZR037			ZR049			ZR061		
Nominal Tonnage	**3**			**4**			**5**		
CONDENSER FAN DATA									
Quantity of fans	1			2			2		
Fan diameter (Inch)	24			24			24		
Type	Prop			Prop			Prop		
Drive type	Direct			Direct			Direct		
Quantity of motors	1			2			2		
Motor HP each	1/3			1/3			1/3		
No. speeds	Var.			Var.			Var.		
RPM	850			850			850		
Total CFM	3500			7000			7000		
BELT DRIVE EVAP FAN DATA									
Quantity	1			1			1		
Fan Size (Inch)	12 x 9			12 x 9			12 x 9		
Type	Centrifugal			Centrifugal			Centrifugal		
Motor Sheave	1VP34		1VL44	1VP34		1VL44	1VP34		1VL44
Blower Sheave	AK61		AK59	AK61		AK59	AK61		AK59
Belt	A47		A47	A47		A47	A47		A47
Motor HP each	1-1/2		1-1/2	1-1/2		1-1/2	1-1/2		2
RPM	1725		1725	1725		1725	1725		1725
Frame size	56		56	56		56	56		56
FILTERS									
Quantity - Size	4 - (24 x 16 x 2)[4,5]			4 - (24 x 16 x 2)[4,5]			4 - (24 x 16 x 2)[4,5]		
	4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 4)[6]			4 - (24 x 16 x 4)[6]		

1. 1st Stage Capacity is 75% of Full Capacity.
2. 1st Stage Capacity is 70% of Full Capacity.
3. ZR049 and ZR061 have crankcase heaters standard.
4. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value).
5. 2 In. Pleated, Optional, MERV 8.
6. 4 In. Pleated, Optional, MERV 13.

ZR078-150 Physical Data

Component	Models									
	ZR078		ZR090		ZR102		ZR120		ZR150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
AHRI COOLING PERFORMANCE										
Gross Capacity @ AHRI A point (Mbh)	80000		90000		105000		124000		157000	
AHRI net capacity (Mbh)	78000		88000		102000[1]/100000[2]		118000		150000	
EER	11.2		11.2		11.2		11.2		11.0	
IEER with Intellispeed	13		14.0[1]/13.8[2]		13.2[1]/13.0[2]		12.9[1]/12.7[2]		13.2[1]/13.0[2]	
CFM	2200		2775		3350		3750		4450	
System power (KW)	6.96		7.77		9.11		10.71		13.39	
Refrigerant type	R-410A		R-410A		R-410A		R-410A		R-410A	
Refrigerant charge (lb-oz)										
System 1	9-0		6-12		11-10		8-11		20-0	
System 2	5-8		6-0		10-3		7-8		19-0	
AHRI HEATING PERFORMANCE										
Heating model	N12	N18	N12	N18	N12	N18	N18	N24	N18	N24
Heat input (K Btu)	120	180	120	180	120	180	180	240	180	240
Heat output (K Btu)	96	144	96	144	96	144	144	192	144	192
AFUE %	-	-	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80	80	80
No. burners	4	6	4	6	4	6	6	8	6	8
No. stages	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]
Temperature Rise Range (ºF)	20-50	35-65	15-45	30-60	10-40	25-55	20-50	35-65	10-40	25-55
Gas Limit Setting (ºF)	165	165	165	165	215	195	195	160	195	160
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)										
Length	89		89		89		89		119-7/16	
Width	59		59		59		59		59	
Height	42		42		50-3/4		50-3/4		50-3/4	
OPERATING WT. (lbs.)	957		965		1200		1200		1465	
COMPRESSORS[4]										
Type	Scroll		Scroll		Scroll		Scroll		Scroll	
Quantity	2		2		2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA										
Face area (Sq. Ft.)	23.8		23.8		29.0		29.0		47.5	
Rows	2 / 1		1		2		1		2	
Fins per inch	20		23		20		23		15	
Tube diameter (in.)	3/8		-		3/8		-		3/8	
Tube diameter (in.)/MM	-		1/25		-		1/25		-	
Circuitry Type	Split-face		2-pass Microchannel		Split-face		2-pass Microchannel		Split-face	
EVAPORATOR COIL DATA										
Face area (Sq. Ft.)	10.6		10.6		13.2		13.2		13.2	
Rows	3		3		4		4		4	
Fins per inch	15		15		15		15		15	
Tube diameter	3/8		3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face		Split-face	
Refrigerant control	TXV		TXV		TXV		TXV		TXV	

ZR078-150 Physical Data (Continued)

Component	Models									
	ZR078		ZR090		ZR102		ZR120		ZR150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
REHEAT COIL DATA										
Face area (Sq. Ft.)	6.66		6.66		10		10		10	
Rows	2		2		2		2		2	
Fins per inch	13		13		13		13		13	
Tube diameter (in.)	3/8		3/8		3/8		3/8		3/8	
CONDENSER FAN DATA										
Quantity of Fans	2		2		2		2		4	
Fan diameter (Inch)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
Quantity of motors	2		2		2		2		4	
Motor HP each	1/3		1/3		1/3		3/4		1/3	
No. speeds	1		1		1		1		1	
RPM	850		850		850		1110		850	
Total CFM	6800		6800		6800		9500		14000	
BELT DRIVE EVAP FAN DATA										
Quantity	1		1		1		1		1	
Fan Size (Inch)	12 x 12		12 x 12		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor Sheave	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VP56
Blower Sheave	AK74	AK64	AK74	AK61	AK89	AK74	AK84	AK74	AK74	BK77
Belt	A49	A49	A49	A49	A56	A54	A56	A54	A54	BX55
Motor HP each	1-1/2	2	1-1/2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
FILTERS										
Quantity - Size	4 - (24 x 16 x 2)[5,6]		4 - (24 x 16 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]		4 - (24 x 20 x 2)[5,6]	
	4 - (24 x 16 x 4)[7]		4 - (24 x 16 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]		4 - (24 x 20 x 4)[7]	

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 1st Stage 60% of 2nd Stage
4. ZR90, ZR102, ZR120, ZR150, have crankcase heaters standard.
5. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
6. 2 In. Pleated, Optional, MERV 8.
7. 4 In. Pleated, Optional, MERV 13.

ZH/ZJ/ZR078-150 Unit Limitations

Size (Tons)	Model	Unit Voltage	Unit Limitations		
			Applied Voltage		Outdoor DB Temp
			Min	Max	Max (°F)
037 (3)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
049 (4)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
061 (5)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
078 (6.5)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
090 (7.5)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
102 (8.5)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
120 (10)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
150 (12.5)	ZH/ZJ/ZR	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125

Capacity Performance

ZH037-150 Cooling Capacities

ZH037 (3.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
750	77	49.1	2.3	20.2	16.8	13.4	-	-	-	46.5	2.5	19.1	15.7	12.4	-	-	-
	72	44.4	2.2	25.1	21.7	18.4	15.0	-	-	41.7	2.5	23.9	20.5	17.2	13.8	-	-
	67	39.6	2.2	30.0	26.6	23.3	19.9	16.5	-	36.9	2.5	28.7	25.3	22.0	18.6	15.2	-
	62	35.4	2.3	35.4	32.8	27.8	24.5	21.1	17.8	32.6	2.5	32.6	31.3	26.3	22.9	19.6	16.2
900	77	51.2	2.2	22.9	18.8	14.8	-	-	-	48.2	2.5	21.6	17.6	13.6	-	-	-
	72	46.2	2.2	28.2	24.2	20.2	16.1	-	-	43.2	2.5	26.8	22.8	18.9	14.9	-	-
	67	41.3	2.2	33.6	29.6	25.6	21.5	17.5	-	38.2	2.5	32.1	28.1	24.1	20.2	16.2	-
	62	36.9	2.3	36.9	35.1	30.6	26.5	22.5	18.5	33.7	2.5	33.7	32.9	28.9	24.9	20.9	17.0
	57	35.4	2.3	35.4	35.4	32.4	28.4	24.3	20.3	33.2	2.5	33.2	33.2	30.2	26.2	22.3	18.3
1050	77	53.3	2.2	25.5	20.8	16.1	-	-	-	49.9	2.5	24.0	19.4	14.8	-	-	-
	72	48.1	2.2	31.4	26.7	22.0	17.3	-	-	44.7	2.5	29.8	25.2	20.6	16.0	-	-
	67	43.0	2.2	37.3	32.6	27.9	23.2	18.5	-	39.5	2.5	35.5	30.9	26.3	21.7	17.1	-
	62	38.3	2.3	38.3	37.5	33.3	28.6	23.9	19.2	34.9	2.5	34.9	34.5	31.5	26.9	22.3	17.7
	57	36.8	2.3	36.8	36.8	35.3	30.6	25.9	21.2	34.3	2.5	34.3	34.3	32.9	28.3	23.7	19.2
1200	77	55.4	2.2	28.2	22.8	17.5	-	-	-	51.5	2.5	26.5	21.3	16.1	-	-	-
	72	50.0	2.2	34.6	29.2	23.8	18.4	-	-	46.2	2.5	32.7	27.5	22.3	17.1	-	-
	67	44.6	2.2	41.0	35.6	30.2	24.8	19.4	-	40.8	2.5	38.9	33.7	28.5	23.3	18.1	-
	62	39.8	2.3	39.8	39.8	36.1	30.7	25.3	19.9	36.1	2.5	36.1	36.1	34.1	28.9	23.7	18.5
	57	38.3	2.2	38.3	38.3	38.3	32.9	27.5	22.1	35.5	2.5	35.5	35.5	35.7	30.5	25.2	20.0
1350	72	50.1	2.2	37.2	31.3	25.4	19.5	-	-	46.5	2.5	35.4	29.6	23.8	18.1	-	-
	67	44.7	2.2	42.9	38.1	32.2	26.3	20.4	-	41.1	2.5	40.1	36.3	30.5	24.7	19.0	-
	62	39.9	2.3	39.9	39.9	38.0	32.1	26.3	20.4	36.3	2.5	36.3	36.3	35.3	29.6	23.8	18.0
	57	38.3	2.2	38.3	38.3	38.3	32.4	26.6	20.7	35.7	2.5	35.7	35.7	35.8	30.0	24.3	18.5
1500	72	50.1	2.2	39.7	33.4	27.0	20.6	-	-	46.8	2.5	38.0	31.7	25.4	19.1	-	-
	67	44.8	2.2	44.8	40.6	34.2	27.8	21.5	-	41.3	2.5	41.3	38.8	32.5	26.2	19.9	-
	62	39.9	2.3	39.9	39.9	39.9	33.6	27.2	20.8	36.5	2.5	36.5	36.5	36.5	30.2	23.9	17.6
	57	38.4	2.3	38.4	38.4	38.4	32.0	25.6	19.2	35.9	2.5	35.9	35.9	35.9	29.6	23.3	17.0
		95°F								**105°F**							
750	77	44.0	2.7	18.0	14.7	11.3	-	-	-	40.2	3.0	15.8	13.5	10.2	-	-	-
	72	39.0	2.7	22.7	19.3	16.0	12.6	-	-	35.5	2.9	21.2	18.0	14.7	11.4	-	-
	67	34.1	2.7	27.4	24.0	20.7	17.3	13.9	-	30.8	2.9	26.6	22.4	19.2	15.9	12.7	-
	62	29.8	2.6	29.8	29.8	24.7	21.4	18.0	14.7	27.0	2.8	27.0	27.0	23.2	20.0	16.7	13.5
900	77	45.2	2.7	20.3	16.3	12.4	-	-	-	41.2	3.0	18.9	15.0	11.2	-	-	-
	72	40.1	2.7	25.4	21.5	17.6	13.6	-	-	36.4	3.0	23.8	20.0	16.2	12.4	-	-
	67	35.1	2.7	30.5	26.6	22.7	18.8	14.9	-	31.5	2.9	28.7	24.9	21.1	17.3	13.5	-
	62	30.6	2.7	30.6	30.6	27.2	23.3	19.4	15.4	27.7	2.9	27.7	27.7	25.6	21.8	17.9	14.1
	57	30.9	2.7	30.9	30.9	28.0	24.1	20.2	16.2	28.2	2.9	28.2	28.2	26.0	22.2	18.4	14.6
1050	77	46.5	2.8	22.5	18.0	13.5	-	-	-	42.2	3.0	21.9	16.6	12.3	-	-	-
	72	41.2	2.7	28.1	23.6	19.1	14.7	-	-	37.2	3.0	26.4	22.0	17.6	13.3	-	-
	67	36.0	2.7	33.7	29.2	24.8	20.3	15.8	-	32.3	3.0	30.9	27.4	23.0	18.7	14.3	-
	62	31.5	2.7	31.5	31.5	29.7	25.2	20.7	16.2	28.3	2.9	28.3	28.3	27.9	23.5	19.2	14.8
	57	31.8	2.7	31.8	31.8	30.5	26.1	21.6	17.1	28.9	2.9	28.9	28.9	28.4	24.0	19.7	15.3
1200	77	47.7	2.8	24.7	19.7	14.7	-	-	-	43.2	3.1	24.9	18.2	13.3	-	-	-
	72	42.3	2.8	30.8	25.8	20.7	15.7	-	-	38.1	3.0	28.9	24.0	19.1	14.2	-	-
	67	37.0	2.8	36.9	31.8	26.8	21.8	16.7	-	33.1	3.0	33.0	29.9	25.0	20.1	15.1	-
	62	32.3	2.7	32.3	32.3	32.1	27.1	22.0	17.0	29.0	2.9	29.0	29.0	30.2	25.3	20.4	15.5
	57	32.6	2.7	32.6	32.6	33.1	28.0	23.0	17.9	29.6	2.9	29.6	29.6	30.7	25.8	20.9	16.0
1350	72	42.9	2.8	33.6	27.9	22.3	16.6	-	-	38.5	3.0	31.7	26.2	20.7	15.2	-	-
	67	37.5	2.7	37.4	34.4	28.8	23.2	17.5	-	33.4	3.0	33.4	31.6	27.0	21.5	16.0	-
	62	32.7	2.7	32.7	32.7	32.6	27.0	21.3	15.7	29.3	2.9	29.3	29.3	29.9	24.4	18.9	13.4
	57	33.0	2.7	33.0	33.0	33.3	27.6	22.0	16.4	29.9	2.9	29.9	29.9	30.5	25.0	19.5	14.0
1500	72	43.4	2.8	36.3	30.1	23.8	17.6	-	-	39.0	3.0	34.4	28.3	22.2	16.1	-	-
	67	37.9	2.7	37.9	37.1	30.8	24.6	18.4	-	33.8	3.0	33.8	33.4	29.0	22.9	16.8	-
	62	33.1	2.7	33.1	33.1	33.1	26.9	20.7	14.4	29.6	2.9	29.6	29.6	29.6	23.6	17.5	11.4
	57	33.5	2.7	33.5	33.5	33.5	27.2	21.0	14.8	30.2	2.9	30.2	30.2	30.2	24.1	18.0	11.9

ZH037 (3.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
750	77	36.4	3.3	13.7	12.3	9.1	-	-	-	32.6	3.5	12.4	10.7	8.1	-	-	-
	72	31.9	3.2	19.7	16.6	13.4	10.3	-	-	28.4	3.4	18.2	15.2	12.2	9.1	-	-
	67	27.4	3.1	25.8	20.9	17.7	14.6	11.4	-	24.1	3.4	24.1	19.3	16.3	13.2	10.2	-
	62	24.2	3.0	24.2	24.2	21.7	18.6	15.4	12.3	21.4	3.2	21.4	21.4	21.4	17.2	14.1	11.1
900	77	37.2	3.3	17.4	13.8	10.1	-	-	-	33.1	3.6	16.7	12.5	8.9	-	-	-
	72	32.6	3.2	22.2	18.5	14.8	11.1	-	-	28.8	3.5	20.6	17.0	13.4	9.8	-	-
	67	28.0	3.2	26.9	23.2	19.5	15.8	12.1	-	24.5	3.4	24.5	21.5	17.9	14.4	10.8	-
	62	24.7	3.1	24.7	24.7	23.9	20.2	16.5	12.8	21.7	3.3	21.7	21.7	21.7	18.7	15.1	11.5
	57	25.4	3.1	25.4	25.4	24.0	20.3	16.6	12.9	22.7	3.3	22.7	22.7	22.0	18.4	14.8	11.3
1050	77	37.9	3.3	21.2	15.2	11.0	-	-	-	33.7	3.6	20.9	14.2	9.7	-	-	-
	72	33.2	3.2	24.6	20.4	16.2	11.9	-	-	29.2	3.5	22.9	18.8	14.7	10.6	-	-
	67	28.6	3.2	28.0	25.6	21.3	17.1	12.9	-	24.8	3.4	24.8	23.7	19.6	15.5	11.4	-
	62	25.2	3.1	25.2	25.2	26.1	21.9	17.6	13.4	22.1	3.3	22.1	22.1	22.1	20.2	16.1	12.0
	57	26.0	3.1	26.0	26.0	26.2	22.0	17.7	13.5	23.0	3.3	23.0	23.0	23.0	19.9	15.8	11.7
1200	77	38.7	3.3	25.0	16.7	11.9	-	-	-	34.2	3.6	25.2	15.9	10.5	-	-	-
	72	33.9	3.3	27.1	22.3	17.5	12.7	-	-	29.7	3.5	25.2	20.6	15.9	11.3	-	-
	67	29.1	3.2	29.1	27.9	23.1	18.3	13.6	-	25.2	3.4	25.2	25.2	21.3	16.6	12.0	-
	62	25.7	3.1	25.7	25.7	28.3	23.5	18.8	14.0	22.4	3.3	22.4	22.4	22.4	21.8	17.1	12.5
	57	26.5	3.1	26.5	26.5	28.4	23.6	18.9	14.1	23.4	3.3	23.4	23.4	23.4	21.5	16.8	12.2
1350	72	34.2	3.3	29.8	24.4	19.1	13.7	-	-	29.9	3.6	27.9	22.7	17.4	12.2	-	-
	67	29.4	3.2	29.4	28.8	25.2	19.8	14.4	-	25.4	3.5	25.4	25.4	23.3	18.1	12.9	-
	62	25.9	3.1	25.9	25.9	27.2	21.9	16.5	11.2	22.5	3.3	22.5	22.5	22.5	19.3	14.1	8.9
	57	26.7	3.1	26.7	26.7	27.7	22.3	17.0	11.6	23.5	3.4	23.5	23.5	23.5	19.7	14.4	9.2
1500	72	34.5	3.3	32.5	26.5	20.6	14.7	-	-	30.1	3.6	30.1	24.8	19.0	13.2	-	-
	67	29.7	3.2	29.7	29.7	27.2	21.2	15.3	-	25.5	3.5	25.5	25.5	25.4	19.6	13.8	-
	62	26.2	3.2	26.2	26.2	26.2	20.2	14.3	8.3	22.7	3.4	22.7	22.7	22.7	16.9	11.1	5.3
	57	26.9	3.2	26.9	26.9	26.9	21.0	15.1	9.1	23.7	3.4	23.7	23.7	23.7	17.9	12.1	6.3

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH049 (4.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1000	77	65.4	3.0	28.0	23.5	19.1	-	-	-	60.3	3.3	25.1	20.8	16.4	-	-	-
	72	59.2	3.0	34.8	30.3	25.9	21.4	-	-	54.5	3.3	31.8	27.5	23.2	18.9	-	-
	67	53.0	2.9	41.6	37.1	32.7	28.3	23.8	-	48.8	3.2	38.6	34.2	29.9	25.6	21.3	-
	62	47.0	2.9	47.0	47.0	40.3	35.9	31.4	27.0	43.1	3.2	43.1	43.1	37.1	32.8	28.5	24.1
1200	77	68.3	3.0	30.8	25.6	20.4	-	-	-	62.9	3.3	27.9	22.9	17.8	-	-	-
	72	61.8	3.0	38.0	32.9	27.7	22.5	-	-	56.9	3.3	35.2	30.2	25.1	20.1	-	-
	67	55.3	2.9	45.3	40.1	35.0	29.8	24.6	-	50.9	3.2	42.5	37.5	32.4	27.4	22.3	-
	62	49.1	2.9	49.1	49.1	43.1	38.0	32.8	27.6	45.0	3.2	45.0	45.0	40.2	35.2	30.1	25.1
	57	48.9	2.9	48.9	48.9	47.1	42.0	36.8	31.6	44.8	3.2	44.8	44.8	42.3	37.2	32.2	27.1
1400	77	71.2	3.0	33.6	27.7	21.8	-	-	-	65.5	3.3	30.7	25.0	19.2	-	-	-
	72	64.4	3.0	41.3	35.4	29.5	23.6	-	-	59.2	3.3	38.6	32.9	27.1	21.3	-	-
	67	57.7	2.9	49.0	43.1	37.3	31.4	25.5	-	52.9	3.2	46.5	40.7	35.0	29.2	23.4	-
	62	51.1	2.9	51.1	51.1	46.0	40.1	34.2	28.3	46.8	3.2	46.8	46.8	43.3	37.6	31.8	26.0
	57	51.0	2.9	51.0	51.0	50.3	44.4	38.5	32.6	46.6	3.2	46.6	46.6	45.5	39.8	34.0	28.2
1600	77	74.1	3.0	36.4	29.8	23.2	-	-	-	68.1	3.4	33.6	27.1	20.6	-	-	-
	72	67.1	3.0	44.6	38.0	31.4	24.7	-	-	61.5	3.3	42.0	35.5	29.0	22.5	-	-
	67	60.0	2.9	52.8	46.1	39.5	32.9	26.3	-	55.0	3.3	50.5	44.0	37.5	31.0	24.5	-
	62	53.2	2.9	53.2	53.2	48.8	42.1	35.5	28.9	48.7	3.2	48.7	48.7	46.5	40.0	33.5	27.0
	57	53.1	2.9	53.1	53.1	53.4	46.8	40.2	33.5	48.4	3.2	48.4	48.4	48.8	42.3	35.8	29.3
1800	72	69.2	3.0	48.1	40.9	33.6	26.4	-	-	63.4	3.4	45.4	38.3	31.2	24.0	-	-
	67	62.0	3.0	58.3	49.6	42.4	35.2	28.0	-	56.7	3.3	54.4	47.4	40.2	33.1	26.0	-
	62	54.9	3.0	54.9	54.9	52.7	45.5	38.3	31.1	50.1	3.3	50.1	50.1	49.0	41.9	34.8	27.7
	57	54.8	2.9	54.8	54.8	54.9	47.7	40.5	33.3	49.9	3.2	49.9	49.9	50.1	43.0	35.8	28.7
2000	72	71.4	3.1	51.6	43.7	35.9	28.1	-	-	65.2	3.4	48.8	41.0	33.3	25.6	-	-
	67	63.9	3.0	63.9	53.1	45.3	37.5	29.7	-	58.3	3.3	58.3	50.7	43.0	35.2	27.5	-
	62	56.6	3.0	56.6	56.6	56.6	48.8	41.0	33.2	51.6	3.3	51.6	51.6	51.6	43.9	36.1	28.4
	57	56.5	3.0	56.5	56.5	56.5	48.6	40.8	33.0	51.4	3.3	51.4	51.4	51.4	43.6	35.9	28.1
		95°F								**105°F**							
1000	77	55.3	3.6	22.2	18.0	13.8	-	-	-	50.6	4.0	19.3	16.2	12.1	-	-	-
	72	49.9	3.6	28.9	24.7	20.5	16.3	-	-	45.4	3.9	26.7	22.7	18.6	14.5	-	-
	67	44.5	3.5	35.5	31.3	27.1	22.9	18.7	-	40.1	3.8	34.2	29.1	25.1	21.0	16.9	-
	62	39.3	3.4	39.3	39.3	33.9	29.7	25.5	21.3	36.2	3.7	36.2	36.2	30.9	26.9	22.8	18.7
1200	77	57.5	3.6	25.1	20.1	15.2	-	-	-	52.4	4.0	22.9	18.2	13.4	-	-	-
	72	51.9	3.6	32.4	27.5	22.6	17.6	-	-	47.0	3.9	30.1	25.3	20.5	15.7	-	-
	67	46.4	3.5	39.8	34.8	29.9	25.0	20.0	-	41.5	3.8	37.3	32.5	27.7	22.9	18.1	-
	62	40.9	3.4	40.9	40.9	37.3	32.4	27.4	22.5	37.5	3.7	37.5	37.5	34.2	29.4	24.6	19.8
	57	40.6	3.5	40.6	40.6	37.4	32.4	27.5	22.6	37.1	3.7	37.1	37.1	33.8	29.0	24.2	19.4
1400	77	59.8	3.7	27.9	22.3	16.6	-	-	-	54.3	4.0	26.6	20.1	14.6	-	-	-
	72	54.0	3.6	35.9	30.3	24.6	19.0	-	-	48.6	3.9	33.5	28.0	22.5	17.0	-	-
	67	48.2	3.6	44.0	38.3	32.6	27.0	21.3	-	43.0	3.8	40.4	35.8	30.3	24.8	19.3	-
	62	42.5	3.5	42.5	42.5	40.7	35.1	29.4	23.7	38.8	3.8	38.8	38.8	37.4	31.9	26.4	20.9
	57	42.2	3.5	42.2	42.2	40.8	35.1	29.5	23.8	38.4	3.8	38.4	38.4	37.0	31.4	25.9	20.4
1600	77	62.0	3.7	30.8	24.4	18.0	-	-	-	56.1	4.1	30.3	22.1	15.9	-	-	-
	72	56.0	3.6	39.5	33.1	26.7	20.3	-	-	50.2	4.0	36.9	30.6	24.4	18.2	-	-
	67	50.0	3.6	48.2	41.8	35.4	29.0	22.6	-	44.4	3.9	43.5	39.2	32.9	26.7	20.5	-
	62	44.1	3.5	44.1	44.1	44.1	37.8	31.4	25.0	40.1	3.8	40.1	40.1	40.7	34.4	28.2	22.0
	57	43.8	3.5	43.8	43.8	44.2	37.8	31.5	25.1	39.7	3.8	39.7	39.7	40.2	33.9	27.7	21.5
1800	72	57.6	3.7	42.7	35.7	28.7	21.7	-	-	51.6	4.0	40.1	33.2	26.3	19.5	-	-
	67	51.4	3.6	50.5	45.1	38.0	31.0	24.0	-	45.6	3.9	45.2	41.9	35.5	28.6	21.8	-
	62	45.3	3.5	45.3	45.3	45.3	38.3	31.3	24.3	41.2	3.8	41.2	41.2	41.5	34.6	27.7	20.8
	57	45.0	3.6	45.0	45.0	45.2	38.2	31.2	24.2	40.8	3.8	40.8	40.8	41.0	34.1	27.2	20.4
2000	72	59.1	3.7	46.0	38.3	30.7	23.0	-	-	53.0	4.1	43.3	35.8	28.3	20.7	-	-
	67	52.7	3.7	52.7	48.3	40.7	33.0	25.3	-	46.8	4.0	46.8	44.6	38.1	30.6	23.1	-
	62	46.5	3.6	46.5	46.5	46.5	38.9	31.2	23.6	42.2	3.9	42.2	42.2	42.2	34.7	27.2	19.6
	57	46.2	3.6	46.2	46.2	46.2	38.6	30.9	23.2	41.8	3.9	41.8	41.8	41.8	34.3	26.8	19.2

ZH049 (4.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1000	77	46.0	4.3	16.4	14.3	10.4	-	-	-	41.4	4.7	13.7	12.1	8.7	-	-	-
	72	40.8	4.2	24.6	20.6	16.7	12.7	-	-	36.3	4.5	22.4	18.6	14.8	11.0	-	-
	67	35.6	4.1	32.8	26.9	23.0	19.0	15.1	-	31.2	4.3	31.2	24.7	20.9	17.1	13.2	-
	62	33.1	4.0	33.1	33.1	28.0	24.1	20.1	16.2	29.9	4.3	29.9	29.9	25.1	21.3	17.5	13.7
1200	77	47.4	4.4	20.8	16.2	11.5	-	-	-	42.3	4.7	19.1	14.2	9.7	-	-	-
	72	42.0	4.2	27.8	23.1	18.5	13.8	-	-	37.1	4.5	25.5	21.0	16.5	11.9	-	-
	67	36.7	4.1	34.8	30.1	25.5	20.8	16.2	-	31.9	4.4	31.9	27.8	23.3	18.7	14.2	-
	62	34.0	4.0	34.0	34.0	31.1	26.4	21.8	17.1	30.6	4.3	30.6	30.6	28.0	23.5	19.0	14.4
	57	33.6	4.0	33.6	33.6	30.2	25.5	20.8	16.2	30.1	4.3	30.1	30.1	26.6	22.0	17.5	13.0
1400	77	48.7	4.4	25.3	18.0	12.6	-	-	-	43.2	4.8	24.6	16.2	10.7	-	-	-
	72	43.2	4.3	31.0	25.7	20.3	14.9	-	-	37.9	4.6	28.6	23.4	18.1	12.9	-	-
	67	37.8	4.1	36.8	33.3	28.0	22.6	17.2	-	32.5	4.4	32.5	30.8	25.6	20.4	15.2	-
	62	35.0	4.1	35.0	35.0	34.1	28.8	23.4	18.0	31.3	4.3	31.3	31.3	30.9	25.6	20.4	15.2
	57	34.6	4.1	34.6	34.6	33.1	27.8	22.4	17.0	30.7	4.3	30.7	30.7	29.3	24.1	18.8	13.6
1600	77	50.1	4.4	29.7	19.9	13.8	-	-	-	44.1	4.8	30.1	18.3	11.7	-	-	-
	72	44.4	4.3	34.3	28.2	22.1	16.0	-	-	38.7	4.6	31.7	25.7	19.8	13.9	-	-
	67	38.8	4.2	38.8	36.5	30.5	24.4	18.3	-	33.2	4.4	33.2	33.2	28.0	22.1	16.2	-
	62	36.0	4.1	36.0	36.0	37.2	31.1	25.0	19.0	31.9	4.4	31.9	31.9	31.9	27.8	21.9	16.0
	57	35.5	4.1	35.5	35.5	36.1	30.0	23.9	17.9	31.4	4.4	31.4	31.4	31.4	26.1	20.2	14.2
1800	72	45.6	4.4	37.5	30.7	24.0	17.2	-	-	39.7	4.7	34.8	28.2	21.6	15.0	-	-
	67	39.9	4.2	39.9	38.7	33.0	26.3	19.6	-	34.1	4.5	34.1	34.1	30.5	23.9	17.3	-
	62	37.0	4.1	37.0	37.0	37.6	30.8	24.1	17.4	32.8	4.4	32.8	32.8	32.8	27.1	20.5	13.9
	57	36.5	4.1	36.5	36.5	36.8	30.0	23.3	16.5	32.2	4.4	32.2	32.2	32.2	25.9	19.3	12.7
2000	72	46.8	4.4	40.6	33.2	25.8	18.4	-	-	40.7	4.8	38.0	30.7	23.4	16.2	-	-
	67	40.9	4.3	40.9	40.9	35.6	28.2	20.8	-	35.0	4.6	35.0	35.0	33.0	25.8	18.5	-
	62	37.9	4.2	37.9	37.9	37.9	30.5	23.1	15.7	33.6	4.5	33.6	33.6	33.6	26.4	19.1	11.8
	57	37.4	4.2	37.4	37.4	37.4	30.0	22.6	15.2	33.1	4.5	33.1	33.1	33.1	25.8	18.5	11.2

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH061 (5.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1250	77	82.5	3.4	36.6	30.6	25.1	-	-	-	75.9	3.9	32.9	27.4	21.9	-	-	-
	72	74.3	3.4	43.9	38.3	32.8	27.3	-	-	68.3	3.8	40.9	35.3	29.8	24.3	-	-
	67	66.2	3.4	51.1	46.0	40.5	35.0	29.4	-	60.7	3.8	48.8	43.3	37.8	32.3	26.8	-
	62	59.3	3.4	59.3	59.3	49.5	43.9	38.4	32.9	54.5	3.8	54.5	54.5	46.2	40.7	35.2	29.7
1500	77	84.7	3.4	40.0	33.6	27.1	-	-	-	78.2	3.9	36.6	30.2	23.8	-	-	-
	72	76.3	3.4	48.4	41.9	35.4	29.0	-	-	70.4	3.9	45.3	38.9	32.4	26.0	-	-
	67	68.0	3.4	56.7	50.2	43.8	37.3	30.8	-	62.5	3.8	54.0	47.5	41.1	34.6	28.2	-
	62	60.9	3.4	60.9	60.9	53.4	47.0	40.5	34.1	56.1	3.8	56.1	56.1	50.2	43.8	37.4	30.9
	57	61.6	3.4	61.6	61.6	54.9	48.4	41.9	35.5	55.2	3.8	55.2	55.2	50.6	44.1	37.7	31.2
1750	77	86.9	3.4	43.5	36.5	29.1	-	-	-	80.5	3.9	40.4	33.0	25.7	-	-	-
	72	78.4	3.4	52.8	45.5	38.1	30.7	-	-	72.4	3.9	49.8	42.4	35.0	27.6	-	-
	67	69.8	3.4	62.2	54.4	47.0	39.6	32.2	-	64.4	3.8	59.1	51.7	44.4	37.0	29.6	-
	62	62.5	3.4	62.5	62.5	57.4	50.0	42.6	35.2	57.8	3.8	57.8	57.8	54.3	46.9	39.5	32.1
	57	63.3	3.4	63.3	63.3	58.9	51.6	44.2	36.8	56.8	3.8	56.8	56.8	54.6	47.2	39.8	32.5
2000	77	89.2	3.4	47.0	39.5	31.2	-	-	-	82.7	3.9	44.2	35.9	27.6	-	-	-
	72	80.4	3.4	57.3	49.0	40.7	32.4	-	-	74.5	3.9	54.2	45.9	37.6	29.3	-	-
	67	71.6	3.4	67.7	58.6	50.3	41.9	33.6	-	66.2	3.8	64.3	56.0	47.7	39.3	31.0	-
	62	64.1	3.4	64.1	64.1	61.4	53.1	44.7	36.4	59.4	3.8	59.4	59.4	58.3	50.0	41.7	33.4
	57	64.9	3.4	64.9	64.9	63.0	54.7	46.4	38.1	58.5	3.8	58.5	58.5	58.6	50.3	42.0	33.7
2250	72	83.6	3.4	61.7	52.7	43.6	34.5	-	-	76.2	3.9	58.5	49.3	40.2	31.1	-	-
	67	74.5	3.4	72.5	62.9	53.8	44.7	35.7	-	67.7	3.8	66.8	60.1	51.0	41.9	32.7	-
	62	66.7	3.4	66.7	66.7	65.3	56.3	47.2	38.1	60.8	3.8	60.8	60.8	60.2	51.1	42.0	32.8
	57	67.5	3.4	67.5	67.5	66.5	57.5	48.4	39.3	59.8	3.8	59.8	59.8	59.9	50.8	41.7	32.5
2500	72	86.9	3.4	66.1	56.3	46.5	36.6	-	-	77.9	3.9	62.7	52.8	42.8	32.9	-	-
	67	77.3	3.4	77.3	67.3	57.3	47.5	37.7	-	69.3	3.8	69.3	64.2	54.3	44.4	34.4	-
	62	69.3	3.4	69.3	69.3	69.3	59.5	49.6	39.8	62.2	3.8	62.2	62.2	62.2	52.2	42.3	32.3
	57	70.0	3.4	70.0	70.0	70.0	60.2	50.4	40.5	61.2	3.8	61.2	61.2	61.2	51.2	41.3	31.3
		95°F								**105°F**							
1250	77	69.3	4.3	29.2	24.1	18.6	-	-	-	62.5	4.7	25.5	21.7	16.3	-	-	-
	72	62.3	4.3	37.9	32.4	26.9	21.4	-	-	55.9	4.6	35.3	29.9	24.5	19.0	-	-
	67	55.2	4.2	46.5	40.6	35.1	29.6	24.1	-	49.4	4.6	45.0	38.1	32.6	27.2	21.8	-
	62	49.7	4.1	49.7	49.7	43.0	37.5	32.0	26.5	44.7	4.5	44.7	44.7	40.1	34.7	29.3	23.8
1500	77	71.7	4.3	33.3	26.8	20.4	-	-	-	64.8	4.8	31.0	24.3	17.9	-	-	-
	72	64.4	4.3	42.3	35.8	29.4	23.0	-	-	58.0	4.7	39.6	33.3	26.9	20.5	-	-
	67	57.1	4.2	51.3	44.8	38.4	32.0	25.6	-	51.1	4.6	48.2	42.3	35.9	29.5	23.2	-
	62	51.4	4.2	51.4	51.4	47.1	40.6	34.2	27.8	46.3	4.5	46.3	46.3	44.2	37.8	31.4	25.1
	57	48.8	4.2	48.8	48.8	46.3	39.8	33.4	27.0	44.1	4.5	44.1	44.1	42.1	35.7	29.4	23.0
1750	77	74.0	4.3	37.3	29.5	22.2	-	-	-	67.1	4.8	36.5	26.8	19.5	-	-	-
	72	66.5	4.3	46.7	39.3	31.9	24.6	-	-	60.0	4.7	44.0	36.7	29.3	22.0	-	-
	67	58.9	4.2	56.0	49.1	41.7	34.4	27.0	-	52.9	4.6	51.5	46.5	39.2	31.8	24.5	-
	62	53.0	4.2	53.0	53.0	51.1	43.8	36.4	29.0	47.9	4.5	47.9	47.9	48.3	40.9	33.6	26.3
	57	50.4	4.2	50.4	50.4	50.2	42.9	35.5	28.2	45.7	4.5	45.7	45.7	45.9	38.6	31.3	23.9
2000	77	76.3	4.4	41.4	32.2	23.9	-	-	-	69.3	4.8	42.0	29.4	21.1	-	-	-
	72	68.6	4.3	51.1	42.8	34.5	26.2	-	-	62.0	4.7	48.4	40.1	31.8	23.5	-	-
	67	60.8	4.2	60.8	53.3	45.0	36.8	28.5	-	54.7	4.6	54.7	50.7	42.4	34.1	25.9	-
	62	54.7	4.2	54.7	54.7	55.2	46.9	38.6	30.3	49.6	4.5	49.6	49.6	52.4	44.1	35.8	27.5
	57	52.0	4.2	52.0	52.0	54.2	45.9	37.7	29.4	47.2	4.5	47.2	47.2	49.7	41.4	33.2	24.9
2250	72	68.8	4.3	55.2	46.0	36.9	27.7	-	-	62.0	4.7	52.4	43.2	34.0	24.9	-	-
	67	61.0	4.2	61.0	57.3	48.2	39.0	29.8	-	54.7	4.6	54.7	52.7	45.5	36.3	27.1	-
	62	54.9	4.2	54.9	54.9	55.1	45.9	36.7	27.6	49.5	4.5	49.5	49.5	50.9	41.8	32.6	23.4
	57	52.2	4.2	52.2	52.2	53.3	44.1	34.9	25.7	47.2	4.6	47.2	47.2	48.5	39.3	30.1	21.0
2500	72	69.0	4.3	59.4	49.3	39.2	29.2	-	-	62.0	4.7	56.4	46.4	36.3	26.3	-	-
	67	61.2	4.2	61.2	61.2	51.3	41.2	31.1	-	54.7	4.6	54.7	54.7	48.5	38.5	28.4	-
	62	55.0	4.2	55.0	55.0	55.0	45.0	34.9	24.8	49.5	4.5	49.5	49.5	49.5	39.5	29.4	19.4
	57	52.3	4.2	52.3	52.3	52.3	42.3	32.2	22.1	47.2	4.6	47.2	47.2	47.2	37.1	27.1	17.0

ZH061 (5.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1250	77	55.7	5.2	21.9	19.2	13.9	-	-	-	48.9	5.6	22.6	15.3	11.5	-	-	-
	72	49.6	5.0	32.7	27.4	22.0	16.7	-	-	43.3	5.4	30.1	24.9	19.6	14.4	-	-
	67	43.5	4.9	43.5	35.5	30.2	24.9	19.5	-	37.6	5.3	37.6	33.4	27.7	22.5	17.3	-
	62	39.7	4.8	39.7	39.7	37.2	31.8	26.5	21.2	34.7	5.1	34.7	34.7	34.7	29.0	23.8	18.5
1500	77	57.9	5.2	28.8	21.7	15.4	-	-	-	51.1	5.6	29.5	19.1	12.9	-	-	-
	72	51.6	5.1	37.0	30.7	24.4	18.1	-	-	45.2	5.5	34.4	28.1	21.9	15.6	-	-
	67	45.2	4.9	45.2	39.7	33.4	27.1	20.8	-	39.2	5.3	39.2	37.1	30.9	24.6	18.4	-
	62	41.3	4.8	41.3	41.3	41.3	35.0	28.7	22.3	36.2	5.2	36.2	36.2	36.2	32.1	25.9	19.6
	57	39.4	4.9	39.4	39.4	37.9	31.6	25.3	19.0	34.7	5.2	34.7	34.7	33.8	27.5	21.3	15.0
1750	77	60.1	5.2	35.7	24.1	16.8	-	-	-	53.2	5.7	36.4	22.9	14.2	-	-	-
	72	53.5	5.1	41.3	34.0	26.7	19.4	-	-	47.1	5.5	38.6	31.4	24.1	16.9	-	-
	67	46.9	5.0	46.9	43.9	36.6	29.3	22.0	-	40.9	5.3	40.9	40.9	34.1	26.8	19.5	-
	62	42.8	4.9	42.8	42.8	45.4	38.1	30.8	23.5	37.8	5.2	37.8	37.8	37.8	35.3	28.0	20.7
	57	40.9	4.9	40.9	40.9	41.6	34.3	27.0	19.7	36.2	5.3	36.2	36.2	36.2	30.0	22.7	15.5
2000	77	62.3	5.3	42.7	26.6	18.3	-	-	-	55.4	5.7	43.3	26.7	15.5	-	-	-
	72	55.5	5.1	45.6	37.4	29.1	20.8	-	-	49.0	5.5	42.9	34.6	26.4	18.1	-	-
	67	48.6	5.0	48.6	48.1	39.8	31.5	23.3	-	42.5	5.4	42.5	42.5	37.2	28.9	20.7	-
	62	44.4	4.9	44.4	44.4	49.5	41.2	33.0	24.7	39.3	5.2	39.3	39.3	39.3	38.4	30.1	21.9
	57	42.4	4.9	42.4	42.4	45.2	36.9	28.7	20.4	37.6	5.3	37.6	37.6	37.6	32.4	24.2	15.9
2250	72	55.2	5.1	49.5	40.4	31.2	22.1	-	-	48.4	5.6	46.7	37.6	28.4	19.3	-	-
	67	48.4	5.0	48.4	48.1	42.8	33.6	24.5	-	42.1	5.4	42.1	42.1	40.1	31.0	21.8	-
	62	44.2	4.9	44.2	44.2	46.7	37.6	28.4	19.3	38.9	5.3	38.9	38.9	38.9	33.4	24.3	15.1
	57	42.2	4.9	42.2	42.2	43.6	34.5	25.3	16.2	37.2	5.3	37.2	37.2	37.2	29.6	20.5	11.4
2500	72	54.9	5.2	53.5	43.4	33.4	23.4	-	-	47.9	5.6	47.9	40.5	30.5	20.5	-	-
	67	48.2	5.0	48.2	48.2	45.7	35.7	25.7	-	41.6	5.4	41.6	41.6	41.6	33.0	23.0	-
	62	44.0	4.9	44.0	44.0	44.0	34.0	23.9	13.9	38.5	5.3	38.5	38.5	38.5	28.4	18.4	8.4
	57	42.0	5.0	42.0	42.0	42.0	32.0	22.0	11.9	36.9	5.4	36.9	36.9	36.9	26.8	16.8	6.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH078 (6.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1625	77	100.1	4.7	38.5	33.6	28.8	-	-	-	98.1	5.3	39.7	32.9	26.1	-	-	-
	72	92.7	4.7	49.4	44.5	39.7	34.9	-	-	89.4	5.3	50.8	44.0	37.2	30.4	-	-
	67	85.4	4.7	60.2	55.4	50.6	45.7	40.9	-	80.6	5.2	61.9	55.1	48.3	41.5	34.7	-
	62	74.8	4.7	74.8	69.6	61.2	56.4	51.6	46.7	72.6	5.2	72.6	68.6	58.8	52.1	45.3	38.5
1950	77	105.7	4.7	47.6	39.7	31.8	-	-	-	102.0	5.3	44.7	36.8	28.8	-	-	-
	72	97.9	4.7	59.7	51.8	43.9	35.9	-	-	92.9	5.3	57.0	49.0	41.0	33.1	-	-
	67	90.1	4.7	71.7	63.8	55.9	48.0	40.1	-	83.9	5.3	69.2	61.2	53.3	45.3	37.3	-
	62	79.0	4.7	79.0	75.6	67.6	59.7	51.8	43.9	75.5	5.2	75.5	72.8	64.9	56.9	48.9	41.0
	57	77.8	4.7	77.8	79.4	72.1	64.2	56.3	48.4	75.3	5.2	75.3	75.3	67.7	59.7	51.7	43.8
2275	77	111.4	4.7	56.8	45.8	34.8	-	-	-	105.9	5.3	49.8	40.6	31.5	-	-	-
	72	103.1	4.7	70.0	59.0	48.0	37.0	-	-	96.5	5.3	63.1	54.0	44.8	35.7	-	-
	67	94.8	4.8	83.2	72.2	61.2	50.2	39.2	-	87.1	5.3	76.5	67.3	58.2	49.1	39.9	-
	62	83.3	4.7	83.3	81.5	74.1	63.1	52.1	41.1	78.4	5.2	78.4	77.1	70.9	61.7	52.6	43.5
	57	82.0	4.7	82.0	82.8	78.9	67.9	56.9	46.0	78.2	5.2	78.2	78.2	74.0	64.8	55.7	46.5
2600	77	117.0	4.7	66.0	51.9	37.8	-	-	-	109.8	5.3	54.8	44.5	34.1	-	-	-
	72	108.3	4.7	80.3	66.2	52.2	38.1	-	-	100.1	5.3	69.3	58.9	48.6	38.3	-	-
	67	99.5	4.8	94.6	80.5	66.5	52.4	38.4	-	90.3	5.3	83.8	73.4	63.1	52.8	42.5	-
	62	87.5	4.7	87.5	87.5	80.5	66.4	52.4	38.3	81.3	5.2	81.3	81.3	76.9	66.6	56.3	45.9
	57	86.2	4.7	86.2	86.2	85.7	71.7	57.6	43.6	81.1	5.2	81.1	81.1	80.2	69.9	59.6	49.3
2925	72	110.3	4.7	82.3	69.0	55.6	42.3	-	-	102.7	5.3	74.5	63.2	51.8	40.5	-	-
	67	101.4	4.8	99.0	84.2	70.9	57.6	44.2	-	92.7	5.3	89.4	78.6	67.3	55.9	44.6	-
	62	89.1	4.7	89.1	89.1	85.6	72.3	58.9	45.6	83.4	5.3	83.4	83.4	81.2	69.9	58.5	47.2
	57	87.7	4.7	87.7	87.7	87.5	74.2	60.9	47.5	83.3	5.2	83.3	83.3	82.8	71.5	60.1	48.8
3250	72	112.3	4.7	84.4	71.7	59.1	46.5	-	-	105.4	5.3	79.8	67.4	55.0	42.7	-	-
	67	103.3	4.7	103.3	88.0	75.3	62.7	50.1	-	95.1	5.3	95.1	83.8	71.4	59.1	46.7	-
	62	90.7	4.7	90.7	90.7	90.7	78.1	65.5	52.8	85.6	5.3	85.6	85.6	85.6	73.2	60.8	48.4
	57	89.3	4.7	89.3	89.3	89.3	76.7	64.1	51.4	85.4	5.3	85.4	85.4	85.4	73.1	60.7	48.3
		95°F								**105°F**							
1625	77	96.1	5.9	41.0	32.2	23.5	-	-	-	87.2	6.5	36.1	29.5	21.5	-	-	-
	72	86.0	5.8	52.3	43.5	34.8	26.0	-	-	78.4	6.3	48.5	40.4	32.4	24.4	-	-
	67	75.9	5.8	63.6	54.8	46.1	37.3	28.6	-	69.5	6.2	60.8	51.4	43.4	35.4	27.4	-
	62	70.3	5.8	70.3	67.6	56.5	47.7	39.0	30.2	63.1	6.1	63.1	61.7	53.8	45.8	37.8	29.8
1950	77	98.3	6.0	41.8	33.8	25.8	-	-	-	89.3	6.5	39.9	31.7	23.6	-	-	-
	72	88.0	5.9	54.3	46.2	38.2	30.2	-	-	80.2	6.4	51.9	43.8	35.7	27.6	-	-
	67	77.7	5.8	66.7	58.7	50.6	42.6	34.6	-	71.2	6.3	64.0	55.9	47.8	39.7	31.5	-
	62	71.9	5.8	71.9	70.1	62.1	54.1	46.0	38.0	64.6	6.2	64.6	63.7	59.2	51.1	43.0	34.8
	57	72.8	5.7	72.8	71.3	63.3	55.3	47.2	39.2	67.1	6.2	67.1	66.3	58.2	50.1	41.9	33.8
2275	77	100.5	6.0	42.7	35.4	28.1	-	-	-	91.3	6.5	43.6	34.0	25.8	-	-	-
	72	89.9	5.9	56.3	49.0	41.7	34.4	-	-	82.1	6.4	55.4	47.2	38.9	30.7	-	-
	67	79.4	5.8	69.8	62.5	55.2	47.9	40.6	-	72.8	6.3	67.2	60.4	52.1	43.9	35.7	-
	62	73.5	5.8	73.5	72.6	67.7	60.4	53.1	45.8	66.1	6.2	66.1	65.6	64.6	56.4	48.1	39.9
	57	74.5	5.7	74.5	73.7	69.0	61.7	54.4	47.1	68.7	6.2	68.7	68.3	63.5	55.3	47.0	38.8
2600	77	102.6	6.0	43.6	37.0	30.4	-	-	-	93.4	6.5	47.4	36.3	27.9	-	-	-
	72	91.9	5.9	58.2	51.7	45.1	38.5	-	-	83.9	6.4	58.9	50.6	42.2	33.8	-	-
	67	81.1	5.8	72.9	66.3	59.8	53.2	46.6	-	74.5	6.3	70.4	64.8	56.5	48.1	39.8	-
	62	75.1	5.8	75.1	75.1	73.3	66.7	60.2	53.6	67.5	6.2	67.5	67.5	70.0	61.6	53.3	44.9
	57	76.1	5.8	76.1	76.1	74.7	68.1	61.6	55.0	70.2	6.2	70.2	70.2	68.8	60.5	52.1	43.7
2925	72	95.2	5.9	66.8	57.4	48.0	38.7	-	-	86.3	6.5	65.6	55.3	45.1	34.8	-	-
	67	84.0	5.8	79.9	73.0	63.7	54.3	45.0	-	76.6	6.3	74.5	69.9	60.4	50.1	39.9	-
	62	77.8	5.8	77.8	77.8	76.9	67.5	58.2	48.8	69.4	6.2	69.4	69.4	70.7	60.4	50.2	39.9
	57	78.8	5.8	78.8	78.8	78.1	68.8	59.4	50.1	72.2	6.3	72.2	72.2	71.5	61.2	51.0	40.7
3250	72	98.5	5.9	75.3	63.1	51.0	38.8	-	-	88.6	6.5	72.3	60.1	48.0	35.8	-	-
	67	87.0	5.9	87.0	79.7	67.6	55.4	43.3	-	78.6	6.4	78.6	75.0	64.2	52.1	40.0	-
	62	80.5	5.9	80.5	80.5	80.5	68.4	56.2	44.1	71.3	6.3	71.3	71.3	71.3	59.2	47.1	34.9
	57	81.6	5.8	81.6	81.6	81.6	69.4	57.3	45.1	74.1	6.3	74.1	74.1	74.1	62.0	49.9	37.7

ZH078 (6.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1625	77	78.3	7.0	31.2	26.7	19.5	-	-	-	69.4	7.5	24.9	23.7	17.5	-	-	-
	72	70.7	6.8	44.7	37.4	30.1	22.9	-	-	63.1	7.3	40.9	34.3	27.8	21.3	-	-
	67	63.2	6.7	58.1	48.0	40.8	33.5	26.2	-	56.8	7.1	56.8	44.7	38.1	31.6	25.1	-
	62	55.8	6.5	55.8	55.8	51.1	43.9	36.6	29.3	48.6	6.9	48.6	48.6	48.6	41.9	35.4	28.9
1950	77	80.3	7.0	37.9	29.7	21.4	-	-	-	71.3	7.6	36.4	27.6	19.3	-	-	-
	72	72.5	6.9	49.6	41.4	33.2	24.9	-	-	64.8	7.4	47.3	39.0	30.7	22.3	-	-
	67	64.7	6.7	61.4	53.1	44.9	36.7	28.5	-	58.3	7.2	58.3	50.4	42.1	33.7	25.4	-
	62	57.2	6.6	57.2	57.2	56.3	48.1	39.9	31.6	49.9	6.9	49.9	49.9	49.9	45.1	36.8	28.5
	57	61.4	6.6	61.4	61.3	53.1	44.9	36.7	28.4	55.7	7.1	55.7	55.7	48.0	39.7	31.4	23.1
2275	77	82.2	7.1	44.6	32.6	23.4	-	-	-	73.1	7.6	47.8	31.5	21.1	-	-	-
	72	74.2	6.9	54.6	45.4	36.2	27.0	-	-	66.4	7.4	53.8	43.6	33.5	23.4	-	-
	67	66.3	6.8	64.6	58.2	49.1	39.9	30.7	-	59.7	7.3	59.7	56.1	46.0	35.9	25.7	-
	62	58.6	6.6	58.6	58.6	61.5	52.3	43.1	34.0	51.2	7.0	51.2	51.2	51.2	48.3	38.2	28.0
	57	62.9	6.7	62.9	62.9	58.0	48.8	39.6	30.5	57.1	7.1	57.1	57.1	52.5	42.4	32.3	22.1
2600	77	84.1	7.1	51.3	35.5	25.4	-	-	-	74.9	7.7	59.3	35.4	22.9	-	-	-
	72	76.0	7.0	59.6	49.4	39.3	29.1	-	-	68.1	7.5	60.2	48.3	36.4	24.5	-	-
	67	67.9	6.8	67.9	63.3	53.2	43.1	32.9	-	61.2	7.3	61.2	61.2	49.9	38.0	26.0	-
	62	60.0	6.6	60.0	60.0	66.7	56.6	46.4	36.3	52.4	7.1	52.4	52.4	52.4	51.5	39.6	27.6
	57	64.4	6.7	64.4	64.4	62.9	52.8	42.6	32.5	58.5	7.2	58.5	58.5	57.0	45.1	33.1	21.2
2925	72	77.4	7.0	64.4	53.3	42.1	31.0	-	-	68.5	7.5	63.2	51.2	39.2	27.2	-	-
	67	69.1	6.8	69.1	66.8	57.0	45.9	34.8	-	61.6	7.3	61.6	61.6	53.7	41.7	29.7	-
	62	61.1	6.7	61.1	61.1	64.4	53.3	42.2	31.0	52.7	7.1	52.7	52.7	52.7	46.2	34.2	22.1
	57	65.6	6.7	65.6	65.6	64.8	53.7	42.5	31.4	58.9	7.2	58.9	58.9	58.2	46.1	34.1	22.1
3250	72	78.8	7.0	69.2	57.1	45.0	32.9	-	-	68.9	7.6	66.2	54.1	42.0	29.9	-	-
	67	70.3	6.9	70.3	70.3	60.9	48.8	36.6	-	62.0	7.4	62.0	62.0	57.6	45.5	33.3	-
	62	62.2	6.7	62.2	62.2	62.2	50.0	37.9	25.8	53.0	7.1	53.0	53.0	53.0	40.9	28.8	16.7
	57	66.7	6.8	66.7	66.7	66.7	54.6	42.5	30.3	59.3	7.2	59.3	59.3	59.3	47.2	35.1	23.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH090 (7.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1875	77	113.8	5.8	49.0	41.0	33.1	-	-	-	112.1	6.5	46.6	38.6	30.6	-	-	-
	72	106.0	5.8	62.6	54.6	46.7	38.7	-	-	102.9	6.4	59.9	51.9	43.9	35.9	-	-
	67	98.1	5.8	76.2	68.3	60.3	52.3	44.4	-	93.8	6.4	73.2	65.2	57.2	49.2	41.2	-
	62	86.5	5.8	86.5	80.4	71.9	64.0	56.0	48.1	83.9	6.4	83.9	79.0	68.5	60.5	52.5	44.4
2250	77	121.4	5.8	54.8	45.5	36.3	-	-	-	116.8	6.5	51.9	42.7	33.5	-	-	-
	72	112.9	5.8	69.7	60.4	51.2	41.9	-	-	107.3	6.4	66.5	57.2	48.0	38.8	-	-
	67	104.5	5.8	84.6	75.3	66.1	56.8	47.5	-	97.7	6.4	81.0	71.8	62.6	53.3	44.1	-
	62	92.2	5.8	92.2	88.1	78.8	69.6	60.3	51.0	87.5	6.4	87.5	84.1	74.9	65.7	56.5	47.3
	57	90.4	5.8	90.4	91.7	85.4	76.2	66.9	57.6	87.7	6.4	87.7	87.7	80.0	70.7	61.5	52.3
2625	77	128.9	5.8	60.6	50.0	39.4	-	-	-	121.5	6.5	57.2	46.8	36.3	-	-	-
	72	119.9	5.8	76.8	66.2	55.6	45.0	-	-	111.6	6.5	73.0	62.6	52.1	41.7	-	-
	67	110.9	5.9	93.0	82.4	71.9	61.3	50.7	-	101.7	6.4	88.8	78.4	67.9	57.5	47.1	-
	62	97.9	5.9	97.9	95.8	85.7	75.1	64.5	54.0	91.0	6.4	91.0	89.3	81.4	70.9	60.5	50.1
	57	96.1	5.8	96.1	96.8	92.9	82.3	71.7	61.1	91.2	6.4	91.2	91.2	86.8	76.4	66.0	55.5
3000	77	136.5	5.8	66.4	54.5	42.6	-	-	-	126.2	6.5	62.5	50.8	39.2	-	-	-
	72	126.9	5.8	83.9	72.0	60.1	48.2	-	-	115.9	6.5	79.5	67.9	56.3	44.6	-	-
	67	117.3	5.9	101.4	89.5	77.6	65.7	53.8	-	105.6	6.5	96.6	85.0	73.3	61.7	50.0	-
	62	103.6	5.9	103.6	103.6	92.6	80.7	68.8	56.9	94.5	6.4	94.5	94.5	87.8	76.1	64.5	52.9
	57	101.8	5.9	101.8	101.8	100.4	88.5	76.6	64.6	94.8	6.4	94.8	94.8	93.7	82.1	70.4	58.8
3375	72	128.9	5.8	88.3	75.7	63.2	50.6	-	-	118.6	6.5	84.9	72.3	59.8	47.2	-	-
	67	119.1	5.8	110.1	94.1	81.6	69.0	56.4	-	108.1	6.5	103.0	90.4	77.9	65.3	52.8	-
	62	105.2	5.9	105.2	105.2	99.6	87.0	74.4	61.8	96.7	6.4	96.7	96.7	93.2	80.7	68.1	55.6
	57	103.4	5.8	103.4	103.4	102.6	90.1	77.5	64.9	96.9	6.4	96.9	96.9	96.4	83.9	71.3	58.8
3750	72	130.9	5.8	92.7	79.5	66.2	53.0	-	-	121.2	6.5	90.2	76.7	63.3	49.8	-	-
	67	121.0	5.8	118.7	98.7	85.5	72.2	59.0	-	110.5	6.5	109.4	95.9	82.4	69.0	55.5	-
	62	106.8	5.8	106.8	106.8	106.5	93.2	80.0	66.7	98.9	6.4	98.9	98.9	98.7	85.2	71.8	58.3
	57	104.9	5.8	104.9	104.9	104.9	91.7	78.4	65.2	99.1	6.4	99.1	99.1	99.1	85.7	72.2	58.7
		95°F								**105°F**							
1875	77	110.3	7.1	44.2	36.2	28.1	-	-	-	103.5	7.7	38.5	33.2	25.2	-	-	-
	72	99.9	7.0	57.2	49.2	41.1	33.0	-	-	93.1	7.6	54.2	46.2	38.2	30.3	-	-
	67	89.5	7.0	70.2	62.2	54.1	46.0	37.9	-	82.7	7.5	69.8	59.2	51.2	43.3	35.3	-
	62	81.3	6.9	81.3	77.5	65.0	57.0	48.9	40.8	78.3	7.4	78.3	75.8	62.2	54.2	46.2	38.3
2250	77	112.2	7.1	49.0	39.8	30.7	-	-	-	103.5	7.8	45.5	36.5	27.4	-	-	-
	72	101.6	7.1	63.2	54.0	44.9	35.7	-	-	93.1	7.7	59.6	50.6	41.5	32.5	-	-
	67	91.0	7.0	77.4	68.2	59.1	49.9	40.7	-	82.7	7.5	73.7	64.7	55.7	46.6	37.6	-
	62	82.7	6.9	82.7	80.2	71.0	61.8	52.7	43.5	78.2	7.4	78.2	76.6	67.5	58.5	49.5	40.4
	57	84.9	6.9	84.9	83.7	74.5	65.3	56.1	47.0	80.0	7.4	80.0	78.7	69.7	60.7	51.6	42.6
2625	77	114.1	7.2	53.8	43.5	33.2	-	-	-	103.5	7.8	52.4	39.7	29.6	-	-	-
	72	103.3	7.1	69.2	58.9	48.6	38.4	-	-	93.1	7.7	65.0	54.9	44.8	34.7	-	-
	67	92.5	7.0	84.6	74.3	64.0	53.8	43.5	-	82.7	7.6	77.6	70.2	60.1	50.0	39.9	-
	62	84.1	6.9	84.1	82.8	77.0	66.7	56.4	46.2	78.2	7.5	78.2	77.4	72.9	62.8	52.7	42.6
	57	86.3	6.9	86.3	85.7	80.8	70.5	60.2	49.9	79.9	7.5	79.9	79.3	75.2	65.1	55.0	44.9
3000	77	115.9	7.2	58.6	47.2	35.8	-	-	-	103.4	7.9	59.4	43.0	31.8	-	-	-
	72	105.0	7.1	75.2	63.8	52.4	41.0	-	-	93.1	7.7	70.5	59.3	48.1	37.0	-	-
	67	94.0	7.1	91.7	80.4	69.0	57.6	46.3	-	82.7	7.6	81.6	75.7	64.5	53.3	42.1	-
	62	85.5	7.0	85.5	85.5	83.0	71.6	60.2	48.8	78.1	7.5	78.1	78.1	78.2	67.1	55.9	44.7
	57	87.8	7.0	87.8	87.8	87.0	75.7	64.3	52.9	79.9	7.5	79.9	79.9	80.8	69.6	58.4	47.2
3375	72	108.3	7.1	81.4	68.9	56.4	43.8	-	-	97.2	7.8	76.7	64.4	52.1	39.8	-	-
	67	97.0	7.1	95.9	86.7	74.2	61.7	49.1	-	86.4	7.6	85.8	81.1	69.8	57.5	45.2	-
	62	88.2	7.0	88.2	88.2	86.9	74.4	61.9	49.3	81.6	7.5	81.6	81.6	81.7	69.4	57.1	44.8
	57	90.5	7.0	90.5	90.5	90.2	77.7	65.1	52.6	83.5	7.5	83.5	83.5	83.9	71.6	59.3	47.0
3750	72	111.6	7.2	87.7	74.0	60.3	46.6	-	-	101.3	7.8	82.8	69.4	56.0	42.6	-	-
	67	100.0	7.1	100.0	93.1	79.4	65.7	52.0	-	90.0	7.7	90.0	86.6	75.0	61.6	48.2	-
	62	90.9	7.0	90.9	90.9	90.9	77.2	63.5	49.9	85.1	7.5	85.1	85.1	85.1	71.7	58.3	44.9
	57	93.3	7.0	93.3	93.3	93.3	79.7	66.0	52.3	87.0	7.5	87.0	87.0	87.0	73.6	60.2	46.8

ZH090 (7.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1875	77	96.7	8.4	32.9	30.3	22.4	-	-	-	89.9	9.0	27.0	24.2	19.6	-	-	-
	72	86.3	8.2	51.1	43.3	35.4	27.5	-	-	79.5	8.8	48.1	40.3	32.5	24.8	-	-
	67	75.9	8.0	69.4	56.2	48.4	40.5	32.6	-	69.1	8.5	69.1	53.3	45.5	37.8	30.0	-
	62	75.3	7.9	75.3	74.0	59.3	51.5	43.6	35.7	72.2	8.4	72.2	72.2	56.5	48.7	40.9	33.2
2250	77	94.8	8.4	42.0	33.1	24.2	-	-	-	86.1	9.1	38.7	29.7	20.9	-	-	-
	72	84.6	8.2	56.0	47.1	38.2	29.3	-	-	76.1	8.8	52.4	43.7	34.9	26.1	-	-
	67	74.4	8.1	70.0	61.1	52.2	43.3	34.4	-	66.1	8.6	66.1	57.6	48.8	40.1	31.3	-
	62	73.8	7.9	73.8	73.0	64.1	55.2	46.3	37.4	69.3	8.4	69.3	69.3	60.6	51.8	43.1	34.3
	57	75.0	7.9	75.0	73.8	64.9	56.0	47.1	38.2	70.1	8.5	70.1	68.9	60.1	51.3	42.6	33.8
2625	77	92.9	8.5	51.1	35.9	26.0	-	-	-	82.3	9.1	50.5	35.2	22.3	-	-	-
	72	82.9	8.3	60.9	51.0	41.0	31.1	-	-	72.7	8.9	56.8	47.0	37.2	27.5	-	-
	67	72.9	8.1	70.7	66.0	56.1	46.2	36.2	-	63.1	8.6	63.1	61.9	52.1	42.4	32.6	-
	62	72.3	8.0	72.3	71.9	68.8	58.9	48.9	39.0	66.4	8.5	66.4	66.4	64.7	54.9	45.2	35.4
	57	73.5	8.0	73.5	72.9	69.7	59.8	49.8	39.9	67.1	8.5	67.1	66.5	64.2	54.4	44.6	34.8
3000	77	91.0	8.5	60.2	38.7	27.8	-	-	-	78.5	9.2	62.2	40.6	23.7	-	-	-
	72	81.2	8.3	65.8	54.8	43.9	32.9	-	-	69.3	8.9	61.2	50.4	39.6	28.8	-	-
	67	71.4	8.2	71.4	70.9	60.0	49.0	38.0	-	60.1	8.7	60.1	60.1	55.5	44.7	33.9	-
	62	70.8	8.0	70.8	70.8	73.5	62.6	51.6	40.6	63.5	8.5	63.5	63.5	63.5	58.1	47.3	36.5
	57	72.0	8.0	72.0	72.0	74.5	63.5	52.5	41.6	64.1	8.6	64.1	64.1	64.1	57.5	46.7	35.9
3375	72	86.1	8.4	71.9	59.9	47.8	35.7	-	-	75.0	9.0	67.2	55.3	43.5	31.7	-	-
	67	75.7	8.2	75.7	75.5	65.3	53.3	41.2	-	65.1	8.7	65.1	65.1	60.9	49.1	37.2	-
	62	75.1	8.1	75.1	75.1	76.5	64.4	52.3	40.3	68.6	8.6	68.6	68.6	68.6	59.4	47.5	35.7
	57	76.4	8.1	76.4	76.4	77.6	65.5	53.5	41.4	69.3	8.6	69.3	69.3	69.3	59.5	47.6	35.8
3750	72	91.0	8.4	78.0	64.9	51.7	38.5	-	-	80.7	9.0	73.2	60.3	47.4	34.5	-	-
	67	80.1	8.2	80.1	80.1	70.7	57.5	44.4	-	70.1	8.8	70.1	70.1	66.3	53.4	40.5	-
	62	79.4	8.1	79.4	79.4	79.4	66.2	53.1	39.9	73.6	8.6	73.6	73.6	73.6	60.7	47.8	34.9
	57	80.7	8.1	80.7	80.7	80.7	67.6	54.4	41.2	74.4	8.6	74.4	74.4	74.4	61.5	48.6	35.7

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH102 (8.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
2125	77	136.4	6.4	58.7	49.1	39.5	-	-	-	134.8	7.0	57.4	47.9	38.4	-	-	-
	72	127.5	6.3	74.7	65.1	55.5	45.9	-	-	122.9	7.0	72.2	62.7	53.1	43.6	-	-
	67	118.6	6.3	90.7	81.1	71.5	61.9	52.3	-	111.0	6.9	86.9	77.4	67.9	58.4	48.9	-
	62	103.1	6.3	103.1	94.8	83.2	73.6	64.0	54.4	99.3	6.9	99.3	92.9	80.2	70.6	61.1	51.6
2550	77	142.1	6.4	65.3	54.2	43.1	-	-	-	138.4	7.1	63.5	52.6	41.6	-	-	-
	72	132.8	6.3	82.7	71.6	60.6	49.5	-	-	126.2	7.0	79.5	68.5	57.5	46.5	-	-
	67	123.4	6.3	100.2	89.1	78.0	66.9	55.8	-	114.0	6.9	95.5	84.5	73.5	62.5	51.5	-
	62	107.3	6.4	107.3	101.8	90.7	79.6	68.6	57.5	102.0	6.9	102.0	97.8	86.8	75.8	64.8	53.8
	57	103.7	6.3	103.7	103.7	95.2	84.1	73.1	62.0	98.6	6.9	98.6	98.6	89.8	78.8	67.8	56.8
2975	77	147.8	6.4	71.8	59.3	46.7	-	-	-	142.1	7.1	69.7	57.2	44.7	-	-	-
	72	138.0	6.4	90.7	78.1	65.6	53.0	-	-	129.5	7.0	86.9	74.4	61.9	49.4	-	-
	67	128.1	6.3	109.6	97.0	84.5	71.9	59.4	-	117.0	7.0	104.0	91.6	79.1	66.6	54.1	-
	62	111.6	6.4	111.6	108.8	98.3	85.7	73.2	60.6	104.7	7.0	104.7	102.6	93.4	80.9	68.4	55.9
	57	107.8	6.3	107.8	107.8	103.1	90.6	78.0	65.5	101.2	6.9	101.2	101.2	96.7	84.2	71.7	59.2
3400	77	153.6	6.4	78.4	64.3	50.3	-	-	-	145.7	7.1	75.8	61.8	47.9	-	-	-
	72	143.2	6.4	98.7	84.7	70.6	56.6	-	-	132.8	7.1	94.2	80.2	66.3	52.3	-	-
	67	132.9	6.3	119.0	105.0	91.0	76.9	62.9	-	120.0	7.0	112.6	98.6	84.7	70.7	56.8	-
	62	115.8	6.4	115.8	115.8	105.8	91.8	77.7	63.7	107.4	7.0	107.4	107.4	100.0	86.0	72.0	58.1
	57	111.9	6.3	111.9	111.9	111.0	97.0	83.0	68.9	103.8	7.0	103.8	103.8	103.5	89.5	75.6	61.6
3825	72	145.4	6.4	105.1	89.8	74.5	59.1	-	-	135.6	7.1	101.0	85.8	70.5	55.2	-	-
	67	135.0	6.3	128.0	111.2	95.9	80.6	65.3	-	122.5	7.0	118.8	105.3	90.1	74.8	59.6	-
	62	117.5	6.4	117.5	117.5	112.6	97.2	81.9	66.6	109.6	7.0	109.6	109.6	105.9	90.7	75.4	60.1
	57	113.5	6.3	113.5	113.5	113.1	97.8	82.5	67.2	106.0	7.0	106.0	106.0	105.8	90.6	75.3	60.0
4250	72	147.6	6.4	111.5	94.9	78.3	61.7	-	-	138.4	7.1	107.8	91.3	74.7	58.2	-	-
	67	137.0	6.3	137.0	117.5	100.9	84.2	67.6	-	124.9	7.0	124.9	112.0	95.5	78.9	62.4	-
	62	119.3	6.4	119.3	119.3	119.3	102.7	86.1	69.5	111.8	7.0	111.8	111.8	111.8	95.3	78.7	62.2
	57	115.2	6.3	115.2	115.2	115.2	98.6	82.0	65.4	108.1	7.0	108.1	108.1	108.1	91.6	75.0	58.5
		95°F								**105°F**							
2125	77	133.1	7.7	56.1	46.7	37.3	-	-	-	116.2	8.5	48.4	41.1	31.9	-	-	-
	72	118.2	7.6	69.6	60.2	50.8	41.4	-	-	104.5	8.3	63.9	54.7	45.5	36.2	-	-
	67	103.3	7.6	83.1	73.7	64.3	54.9	45.5	-	92.7	8.2	79.5	68.3	59.0	49.8	40.5	-
	62	95.6	7.4	95.6	91.1	77.1	67.7	58.3	48.9	84.7	8.0	84.7	82.5	69.4	60.1	50.9	41.6
2550	77	134.7	7.7	61.8	50.9	40.0	-	-	-	118.6	8.5	56.1	45.3	34.6	-	-	-
	72	119.6	7.7	76.3	65.4	54.5	43.6	-	-	106.6	8.4	70.9	60.1	49.3	38.5	-	-
	67	104.5	7.6	90.8	79.9	69.0	58.1	47.2	-	94.6	8.2	85.7	74.9	64.1	53.3	42.5	-
	62	96.7	7.5	96.7	93.7	82.8	71.9	61.0	50.1	86.5	8.1	86.5	85.0	75.3	64.5	53.7	42.9
	57	93.6	7.5	93.6	93.6	84.4	73.5	62.6	51.7	84.8	8.1	84.8	84.8	76.0	65.2	54.4	43.6
2975	77	136.3	7.8	67.5	55.1	42.7	-	-	-	121.0	8.6	63.9	49.6	37.3	-	-	-
	72	121.0	7.7	83.0	70.6	58.2	45.8	-	-	108.8	8.4	77.9	65.5	53.2	40.9	-	-
	67	105.8	7.7	98.5	86.1	73.7	61.3	48.9	-	96.5	8.3	91.9	81.5	69.2	56.8	44.5	-
	62	97.8	7.5	97.8	96.3	88.5	76.1	63.7	51.3	88.3	8.1	88.3	87.5	81.2	68.9	56.5	44.2
	57	94.7	7.6	94.7	94.7	90.2	77.8	65.4	53.0	86.5	8.2	86.5	86.5	82.0	69.6	57.3	45.0
3400	77	137.9	7.8	73.2	59.4	45.5	-	-	-	123.4	8.6	71.6	53.8	39.9	-	-	-
	72	122.4	7.8	89.7	75.8	62.0	48.1	-	-	110.9	8.5	84.8	71.0	57.1	43.2	-	-
	67	107.0	7.7	106.2	92.3	78.4	64.5	50.7	-	98.5	8.3	98.1	88.1	74.2	60.3	46.5	-
	62	99.0	7.6	99.0	99.0	94.1	80.2	66.4	52.5	90.0	8.2	90.0	90.0	87.1	73.2	59.4	45.5
	57	95.8	7.6	95.8	95.8	95.9	82.1	68.2	54.3	88.3	8.2	88.3	88.3	87.9	74.1	60.2	46.3
3825	72	125.8	7.8	96.9	81.7	66.6	51.4	-	-	112.9	8.5	91.2	76.2	61.1	46.1	-	-
	67	109.9	7.7	109.5	99.4	84.2	69.1	53.9	-	100.2	8.4	100.0	93.4	79.5	64.4	49.4	-
	62	101.7	7.6	101.7	101.7	99.3	84.1	68.9	53.7	91.6	8.2	91.6	91.6	90.1	75.1	60.0	45.0
	57	98.4	7.6	98.4	98.4	98.5	83.3	68.1	52.9	89.8	8.3	89.8	89.8	89.6	74.6	59.5	44.5
4250	72	129.2	7.8	104.1	87.6	71.2	54.7	-	-	114.8	8.6	97.6	81.4	65.2	49.0	-	-
	67	112.9	7.8	112.9	106.6	90.1	73.6	57.1	-	101.9	8.4	101.9	98.7	84.7	68.5	52.3	-
	62	104.4	7.6	104.4	104.4	104.4	87.9	71.4	54.9	93.1	8.3	93.1	93.1	93.1	76.9	60.7	44.5
	57	101.0	7.7	101.0	101.0	101.0	84.5	68.0	51.5	91.3	8.3	91.3	91.3	91.3	75.1	58.9	42.7

ZH102 (8.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
2125	77	99.3	9.3	40.7	35.5	26.4	-	-	-	82.4	10.1	33.8	29.9	21.0	-	-	-
	72	90.7	9.0	58.3	49.2	40.1	31.0	-	-	76.9	9.7	52.6	43.7	34.8	25.9	-	-
	67	82.0	8.8	75.8	62.9	53.8	44.7	35.6	-	71.4	9.4	71.4	57.5	48.5	39.6	30.7	-
	62	73.9	8.6	73.9	73.9	61.6	52.5	43.4	34.3	63.1	9.2	63.1	63.1	53.8	44.9	35.9	27.0
2550	77	102.5	9.4	50.5	39.8	29.1	-	-	-	86.4	10.2	45.4	34.2	23.7	-	-	-
	72	93.6	9.1	65.5	54.8	44.1	33.5	-	-	80.6	9.8	60.1	49.5	39.0	28.4	-	-
	67	84.7	8.8	80.5	69.9	59.2	48.5	37.8	-	74.8	9.4	74.8	64.9	54.3	43.7	33.2	-
	62	76.3	8.7	76.3	76.3	67.7	57.1	46.4	35.7	66.1	9.3	66.1	66.1	60.2	49.7	39.1	28.5
	57	76.1	8.7	76.1	76.1	67.6	56.9	46.2	35.6	67.3	9.3	67.3	67.3	59.2	48.6	38.0	27.5
2975	77	105.7	9.4	60.2	44.0	31.8	-	-	-	90.4	10.2	57.1	38.5	26.3	-	-	-
	72	96.5	9.1	72.7	60.5	48.2	35.9	-	-	84.3	9.8	67.6	55.4	43.2	30.9	-	-
	67	87.3	8.9	85.3	76.9	64.6	52.3	40.0	-	78.1	9.5	78.1	72.3	60.0	47.8	35.6	-
	62	78.7	8.7	78.7	78.7	73.9	61.7	49.4	37.1	69.1	9.3	69.1	69.1	66.7	54.4	42.2	30.0
	57	78.4	8.8	78.4	78.4	73.8	61.5	49.2	36.9	70.3	9.4	70.3	70.3	65.5	53.3	41.1	28.9
3400	77	108.9	9.5	69.9	48.3	34.4	-	-	-	94.4	10.3	68.7	42.8	28.9	-	-	-
	72	99.4	9.2	79.9	66.1	52.2	38.3	-	-	87.9	9.9	75.1	61.2	47.3	33.5	-	-
	67	90.0	8.9	90.0	83.9	70.0	56.1	42.3	-	81.5	9.5	81.5	79.6	65.8	51.9	38.1	-
	62	81.1	8.8	81.1	81.1	80.1	66.2	52.4	38.5	72.1	9.4	72.1	72.1	72.1	59.2	45.4	31.5
	57	80.8	8.8	80.8	80.8	79.9	66.0	52.2	38.3	73.3	9.4	73.3	73.3	71.9	58.0	44.2	30.3
3825	72	99.9	9.3	85.5	70.6	55.7	40.8	-	-	87.0	10.0	79.8	65.0	50.3	35.6	-	-
	67	90.4	9.0	90.4	87.4	74.7	59.8	44.9	-	80.6	9.6	80.6	80.6	69.9	55.2	40.5	-
	62	81.5	8.9	81.5	81.5	81.0	66.1	51.2	36.3	71.4	9.5	71.4	71.4	71.4	57.1	42.4	27.6
	57	81.2	8.9	81.2	81.2	80.8	65.9	51.0	36.1	72.6	9.6	72.6	72.6	71.9	57.2	42.4	27.7
4250	72	100.4	9.4	91.0	75.1	59.2	43.3	-	-	86.0	10.1	84.5	68.9	53.3	37.6	-	-
	67	90.8	9.1	90.8	90.8	79.4	63.5	47.6	-	79.8	9.8	79.8	79.8	74.1	58.5	42.9	-
	62	81.9	9.0	81.9	81.9	81.9	66.0	50.1	34.2	70.6	9.6	70.6	70.6	70.6	55.0	39.4	23.8
	57	81.6	9.0	81.6	81.6	81.6	65.7	49.8	33.9	71.9	9.7	71.9	71.9	71.9	56.3	40.7	25.1

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH120 (10 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
2500	77	148.4	7.2	37.9	39.0	40.1	-	-	-	145.3	7.9	35.2	36.6	38.0	-	-	-
	72	138.6	7.0	56.2	57.2	58.3	59.4	-	-	134.2	7.7	53.1	54.5	55.9	57.3	-	-
	67	128.8	6.7	74.4	75.5	76.5	77.6	78.7	-	123.2	7.6	70.9	72.3	73.7	75.1	76.5	-
	62	119.6	6.7	103.4	95.5	94.1	95.2	96.2	97.3	115.1	7.6	100.5	93.0	90.7	92.1	93.5	94.9
3000	77	155.1	7.2	54.6	49.4	44.1	-	-	-	150.7	7.9	51.9	46.8	41.8	-	-	-
	72	144.8	7.0	74.7	69.4	64.2	59.0	-	-	139.3	7.8	71.5	66.5	61.4	56.4	-	-
	67	134.6	6.7	94.8	89.5	84.3	79.0	73.8	-	127.8	7.6	91.1	86.1	81.0	76.0	71.0	-
	62	124.9	6.7	114.1	108.9	103.6	98.4	93.2	87.9	119.5	7.6	109.7	104.7	99.7	94.6	89.6	84.5
	57	122.1	6.7	116.9	111.7	106.4	101.2	95.9	90.7	116.7	7.6	111.4	106.3	101.3	96.3	91.2	86.2
3500	77	161.8	7.2	71.2	59.7	48.2	-	-	-	156.2	7.9	68.5	57.1	45.6	-	-	-
	72	151.1	6.9	93.2	81.6	70.1	58.6	-	-	144.3	7.8	89.9	78.5	67.0	55.5	-	-
	67	140.3	6.7	115.1	103.6	92.0	80.5	68.9	-	132.5	7.6	111.3	99.8	88.4	76.9	65.4	-
	62	130.3	6.7	124.9	122.3	113.2	101.6	90.1	78.6	123.8	7.6	118.9	116.4	108.7	97.2	85.7	74.2
	57	127.3	6.7	124.7	122.1	116.2	104.7	93.1	81.6	121.0	7.6	118.3	115.8	110.4	99.0	87.5	76.0
4000	77	168.5	7.2	87.9	70.1	52.2	-	-	-	161.7	7.9	85.2	67.3	49.4	-	-	-
	72	157.3	6.9	111.7	93.8	76.0	58.2	-	-	149.4	7.8	108.4	90.4	72.5	54.6	-	-
	67	146.1	6.7	135.4	117.6	99.8	81.9	64.1	-	137.1	7.7	131.5	113.6	95.7	77.8	59.9	-
	62	135.7	6.6	135.7	135.7	122.7	104.9	87.0	69.2	128.2	7.6	128.2	128.2	117.7	99.8	81.8	63.9
	57	132.6	6.6	132.6	132.6	126.0	108.1	90.3	72.5	125.2	7.6	125.2	125.2	119.6	101.7	83.8	65.8
4500	72	157.8	7.0	102.0	89.8	77.6	65.4	-	-	150.2	7.8	98.7	86.5	74.4	62.3	-	-
	67	146.6	6.8	126.3	114.1	101.9	89.7	77.5	-	137.9	7.7	122.4	110.3	98.2	86.0	73.9	-
	62	136.1	6.8	136.1	136.1	125.3	113.1	100.9	88.7	128.9	7.6	128.9	128.9	120.7	108.6	96.5	84.3
	57	133.0	6.8	133.0	133.0	128.9	116.7	104.5	92.3	125.9	7.6	125.9	125.9	122.7	110.6	98.4	86.3
5000	72	158.3	7.2	92.4	85.8	79.3	72.7	-	-	151.1	7.9	89.0	82.6	76.3	69.9	-	-
	67	147.1	6.9	117.2	110.6	104.1	97.5	91.0	-	138.6	7.8	113.3	107.0	100.6	94.3	87.9	-
	62	136.6	6.9	136.6	136.6	128.0	121.4	114.9	108.3	129.6	7.7	129.6	129.6	123.8	117.4	111.1	104.7
	57	133.4	6.9	133.4	133.4	131.8	125.2	118.6	112.1	126.6	7.7	126.6	126.6	125.8	119.4	113.1	106.7
		95°F								105°F							
2500	77	142.1	8.5	32.5	34.3	36.0	-	-	-	130.2	9.7	26.3	30.7	32.7	-	-	-
	72	129.8	8.5	50.0	51.7	53.4	55.2	-	-	120.3	9.7	46.3	48.4	50.4	52.5	-	-
	67	117.5	8.5	67.4	69.2	70.9	72.6	74.4	-	110.4	9.7	66.3	66.1	68.2	70.2	72.3	-
	62	110.7	8.4	97.7	90.5	87.2	88.9	90.7	92.4	104.5	9.6	92.5	85.6	82.2	84.3	86.3	88.4
3000	77	146.4	8.5	49.2	44.3	39.5	-	-	-	133.8	9.8	45.2	40.5	35.9	-	-	-
	72	133.7	8.5	68.3	63.5	58.7	53.8	-	-	123.6	9.7	64.6	59.9	55.3	50.6	-	-
	67	121.1	8.6	87.5	82.7	77.8	73.0	68.1	-	113.4	9.7	84.0	79.3	74.7	70.0	65.4	-
	62	114.0	8.5	105.4	100.5	95.7	90.8	86.0	81.2	107.3	9.6	99.4	94.7	90.1	85.4	80.8	76.1
	57	111.4	8.5	105.8	101.0	96.2	91.3	86.5	81.6	104.7	9.6	99.7	95.1	90.4	85.8	81.1	76.5
3500	77	150.6	8.5	65.8	54.4	43.0	-	-	-	137.3	9.8	64.0	50.3	39.0	-	-	-
	72	137.6	8.6	86.7	75.3	63.9	52.4	-	-	126.9	9.8	82.8	71.4	60.1	48.7	-	-
	67	124.6	8.6	107.6	96.1	84.7	73.3	61.9	-	116.5	9.7	101.6	92.5	81.2	69.8	58.5	-
	62	117.3	8.5	113.0	110.6	104.2	92.8	81.3	69.9	110.2	9.7	106.2	103.9	97.9	86.6	75.2	63.9
	57	114.6	8.5	111.9	109.4	104.7	93.3	81.9	70.4	107.4	9.6	105.0	102.6	98.3	87.0	75.6	64.3
4000	77	154.9	8.6	82.5	64.5	46.5	-	-	-	140.9	9.8	82.8	60.2	42.1	-	-	-
	72	141.5	8.6	105.1	87.1	69.1	51.1	-	-	130.2	9.8	101.0	83.0	64.9	46.8	-	-
	67	128.1	8.6	127.6	109.6	91.6	73.6	55.6	-	119.5	9.8	119.2	105.7	87.7	69.6	51.6	-
	62	120.7	8.5	120.7	120.7	112.7	94.7	76.7	58.7	113.0	9.7	113.0	113.0	105.8	87.7	69.7	51.6
	57	117.9	8.5	117.9	117.9	113.2	95.2	77.2	59.2	110.2	9.6	110.2	110.2	106.2	88.1	70.1	52.0
4500	72	142.7	8.6	95.3	83.2	71.2	59.1	-	-	131.2	9.8	91.1	79.1	67.1	55.1	-	-
	67	129.1	8.6	118.5	106.5	94.4	82.3	70.3	-	120.4	9.8	112.4	102.7	90.7	78.7	66.7	-
	62	121.6	8.5	121.6	121.6	116.1	104.0	92.0	79.9	113.9	9.7	113.9	113.9	109.4	97.4	85.4	73.5
	57	118.8	8.5	118.8	118.8	116.5	104.5	92.4	80.3	111.0	9.6	111.0	111.0	109.0	97.1	85.1	73.1
5000	72	143.8	8.6	85.5	79.4	73.3	67.1	-	-	132.2	9.8	81.2	75.3	69.4	63.4	-	-
	67	130.2	8.6	109.4	103.3	97.2	91.1	84.9	-	121.3	9.8	105.5	99.6	93.7	87.8	81.9	-
	62	122.6	8.5	122.6	122.6	119.5	113.4	107.3	101.1	114.8	9.7	114.8	114.8	113.0	107.1	101.2	95.3
	57	119.8	8.5	119.8	119.8	119.8	113.7	107.5	101.4	111.9	9.6	111.9	111.9	111.9	106.0	100.1	94.2

ZH120 (10 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
2500	77	118.3	11.0	20.1	27.1	29.5	-	-	-	106.4	12.3	13.8	23.5	26.2	-	-	-
	72	110.8	10.9	42.7	45.0	47.4	49.8	-	-	101.3	12.2	39.0	41.7	44.4	47.1	-	-
	67	103.3	10.9	65.2	63.0	65.4	67.8	70.2	-	96.2	12.0	64.1	59.9	62.6	65.4	68.1	-
	62	98.3	10.8	87.3	80.7	77.2	79.6	82.0	84.4	92.1	12.0	82.1	75.7	72.3	75.0	77.7	80.4
3000	77	121.2	11.0	41.1	36.7	32.2	-	-	-	108.6	12.3	37.1	32.8	28.6	-	-	-
	72	113.5	10.9	60.8	56.3	51.9	47.4	-	-	103.4	12.1	57.0	52.7	48.5	44.2	-	-
	67	105.8	10.9	80.4	76.0	71.5	67.1	62.6	-	98.2	12.0	76.9	72.6	68.4	64.1	59.8	-
	62	100.7	10.8	93.4	88.9	84.5	80.0	75.6	71.1	94.0	12.0	87.3	83.1	78.8	74.6	70.3	66.1
	57	97.9	10.7	93.6	89.1	84.7	80.2	75.8	71.3	91.2	11.8	87.5	83.2	79.0	74.7	70.4	66.2
3500	77	124.0	11.0	62.1	46.3	35.0	-	-	-	110.7	12.3	60.4	42.2	31.0	-	-	-
	72	116.2	10.9	78.9	67.6	56.3	45.0	-	-	105.5	12.1	75.0	63.7	52.5	41.3	-	-
	67	108.3	10.9	95.6	88.9	77.6	66.3	55.0	-	100.2	12.0	89.7	85.3	74.1	62.8	51.6	-
	62	103.0	10.8	99.4	97.2	91.7	80.4	69.1	57.8	95.9	12.0	92.6	90.4	85.4	74.2	63.0	51.8
	57	100.2	10.7	98.1	95.8	91.9	80.6	69.4	58.1	93.0	11.8	91.2	89.1	85.5	74.3	63.1	51.9
4000	77	126.9	11.0	83.1	55.8	37.7	-	-	-	112.9	12.3	83.6	51.5	33.3	-	-	-
	72	118.9	11.0	97.0	78.8	60.7	42.6	-	-	107.5	12.1	92.9	74.7	56.6	38.4	-	-
	67	110.8	10.9	110.8	101.8	83.7	65.6	47.5	-	102.2	12.0	102.2	98.0	79.8	61.6	43.4	-
	62	105.4	10.8	105.4	105.4	98.9	80.8	62.6	44.5	97.8	12.0	97.8	97.8	92.0	73.8	55.6	37.4
	57	102.5	10.7	102.5	102.5	99.2	81.0	62.9	44.8	94.9	11.8	94.9	94.9	92.1	73.9	55.8	37.6
4500	72	119.7	10.9	86.9	75.0	63.1	51.2	-	-	108.2	12.1	82.7	70.9	59.1	47.2	-	-
	67	111.6	10.9	106.2	98.9	87.0	75.1	63.2	-	102.8	12.0	100.1	95.1	83.3	71.4	59.6	-
	62	106.2	10.8	106.2	106.2	102.7	90.8	78.9	67.0	98.4	12.0	98.4	98.4	96.0	84.2	72.4	60.6
	57	103.3	10.7	103.3	103.3	101.6	89.7	77.8	65.9	95.5	11.8	95.5	95.5	94.1	82.3	70.5	58.6
5000	72	120.5	10.9	76.8	71.1	65.5	59.8	-	-	108.9	12.1	72.5	67.0	61.5	56.1	-	-
	67	112.4	10.9	101.6	95.9	90.2	84.6	78.9	-	103.5	12.0	97.7	92.2	86.8	81.3	75.8	-
	62	106.9	10.8	106.9	106.9	106.6	100.9	95.2	89.5	99.0	12.0	99.0	99.0	99.0	94.6	89.2	83.7
	57	104.0	10.7	104.0	104.0	104.0	98.3	92.6	86.9	96.1	11.8	96.1	96.1	96.1	90.6	85.2	79.7

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZH150 (12.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
3125	77	204.4	9.6	82.4	68.5	54.6	-	-	-	192.2	10.6	77.2	63.6	50.0	-	-	-
	72	186.6	9.3	106.6	92.6	78.7	64.8	-	-	176.1	10.4	100.7	87.2	73.6	60.0	-	-
	67	168.8	9.1	130.7	116.8	102.9	88.9	75.0	-	159.9	10.2	124.3	110.7	97.1	83.6	70.0	-
	62	153.0	9.0	153.0	143.5	127.2	113.3	99.4	85.5	144.9	10.0	144.9	138.4	120.1	106.6	93.0	79.4
3750	77	210.2	9.7	89.0	73.6	58.1	-	-	-	197.5	10.7	84.3	69.1	53.9	-	-	-
	72	191.8	9.4	114.7	99.3	83.9	68.4	-	-	180.9	10.5	109.7	94.4	79.2	64.0	-	-
	67	173.5	9.1	140.4	125.0	109.6	94.2	78.7	-	164.3	10.2	135.0	119.8	104.6	89.4	74.2	-
	62	157.2	9.0	157.2	150.9	135.5	120.1	104.7	89.3	148.9	10.1	148.9	144.5	129.3	114.1	98.9	83.7
	57	152.9	8.9	152.9	152.9	144.1	128.7	113.3	97.8	146.9	10.0	146.9	146.9	135.2	120.0	104.8	89.6
4375	77	215.9	9.7	95.5	78.6	61.7	-	-	-	202.8	10.8	91.4	74.5	57.7	-	-	-
	72	197.1	9.4	122.8	105.9	89.0	72.1	-	-	185.7	10.5	118.6	101.7	84.9	68.0	-	-
	67	178.3	9.2	150.1	133.2	116.3	99.4	82.5	-	168.6	10.3	145.8	128.9	112.0	95.2	78.3	-
	62	161.5	9.1	161.5	158.4	143.8	126.9	110.0	93.1	152.8	10.1	152.8	150.7	138.5	121.7	104.8	88.0
	57	157.1	9.0	157.1	157.1	152.9	136.0	119.1	102.2	150.8	10.1	150.8	150.8	144.8	128.0	111.1	94.3
5000	77	221.6	9.8	102.1	83.7	65.3	-	-	-	208.0	10.8	98.5	80.0	61.5	-	-	-
	72	202.3	9.5	130.9	112.6	94.2	75.8	-	-	190.5	10.6	127.5	109.0	90.5	72.0	-	-
	67	183.0	9.2	159.8	141.4	123.0	104.6	86.2	-	173.0	10.4	156.5	138.0	119.5	101.0	82.5	-
	62	165.8	9.1	165.8	165.8	152.1	133.7	115.3	96.9	156.8	10.2	156.8	156.8	147.8	129.3	110.8	92.3
	57	161.2	9.0	161.2	161.2	161.8	143.4	125.0	106.6	154.8	10.1	154.8	154.8	154.5	136.0	117.5	99.0
5625	72	206.6	9.5	140.7	121.0	101.3	81.6	-	-	193.5	10.6	136.3	116.5	96.7	76.9	-	-
	67	186.9	9.2	174.9	152.0	132.3	112.6	92.9	-	175.7	10.4	167.3	147.5	127.7	107.9	88.1	-
	62	169.3	9.2	169.3	169.3	162.5	142.8	123.1	103.4	159.3	10.2	159.3	159.3	154.7	135.0	115.2	95.4
	57	164.7	9.0	164.7	164.7	165.0	145.3	125.6	105.8	157.2	10.1	157.2	157.2	157.0	137.2	117.5	97.7
6250	72	210.9	9.5	150.5	129.4	108.4	87.4	-	-	196.5	10.6	145.1	124.0	102.9	81.8	-	-
	67	190.8	9.3	190.0	162.7	141.6	120.6	99.6	-	178.4	10.4	178.0	157.0	135.9	114.8	93.7	-
	62	172.9	9.2	172.9	172.9	172.9	151.8	130.8	109.8	161.7	10.2	161.7	161.7	161.7	140.6	119.6	98.5
	57	168.1	9.0	168.1	168.1	168.1	147.1	126.1	105.0	159.6	10.2	159.6	159.6	159.6	138.5	117.4	96.4
		95°F								**105°F**							
3125	77	180.0	11.6	71.9	58.7	45.5	-	-	-	169.2	13.1	68.8	56.1	43.0	-	-	-
	72	165.5	11.4	94.9	81.7	68.5	55.2	-	-	155.1	13.0	91.6	78.5	65.5	52.4	-	-
	67	151.0	11.3	117.8	104.6	91.4	78.2	65.0	-	140.9	12.8	114.3	100.9	87.9	74.9	61.8	-
	62	136.9	11.0	136.9	133.3	113.0	99.8	86.6	73.4	128.7	12.5	128.7	126.9	108.9	95.8	82.8	69.8
3750	77	184.8	11.7	79.6	64.6	49.6	-	-	-	173.5	13.2	76.3	61.6	46.8	-	-	-
	72	169.9	11.5	104.6	89.6	74.6	59.6	-	-	159.0	13.0	100.7	86.0	71.2	56.5	-	-
	67	155.0	11.4	129.6	114.6	99.6	84.6	69.6	-	144.5	12.8	125.1	110.4	95.6	80.9	66.1	-
	62	140.5	11.1	140.5	138.1	123.1	108.1	93.1	78.1	131.9	12.6	131.9	130.7	118.4	103.7	88.9	74.1
	57	141.0	11.0	141.0	141.0	126.3	111.3	96.3	81.3	131.4	12.6	131.4	131.4	118.3	103.5	88.8	74.0
4375	77	189.6	11.8	87.3	70.5	53.7	-	-	-	177.8	13.2	83.9	67.1	50.6	-	-	-
	72	174.3	11.6	114.3	97.5	80.7	63.9	-	-	162.9	13.1	109.9	93.4	77.0	60.5	-	-
	67	159.0	11.5	141.4	124.6	107.8	91.0	74.2	-	148.1	12.9	135.9	119.8	103.3	86.9	70.4	-
	62	144.2	11.2	144.2	143.0	133.3	116.5	99.7	82.9	135.2	12.6	135.2	134.6	128.0	111.5	95.0	78.5
	57	144.6	11.1	144.6	144.6	136.7	119.9	103.1	86.3	134.6	12.6	134.6	134.6	127.8	111.4	94.9	78.4
5000	77	194.4	11.9	94.9	76.3	57.7	-	-	-	182.0	13.3	91.5	72.6	54.4	-	-	-
	72	178.7	11.7	124.1	105.5	86.9	68.3	-	-	166.8	13.1	119.1	100.9	82.7	64.5	-	-
	67	163.0	11.6	153.2	134.6	116.0	97.4	78.8	-	151.6	12.9	146.7	129.2	111.0	92.9	74.7	-
	62	147.8	11.3	147.8	147.8	143.4	124.8	106.2	87.6	138.4	12.7	138.4	138.4	137.5	119.3	101.1	82.9
	57	148.3	11.2	148.3	148.3	147.1	128.5	109.9	91.3	137.8	12.7	137.8	137.8	137.4	119.2	101.0	82.8
5625	72	180.4	11.7	131.9	112.0	92.2	72.3	-	-	168.0	13.2	127.6	107.9	88.2	68.6	-	-
	67	164.5	11.6	159.6	142.9	123.1	103.2	83.3	-	152.7	13.0	150.2	137.8	118.5	98.8	79.1	-
	62	149.2	11.3	149.2	149.2	147.0	127.1	107.3	87.4	139.4	12.7	139.4	139.4	138.9	119.3	99.6	80.0
	57	149.7	11.2	149.7	149.7	149.1	129.2	109.4	89.5	138.8	12.7	138.8	138.8	138.6	118.9	99.3	79.6
6250	72	182.1	11.8	139.7	118.6	97.4	76.3	-	-	169.2	13.2	136.0	114.9	93.8	72.6	-	-
	67	166.1	11.6	166.1	151.3	130.1	109.0	87.9	-	153.7	13.0	153.7	146.3	125.9	104.8	83.6	-
	62	150.6	11.3	150.6	150.6	150.6	129.5	108.3	87.2	140.4	12.7	140.4	140.4	140.4	119.2	98.1	77.0
	57	151.1	11.3	151.1	151.1	151.1	130.0	108.8	87.7	139.8	12.7	139.8	139.8	139.8	118.6	97.5	76.4

ZH150 (12.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
3125	77	158.4	14.6	65.6	53.5	40.6	-	-	-	147.6	16.1	60.0	50.8	38.1	-	-	-
	72	144.6	14.5	88.2	75.4	62.5	49.6	-	-	134.2	16.0	84.9	72.2	59.5	46.8	-	-
	67	130.9	14.3	110.9	97.3	84.4	71.5	58.7	-	120.9	15.8	107.4	93.6	80.9	68.2	55.5	-
	62	120.5	14.0	120.5	120.5	104.7	91.9	79.0	66.1	112.3	15.6	112.3	112.3	100.7	87.9	75.2	62.5
3750	77	162.2	14.7	73.1	58.6	44.1	-	-	-	150.8	16.1	69.9	55.6	41.3	-	-	-
	72	148.1	14.5	96.9	82.4	67.9	53.3	-	-	137.2	16.0	93.0	78.7	64.5	50.2	-	-
	67	134.0	14.3	120.6	106.1	91.6	77.1	62.6	-	123.5	15.8	116.2	101.9	87.6	73.4	59.1	-
	62	123.3	14.1	123.3	123.3	113.7	99.2	84.7	70.2	114.8	15.6	114.8	114.8	109.0	94.7	80.5	66.2
	57	121.8	14.1	121.8	121.8	110.3	95.8	81.2	66.7	112.1	15.6	112.1	112.1	102.2	88.0	73.7	59.4
4375	77	165.9	14.7	80.6	63.7	47.6	-	-	-	154.1	16.1	79.7	60.3	44.5	-	-	-
	72	151.5	14.5	105.5	89.4	73.2	57.1	-	-	140.1	15.9	101.1	85.3	69.5	53.6	-	-
	67	137.1	14.3	130.4	115.0	98.9	82.7	66.6	-	126.2	15.8	125.0	110.2	94.4	78.6	62.7	-
	62	126.2	14.1	126.2	126.2	122.7	106.5	90.4	74.2	117.2	15.5	117.2	117.2	117.2	101.6	85.7	69.9
	57	124.6	14.1	124.6	124.6	119.0	102.8	86.7	70.5	114.6	15.6	114.6	114.6	110.1	94.3	78.4	62.6
5000	77	169.7	14.7	88.1	68.8	51.0	-	-	-	157.3	16.1	89.6	65.1	47.7	-	-	-
	72	155.0	14.5	114.2	96.4	78.6	60.8	-	-	143.1	15.9	109.2	91.8	74.4	57.0	-	-
	67	140.2	14.3	140.2	123.9	106.1	88.3	70.5	-	128.9	15.7	128.9	118.6	101.1	83.7	66.3	-
	62	129.1	14.1	129.1	129.1	131.7	113.9	96.1	78.3	119.7	15.5	119.7	119.7	119.7	108.4	91.0	73.6
	57	127.4	14.2	127.4	127.4	127.7	109.9	92.1	74.3	117.0	15.6	117.0	117.0	117.0	100.6	83.2	65.7
5625	72	155.6	14.6	123.2	103.8	84.3	64.9	-	-	143.2	16.0	118.9	99.7	80.4	61.2	-	-
	67	140.8	14.4	140.8	132.6	113.9	94.4	74.9	-	128.9	15.8	128.9	127.5	109.3	90.0	70.8	-
	62	129.6	14.1	129.6	129.6	130.9	111.4	92.0	72.5	119.8	15.6	119.8	119.8	119.8	103.6	84.3	65.1
	57	127.9	14.2	127.9	127.9	128.1	108.6	89.1	69.7	117.0	15.6	117.0	117.0	117.0	98.3	79.0	59.8
6250	72	156.2	14.6	132.3	111.2	90.1	69.0	-	-	143.3	16.0	128.6	107.5	86.4	65.3	-	-
	67	141.4	14.4	141.4	141.4	121.6	100.5	79.4	-	129.0	15.8	129.0	129.0	117.4	96.3	75.2	-
	62	130.1	14.2	130.1	130.1	130.1	109.0	87.9	66.8	119.9	15.6	119.9	119.9	119.9	98.8	77.7	56.5
	57	128.4	14.2	128.4	128.4	128.4	107.3	86.2	65.1	117.1	15.7	117.1	117.1	117.1	96.0	74.9	53.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ037-150 Cooling Capacities

ZJ037 (3.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
750	77	49.2	2.1	19.7	16.4	13.1	-	-	-	45.1	2.3	18.0	14.8	11.6	-	-	-
	72	43.8	2.0	24.5	21.2	17.9	14.6	-	-	40.2	2.3	22.8	19.6	16.4	13.2	-	-
	67	38.4	2.0	29.4	26.1	22.8	19.5	16.2	-	35.2	2.2	27.5	24.3	21.1	17.9	14.7	-
	62	33.2	2.0	33.2	33.2	27.2	23.9	20.6	17.3	30.4	2.2	30.4	30.4	25.3	22.0	18.8	15.6
900	77	51.6	2.0	22.2	18.3	14.5	-	-	-	47.4	2.3	20.6	16.8	13.0	-	-	-
	72	45.9	2.0	27.6	23.7	19.8	15.9	-	-	42.2	2.3	25.9	22.1	18.3	14.4	-	-
	67	40.3	2.0	33.0	29.1	25.2	21.3	17.4	-	37.0	2.2	31.1	27.3	23.5	19.7	15.9	-
	62	34.8	2.0	34.8	34.8	30.1	26.2	22.3	18.4	31.9	2.2	31.9	31.9	28.2	24.4	20.6	16.8
	57	29.4	2.0	29.4	29.4	31.7	27.8	23.9	20.0	28.9	2.2	28.9	28.9	28.9	25.1	21.3	17.5
1050	77	54.0	2.0	24.8	20.3	15.8	-	-	-	49.7	2.3	23.1	18.7	14.3	-	-	-
	72	48.1	2.0	30.7	26.2	21.7	17.3	-	-	44.2	2.3	28.9	24.5	20.1	15.7	-	-
	67	42.2	2.0	36.6	32.1	27.6	23.2	18.7	-	38.7	2.2	34.8	30.4	26.0	21.6	17.2	-
	62	36.4	2.0	36.4	36.4	33.0	28.5	24.0	19.5	33.5	2.2	33.5	33.5	31.1	26.7	22.3	17.9
	57	30.8	2.0	30.8	30.8	38.9	32.1	29.9	25.4	30.3	2.2	30.3	30.3	33.9	28.4	25.1	20.7
1200	77	56.4	2.0	27.4	22.3	17.2	-	-	-	52.0	2.3	25.6	20.6	15.6	-	-	-
	72	50.2	2.0	33.8	28.7	23.7	18.6	-	-	46.3	2.3	32.0	27.0	22.0	17.0	-	-
	67	44.1	2.0	40.2	35.2	30.1	25.0	19.9	-	40.5	2.2	38.4	33.4	28.4	23.4	18.4	-
	62	38.1	2.0	38.1	38.1	35.9	30.8	25.7	20.6	35.0	2.2	35.0	35.0	34.0	29.0	24.0	19.0
	57	32.2	2.0	32.2	32.2	46.0	36.4	35.8	30.7	31.7	2.2	31.7	31.7	38.9	31.7	28.9	23.9
1350	72	51.5	2.0	36.7	31.0	25.4	19.7	-	-	47.2	2.3	34.8	29.2	23.6	18.1	-	-
	67	45.1	2.0	43.2	37.9	32.3	26.6	20.9	-	41.3	2.2	40.3	36.1	30.5	24.9	19.4	-
	62	39.0	2.0	39.0	39.0	37.9	32.2	26.6	20.9	35.7	2.2	35.7	35.7	35.2	29.6	24.1	18.5
	57	33.0	2.0	33.0	33.0	39.9	31.9	28.6	22.9	32.3	2.2	32.3	32.3	35.9	29.3	24.8	19.3
1500	72	52.7	2.0	39.6	33.3	27.1	20.9	-	-	48.1	2.3	37.5	31.4	25.3	19.2	-	-
	67	46.2	2.0	46.2	40.7	34.4	28.2	22.0	-	42.2	2.2	42.2	38.7	32.6	26.5	20.4	-
	62	39.9	2.0	39.9	39.9	39.9	33.7	27.4	21.2	36.4	2.2	36.4	36.4	36.4	30.3	24.2	18.1
	57	33.8	2.0	33.8	33.8	33.8	27.5	21.3	15.0	32.9	2.2	32.9	32.9	32.9	26.8	20.7	14.6
		95°F								**105°F**							
750	77	41.1	2.6	16.4	13.3	10.2	-	-	-	36.8	2.8	13.8	11.6	8.6	-	-	-
	72	36.5	2.5	21.0	17.9	14.8	11.7	-	-	32.9	2.7	19.3	16.3	13.3	10.3	-	-
	67	31.9	2.4	25.6	22.5	19.4	16.3	13.2	-	28.9	2.7	24.9	21.0	18.0	15.0	12.0	-
	62	27.6	2.4	27.6	27.6	23.3	20.2	17.1	14.0	24.9	2.6	24.9	24.9	21.8	18.8	15.8	12.8
900	77	43.3	2.6	18.9	15.2	11.5	-	-	-	38.6	2.8	16.9	13.3	9.7	-	-	-
	72	38.5	2.5	24.1	20.4	16.7	13.0	-	-	34.5	2.7	22.2	18.6	15.0	11.4	-	-
	67	33.6	2.4	29.3	25.6	21.9	18.1	14.4	-	30.3	2.7	27.6	24.0	20.4	16.8	13.2	-
	62	29.0	2.4	29.0	29.0	26.2	22.5	18.8	15.1	26.1	2.6	26.1	26.1	24.6	21.0	17.4	13.8
	57	28.3	2.4	28.3	28.3	26.0	22.3	18.6	14.9	25.5	2.6	25.5	25.5	23.6	20.0	16.4	12.8
1050	77	45.4	2.6	21.4	17.1	12.7	-	-	-	40.4	2.8	20.0	15.0	10.8	-	-	-
	72	40.4	2.5	27.2	22.8	18.5	14.2	-	-	36.1	2.8	25.1	20.9	16.8	12.6	-	-
	67	35.3	2.5	32.9	28.6	24.3	20.0	15.7	-	31.7	2.7	30.2	26.9	22.7	18.5	14.3	-
	62	30.5	2.4	30.5	30.5	29.1	24.8	20.5	16.2	27.3	2.6	27.3	27.3	27.4	23.3	19.1	14.9
	57	29.7	2.4	29.7	29.7	29.0	24.6	20.3	16.0	26.7	2.6	26.7	26.7	26.4	22.2	18.0	13.8
1200	77	47.6	2.6	23.9	19.0	14.0	-	-	-	42.2	2.9	23.1	16.7	11.9	-	-	-
	72	42.3	2.5	30.2	25.3	20.4	15.5	-	-	37.7	2.8	28.0	23.3	18.5	13.7	-	-
	67	37.0	2.5	36.6	31.7	26.8	21.8	16.9	-	33.1	2.7	32.9	29.8	25.0	20.3	15.5	-
	62	32.0	2.4	32.0	32.0	32.1	27.2	22.2	17.3	28.5	2.6	28.5	28.5	30.3	25.5	20.7	15.9
	57	31.2	2.4	31.2	31.2	31.9	27.0	22.0	17.1	27.9	2.7	27.9	27.9	29.1	24.3	19.5	14.7
1350	72	43.0	2.5	32.8	27.4	21.9	16.5	-	-	38.2	2.8	30.5	25.2	19.9	14.6	-	-
	67	37.6	2.5	37.4	34.2	28.7	23.3	17.9	-	33.6	2.7	33.5	31.6	27.0	21.7	16.4	-
	62	32.4	2.4	32.4	32.4	32.5	27.1	21.6	16.2	28.9	2.7	28.9	28.9	29.8	24.5	19.2	13.9
	57	31.6	2.4	31.6	31.6	32.0	26.6	21.1	15.7	28.3	2.7	28.3	28.3	28.9	23.6	18.3	13.0
1500	72	43.6	2.5	35.4	29.4	23.4	17.5	-	-	38.7	2.8	32.9	27.1	21.3	15.5	-	-
	67	38.1	2.5	38.1	36.7	30.7	24.8	18.8	-	34.0	2.7	34.0	33.3	28.9	23.0	17.2	-
	62	32.9	2.4	32.9	32.9	32.9	27.0	21.0	15.1	29.3	2.7	29.3	29.3	29.3	23.5	17.6	11.8
	57	32.1	2.4	32.1	32.1	32.1	26.2	20.2	14.2	28.7	2.7	28.7	28.7	28.7	22.9	17.0	11.2

ZJ037 (3.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
750	77	32.6	3.1	11.2	9.9	7.0	-	-	-	28.3	3.3	9.2	7.9	5.4	-	-	-
	72	29.2	3.0	17.7	14.8	11.8	8.9	-	-	25.6	3.2	16.0	13.2	10.3	7.5	-	-
	67	25.9	2.9	24.2	19.6	16.6	13.7	10.8	-	22.9	3.1	22.9	18.1	15.3	12.4	9.6	-
	62	22.2	2.8	22.2	22.2	20.3	17.4	14.4	11.5	19.5	3.0	19.5	19.5	19.5	16.0	13.1	10.3
900	77	34.0	3.1	14.9	11.4	7.9	-	-	-	29.4	3.4	13.4	9.6	6.2	-	-	-
	72	30.5	3.0	20.4	16.9	13.4	9.9	-	-	26.5	3.2	18.6	15.2	11.8	8.4	-	-
	67	27.0	2.9	25.9	22.4	18.9	15.4	11.9	-	23.7	3.1	23.7	20.8	17.4	14.0	10.6	-
	62	23.1	2.8	23.1	23.1	23.0	19.5	16.0	12.5	20.2	3.0	20.2	20.2	20.2	18.0	14.7	11.3
	57	22.8	2.8	22.8	22.8	21.2	17.8	14.3	10.8	20.0	3.1	20.0	20.0	18.8	15.5	12.1	8.7
1050	77	35.4	3.1	18.7	12.9	8.9	-	-	-	30.4	3.4	17.6	11.3	7.0	-	-	-
	72	31.8	3.0	23.1	19.1	15.0	10.9	-	-	27.5	3.3	21.1	17.2	13.2	9.3	-	-
	67	28.1	2.9	27.5	25.2	21.1	17.0	13.0	-	24.5	3.1	24.5	23.4	19.5	15.6	11.7	-
	62	24.1	2.8	24.1	24.1	25.7	21.7	17.6	13.6	20.9	3.0	20.9	20.9	20.9	20.1	16.2	12.2
	57	23.7	2.9	23.7	23.7	23.8	19.7	15.6	11.6	20.7	3.1	20.7	20.7	20.7	17.2	13.3	9.4
1200	77	36.8	3.1	22.4	14.5	9.8	-	-	-	31.4	3.4	21.9	12.9	7.7	-	-	-
	72	33.0	3.0	25.8	21.2	16.6	12.0	-	-	28.4	3.3	23.6	19.1	14.7	10.2	-	-
	67	29.2	2.9	29.2	28.0	23.3	18.7	14.1	-	25.4	3.1	25.4	25.4	21.6	17.2	12.7	-
	62	25.0	2.8	25.0	25.0	28.5	23.8	19.2	14.6	21.6	3.0	21.6	21.6	21.6	21.6	17.7	13.2
	57	24.7	2.9	24.7	24.7	26.3	21.6	17.0	12.4	21.4	3.1	21.4	21.4	21.4	19.0	14.5	10.0
1350	72	33.4	3.0	28.2	23.0	17.9	12.7	-	-	28.6	3.3	25.9	20.9	15.9	10.9	-	-
	67	29.6	2.9	29.6	28.9	25.2	20.0	14.9	-	25.6	3.2	25.6	25.6	23.4	18.4	13.4	-
	62	25.3	2.9	25.3	25.3	27.0	21.9	16.7	11.6	21.8	3.1	21.8	21.8	21.8	19.3	14.3	9.3
	57	24.9	2.9	24.9	24.9	25.7	20.6	15.4	10.3	21.6	3.1	21.6	21.6	21.6	17.6	12.6	7.6
1500	72	33.8	3.1	30.5	24.8	19.2	13.5	-	-	28.9	3.3	28.1	22.6	17.0	11.5	-	-
	67	29.9	3.0	29.9	29.9	27.0	21.3	15.6	-	25.8	3.2	25.8	25.8	25.1	19.6	14.0	-
	62	25.6	2.9	25.6	25.6	25.6	19.9	14.3	8.6	22.0	3.1	22.0	22.0	22.0	16.4	10.9	5.4
	57	25.2	2.9	25.2	25.2	25.2	19.6	13.9	8.2	21.8	3.2	21.8	21.8	21.8	16.2	10.7	5.2

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ049 (4.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1000	77	79.0	3.0	29.4	25.1	20.7	-	-	-	65.9	3.2	26.7	22.4	18.1	-	-	-
	72	68.7	2.9	35.7	31.3	27.0	22.6	-	-	58.0	3.2	32.8	28.5	24.2	20.0	-	-
	67	58.4	2.8	42.0	37.6	33.3	28.9	24.5	-	50.1	3.1	38.9	34.6	30.3	26.1	21.8	-
	62	54.5	2.9	54.5	51.1	39.9	35.5	31.2	26.8	45.3	3.1	45.3	43.6	36.8	32.6	28.3	24.0
1200	77	78.9	3.0	32.6	27.5	22.4	-	-	-	67.5	3.2	29.9	24.8	19.8	-	-	-
	72	68.5	2.9	39.4	34.3	29.2	24.1	-	-	59.5	3.2	36.6	31.5	26.5	21.4	-	-
	67	58.2	2.8	46.2	41.1	36.0	30.9	25.8	-	51.4	3.1	43.2	38.2	33.1	28.1	23.1	-
	62	54.4	2.9	54.4	52.2	43.1	38.0	32.9	27.8	46.4	3.1	46.4	45.3	40.3	35.2	30.2	25.1
	57	54.2	2.9	54.2	54.2	46.4	41.3	36.2	31.1	46.0	3.1	46.0	46.0	41.6	36.6	31.6	26.5
1400	77	78.8	2.9	35.8	29.9	24.1	-	-	-	69.2	3.2	33.1	27.3	21.5	-	-	-
	72	68.4	2.9	43.0	37.2	31.4	25.5	-	-	60.9	3.2	40.4	34.5	28.7	22.9	-	-
	67	58.0	2.8	50.3	44.5	38.7	32.8	27.0	-	52.6	3.1	47.6	41.8	36.0	30.2	24.3	-
	62	54.4	2.8	54.4	53.2	46.3	40.5	34.7	28.8	47.5	3.1	47.5	47.0	43.7	37.9	32.1	26.2
	57	54.2	2.8	54.2	54.2	50.0	44.1	38.3	32.4	47.1	3.1	47.1	47.1	45.2	39.4	33.6	27.8
1600	77	78.7	2.9	38.9	32.4	25.8	-	-	-	70.8	3.2	36.4	29.8	23.2	-	-	-
	72	68.2	2.9	46.7	40.1	33.6	27.0	-	-	62.3	3.2	44.2	37.6	31.0	24.4	-	-
	67	57.8	2.8	54.5	47.9	41.4	34.8	28.2	-	53.9	3.1	52.0	45.4	38.8	32.2	25.6	-
	62	54.3	2.8	54.3	54.3	49.6	43.0	36.4	29.8	48.7	3.1	48.7	48.7	47.1	40.5	33.9	27.4
	57	54.1	2.8	54.1	54.1	53.5	46.9	40.3	33.8	48.2	3.1	48.2	48.2	48.7	42.1	35.6	29.0
1800	72	62.0	3.2	44.6	37.0	29.5	22.0	-	-	59.3	3.4	44.7	37.3	29.9	22.5	-	-
	67	52.4	3.1	50.8	43.8	36.2	28.7	21.2	-	51.3	3.3	50.3	44.9	37.5	30.0	22.6	-
	62	49.5	3.2	49.5	49.5	47.0	39.5	32.0	24.5	46.3	3.3	46.3	46.3	45.5	38.1	30.7	23.3
	57	49.3	3.2	49.3	49.3	49.0	41.5	34.0	26.5	45.9	3.3	45.9	45.9	46.1	38.7	31.3	23.9
2000	72	55.8	3.5	42.4	33.9	25.5	17.0	-	-	56.3	3.5	45.3	37.1	28.9	20.6	-	-
	67	47.0	3.5	47.0	39.6	31.1	22.7	14.2	-	48.7	3.5	48.7	44.4	36.1	27.9	19.6	-
	62	44.6	3.5	44.6	44.6	44.4	36.0	27.5	19.1	44.0	3.5	44.0	44.0	43.9	35.6	27.4	19.1
	57	44.6	3.5	44.6	44.6	44.6	36.1	27.6	19.2	43.6	3.5	43.6	43.6	43.6	35.3	27.1	18.8
		95°F								**105°F**							
1000	77	52.8	3.4	23.9	19.7	15.5	-	-	-	49.1	3.8	19.3	16.9	13.0	-	-	-
	72	47.4	3.4	29.8	25.6	21.5	17.3	-	-	43.6	3.8	27.0	22.9	18.9	14.8	-	-
	67	41.9	3.4	35.7	31.6	27.4	23.2	19.0	-	38.1	3.7	34.7	28.9	24.7	20.7	16.6	-
	62	36.1	3.3	36.1	36.1	33.7	29.6	25.4	21.2	33.9	3.6	33.9	33.9	29.9	25.8	21.8	17.7
1200	77	56.2	3.5	27.2	22.2	17.2	-	-	-	51.6	3.9	24.5	19.5	14.6	-	-	-
	72	50.4	3.5	33.7	28.8	23.8	18.8	-	-	45.8	3.8	31.1	26.1	21.2	16.2	-	-
	67	44.6	3.4	40.3	35.3	30.3	25.4	20.4	-	40.0	3.7	37.7	32.7	27.8	22.8	17.9	-
	62	38.4	3.3	38.4	38.4	37.4	32.4	27.4	22.4	35.6	3.6	35.6	35.6	33.6	28.7	23.7	18.8
	57	37.7	3.3	37.7	37.7	36.8	31.9	26.9	21.9	35.2	3.6	35.2	35.2	33.2	28.3	23.3	18.4
1400	77	59.6	3.5	30.5	24.7	18.9	-	-	-	54.0	3.9	29.6	22.1	16.1	-	-	-
	72	53.4	3.5	37.7	31.9	26.1	20.3	-	-	48.0	3.8	35.1	29.3	23.5	17.7	-	-
	67	47.3	3.5	44.9	39.1	33.3	27.5	21.7	-	42.0	3.8	40.7	36.5	30.8	25.0	19.2	-
	62	40.7	3.4	40.7	40.7	41.0	35.2	29.4	23.7	37.3	3.7	37.3	37.3	37.3	31.5	25.6	19.8
	57	40.0	3.4	40.0	40.0	40.4	34.6	28.8	23.1	36.8	3.7	36.8	36.8	36.9	31.0	25.2	19.4
1600	77	63.0	3.6	33.8	27.2	20.6	-	-	-	56.5	3.9	34.7	24.7	17.7	-	-	-
	72	56.5	3.5	41.6	35.0	28.4	21.8	-	-	50.2	3.9	39.2	32.5	25.8	19.1	-	-
	67	50.0	3.5	49.4	42.8	36.2	29.6	23.0	-	43.9	3.8	43.6	40.3	33.9	27.2	20.5	-
	62	43.0	3.4	43.0	43.0	44.7	38.1	31.5	24.9	39.0	3.7	39.0	39.0	41.0	34.3	27.6	20.9
	57	42.3	3.4	42.3	42.3	44.0	37.4	30.8	24.2	38.5	3.7	38.5	38.5	40.5	33.8	27.1	20.4
1800	72	56.7	3.5	44.9	37.6	30.3	23.0	-	-	49.9	3.9	42.3	35.1	27.6	20.2	-	-
	67	50.1	3.5	49.9	46.0	38.7	31.4	24.0	-	43.7	3.8	43.5	41.6	36.3	28.9	21.5	-
	62	43.2	3.4	43.2	43.2	44.0	36.7	29.4	22.1	38.7	3.7	38.7	38.7	39.7	32.3	24.9	17.5
	57	42.4	3.4	42.4	42.4	43.3	36.0	28.7	21.3	38.3	3.7	38.3	38.3	39.3	31.9	24.4	17.0
2000	72	56.9	3.5	48.3	40.3	32.2	24.2	-	-	49.7	3.9	45.4	37.6	29.5	21.3	-	-
	67	50.3	3.5	50.3	49.1	41.1	33.1	25.1	-	43.4	3.8	43.4	42.8	38.7	30.6	22.4	-
	62	43.3	3.4	43.3	43.3	43.3	35.3	27.3	19.2	38.5	3.7	38.5	38.5	38.5	30.4	22.2	14.1
	57	42.6	3.4	42.6	42.6	42.6	34.5	26.5	18.5	38.1	3.7	38.1	38.1	38.1	29.9	21.8	13.6

ZJ049 (4.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1000	77	45.4	4.2	14.8	14.2	10.4	-	-	-	41.7	4.6	12.4	9.6	7.9	-	-	-
	72	39.8	4.1	24.2	20.2	16.3	12.3	-	-	36.1	4.4	21.4	17.5	13.6	9.8	-	-
	67	34.3	4.0	33.7	26.3	22.1	18.1	14.1	-	30.5	4.3	30.5	23.8	19.4	15.5	11.6	-
	62	31.6	3.9	31.6	31.6	26.1	22.1	18.1	14.2	29.4	4.2	29.4	29.4	22.3	18.4	14.5	10.6
1200	77	46.9	4.3	21.7	16.8	11.9	-	-	-	42.3	4.6	20.6	14.1	9.3	-	-	-
	72	41.2	4.1	28.4	23.5	18.6	13.7	-	-	36.6	4.5	25.7	20.9	16.0	11.1	-	-
	67	35.5	4.0	35.1	30.1	25.2	20.3	15.4	-	30.9	4.3	30.9	27.6	22.7	17.8	12.9	-
	62	32.7	3.9	32.7	32.7	29.8	24.9	20.0	15.1	29.9	4.2	29.9	29.9	26.0	21.1	16.3	11.4
	57	32.6	3.9	32.6	32.6	29.6	24.7	19.8	14.9	30.0	4.2	30.0	30.0	26.0	21.1	16.2	11.3
1400	77	48.5	4.3	28.7	19.5	13.4	-	-	-	43.0	4.7	28.8	18.7	10.7	-	-	-
	72	42.6	4.2	32.6	26.7	20.9	15.0	-	-	37.1	4.5	30.1	24.2	18.3	12.4	-	-
	67	36.7	4.1	36.4	34.0	28.4	22.5	16.7	-	31.3	4.3	31.3	31.3	25.9	20.0	14.1	-
	62	33.8	4.0	33.8	33.8	33.5	27.7	21.8	16.0	30.3	4.3	30.3	30.3	29.8	23.9	18.0	12.1
	57	33.7	4.0	33.7	33.7	33.3	27.4	21.6	15.7	30.5	4.3	30.5	30.5	29.7	23.9	18.0	12.1
1600	77	50.1	4.3	35.7	22.1	14.9	-	-	-	43.6	4.7	37.0	23.2	12.0	-	-	-
	72	43.9	4.2	36.8	30.0	23.2	16.4	-	-	37.7	4.5	34.4	27.5	20.6	13.7	-	-
	67	37.8	4.1	37.8	37.8	31.5	24.7	17.9	-	31.8	4.4	31.8	31.8	29.2	22.3	15.4	-
	62	34.9	4.0	34.9	34.9	37.3	30.5	23.7	16.9	30.8	4.3	30.8	30.8	30.8	26.7	19.8	12.9
	57	34.8	4.0	34.8	34.8	37.0	30.2	23.4	16.6	31.0	4.3	31.0	31.0	31.0	26.6	19.7	12.8
1800	72	43.2	4.2	39.6	32.5	25.0	17.4	-	-	36.5	4.6	36.5	29.9	22.3	14.7	-	-
	67	37.2	4.1	37.2	37.2	33.9	26.4	18.9	-	30.7	4.4	30.7	30.7	30.7	23.9	16.3	-
	62	34.3	4.0	34.3	34.3	35.5	27.9	20.4	12.9	29.9	4.3	29.9	29.9	29.9	23.6	15.9	8.3
	57	34.2	4.0	34.2	34.2	35.3	27.8	20.2	12.7	30.1	4.3	30.1	30.1	30.1	23.7	16.0	8.4
2000	72	42.4	4.3	42.4	35.0	26.7	18.5	-	-	35.2	4.6	35.2	32.4	24.0	15.6	-	-
	67	36.5	4.1	36.5	36.5	36.3	28.1	19.8	-	29.7	4.4	29.7	29.7	29.7	25.5	17.1	-
	62	33.7	4.0	33.7	33.7	33.7	25.4	17.2	8.9	28.9	4.4	28.9	28.9	28.9	20.5	12.1	3.7
	57	33.6	4.0	33.6	33.6	33.6	25.3	17.0	8.8	29.1	4.4	29.1	29.1	29.1	20.7	12.3	3.9

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ061 (5.0 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1250	77	79.8	3.1	35.0	28.5	22.5	-	-	-	74.2	3.6	32.0	26.2	20.4	-	-	-
	72	72.2	3.1	42.9	36.9	30.9	24.9	-	-	67.2	3.6	40.3	34.4	28.6	22.8	-	-
	67	64.6	3.2	50.8	45.3	39.3	33.2	27.2	-	60.1	3.6	48.5	42.7	36.9	31.1	25.3	-
	62	57.1	3.1	57.1	57.1	47.4	41.4	35.4	29.4	53.6	3.5	53.6	53.6	44.7	38.9	33.0	27.2
1500	77	83.4	3.1	38.6	31.7	24.8	-	-	-	77.3	3.6	36.0	29.3	22.5	-	-	-
	72	75.5	3.2	47.8	40.9	34.0	27.1	-	-	70.0	3.6	45.1	38.4	31.6	24.9	-	-
	67	67.5	3.2	57.1	50.1	43.2	36.3	29.3	-	62.7	3.6	54.3	47.5	40.8	34.0	27.3	-
	62	59.7	3.1	59.7	59.7	52.2	45.2	38.3	31.4	55.9	3.5	55.9	55.9	49.4	42.6	35.9	29.1
	57	59.9	3.2	59.9	59.9	55.9	49.0	42.0	35.1	54.8	3.6	54.8	54.8	50.3	43.6	36.9	30.1
1750	77	87.0	3.2	42.3	34.9	27.0	-	-	-	80.4	3.7	40.0	32.3	24.7	-	-	-
	72	78.8	3.2	52.8	44.9	37.1	29.2	-	-	72.8	3.7	50.0	42.3	34.7	27.0	-	-
	67	70.5	3.2	63.3	55.0	47.1	39.3	31.4	-	65.2	3.6	60.0	52.3	44.7	37.0	29.3	-
	62	62.3	3.1	62.3	62.3	56.9	49.1	41.2	33.4	58.1	3.6	58.1	58.1	54.1	46.4	38.7	31.0
	57	62.4	3.2	62.4	62.4	61.0	53.2	45.3	37.5	57.0	3.6	57.0	57.0	55.1	47.5	39.8	32.1
2000	77	90.6	3.2	45.9	38.0	29.3	-	-	-	83.5	3.7	44.0	35.4	26.8	-	-	-
	72	82.0	3.2	57.7	48.9	40.2	31.4	-	-	75.6	3.7	54.9	46.3	37.7	29.1	-	-
	67	73.4	3.2	69.5	59.8	51.1	42.3	33.6	-	67.7	3.7	65.7	57.1	48.5	39.9	31.3	-
	62	64.9	3.2	64.9	64.9	61.7	52.9	44.2	35.4	60.4	3.6	60.4	60.4	58.8	50.2	41.5	32.9
	57	65.0	3.2	65.0	65.0	66.1	57.4	48.6	39.9	59.2	3.6	59.2	59.2	59.9	51.3	42.7	34.1
2250	72	84.2	3.2	62.2	52.6	43.0	33.4	-	-	77.4	3.7	59.3	49.9	40.4	30.9	-	-
	67	75.4	3.2	73.4	64.3	54.7	45.1	35.5	-	69.3	3.7	68.3	61.5	52.0	42.6	33.1	-
	62	66.6	3.2	66.6	66.6	65.0	55.4	45.8	36.2	61.8	3.6	61.8	61.8	61.0	51.5	42.1	32.6
	57	66.8	3.2	66.8	66.8	67.3	57.7	48.1	38.5	60.7	3.6	60.7	60.7	61.0	51.5	42.1	32.6
2500	72	86.4	3.2	66.8	56.3	45.9	35.5	-	-	79.2	3.7	63.7	53.4	43.1	32.8	-	-
	67	77.3	3.2	77.3	68.8	58.3	47.9	37.5	-	70.9	3.7	70.9	65.9	55.6	45.2	34.9	-
	62	68.4	3.2	68.4	68.4	68.4	57.9	47.5	37.1	63.2	3.6	63.2	63.2	63.2	52.9	42.6	32.3
	57	68.5	3.2	68.5	68.5	68.5	58.1	47.6	37.2	62.1	3.6	62.1	62.1	62.1	51.8	41.5	31.1
		95°F								**105°F**							
1250	77	68.5	4.1	29.0	23.9	18.2	-	-	-	63.5	4.5	25.6	22.1	16.6	-	-	-
	72	62.1	4.1	37.6	32.0	26.4	20.8	-	-	57.3	4.4	35.7	30.1	24.6	19.1	-	-
	67	55.7	4.0	46.2	40.1	34.5	28.9	23.3	-	51.0	4.4	45.7	38.1	32.6	27.1	21.5	-
	62	50.1	4.0	50.1	50.1	41.9	36.3	30.7	25.1	46.7	4.3	46.7	46.7	38.4	32.8	27.3	21.8
1500	77	71.1	4.1	33.4	26.8	20.3	-	-	-	65.8	4.5	31.5	25.0	18.5	-	-	-
	72	64.5	4.1	42.4	35.9	29.3	22.7	-	-	59.3	4.5	40.4	33.9	27.4	20.9	-	-
	67	57.8	4.1	51.5	44.9	38.3	31.8	25.2	-	52.8	4.4	49.3	42.8	36.3	29.8	23.3	-
	62	52.0	4.0	52.0	52.0	46.6	40.0	33.4	26.9	48.4	4.3	48.4	48.4	42.7	36.2	29.7	23.2
	57	49.8	4.0	49.8	49.8	44.8	38.2	31.7	25.1	46.4	4.3	46.4	46.4	41.7	35.2	28.7	22.2
1750	77	73.7	4.2	37.8	29.8	22.3	-	-	-	68.1	4.6	37.3	27.8	20.4	-	-	-
	72	66.8	4.1	47.3	39.7	32.2	24.7	-	-	61.4	4.5	45.1	37.7	30.2	22.7	-	-
	67	59.9	4.1	56.7	49.7	42.2	34.7	27.2	-	54.7	4.5	52.9	47.5	40.0	32.5	25.1	-
	62	53.9	4.0	53.9	53.9	51.2	43.7	36.2	28.7	50.1	4.4	50.1	50.1	47.1	39.6	32.1	24.7
	57	51.6	4.0	51.6	51.6	49.3	41.8	34.2	26.7	48.1	4.4	48.1	48.1	45.9	38.5	31.0	23.5
2000	77	76.3	4.2	42.2	32.8	24.3	-	-	-	70.4	4.6	43.1	30.7	22.3	-	-	-
	72	69.2	4.1	52.1	43.6	35.2	26.7	-	-	63.5	4.5	49.8	41.4	33.0	24.6	-	-
	67	62.0	4.1	62.0	54.5	46.0	37.5	29.1	-	56.5	4.5	56.5	52.1	43.7	35.3	26.9	-
	62	55.8	4.0	55.8	55.8	55.9	47.4	38.9	30.5	51.8	4.4	51.8	51.8	51.4	43.0	34.6	26.2
	57	53.4	4.0	53.4	53.4	53.7	45.3	36.8	28.4	49.7	4.4	49.7	49.7	50.2	41.7	33.3	24.9
2250	72	70.6	4.2	56.4	47.1	37.7	28.4	-	-	64.6	4.6	54.1	44.8	35.5	26.2	-	-
	67	63.3	4.1	63.3	58.7	49.4	40.1	30.7	-	57.6	4.5	57.6	55.0	47.0	37.8	28.5	-
	62	57.0	4.0	57.0	57.0	57.0	47.7	38.3	29.0	52.8	4.4	52.8	52.8	52.6	43.3	34.0	24.7
	57	54.5	4.0	54.5	54.5	54.7	45.4	36.0	26.7	50.6	4.4	50.6	50.6	50.8	41.6	32.3	23.0
2500	72	72.0	4.2	60.7	50.5	40.3	30.1	-	-	65.8	4.6	58.3	48.2	38.0	27.9	-	-
	67	64.6	4.1	64.6	63.0	52.8	42.6	32.4	-	58.6	4.5	58.6	57.8	50.4	40.2	30.1	-
	62	58.1	4.0	58.1	58.1	58.1	48.0	37.8	27.6	53.7	4.4	53.7	53.7	53.7	43.6	33.4	23.3
	57	55.7	4.0	55.7	55.7	55.7	45.5	35.3	25.1	51.5	4.4	51.5	51.5	51.5	41.4	31.2	21.1

ZJ061 (5.0 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1250	77	58.5	4.9	22.3	20.4	14.9	-	-	-	53.4	5.3	21.9	17.7	13.3	-	-	-
	72	52.4	4.8	33.7	28.3	22.8	17.4	-	-	47.6	5.2	31.8	26.4	21.0	15.6	-	-
	67	46.3	4.7	45.1	36.1	30.7	25.2	19.8	-	41.7	5.1	41.7	34.1	28.7	23.4	18.0	-
	62	43.3	4.7	43.3	43.3	34.8	29.3	23.9	18.4	40.0	5.0	40.0	40.0	31.2	25.8	20.5	15.1
1500	77	60.5	4.9	29.6	23.1	16.7	-	-	-	55.1	5.3	29.6	21.3	14.9	-	-	-
	72	54.2	4.9	38.3	31.9	25.5	19.0	-	-	49.1	5.3	36.3	29.9	23.6	17.2	-	-
	67	47.9	4.8	47.1	40.7	34.3	27.8	21.4	-	43.0	5.2	43.0	38.6	32.2	25.8	19.5	-
	62	44.8	4.7	44.8	44.8	38.9	32.4	26.0	19.6	41.2	5.1	41.2	41.2	35.0	28.6	22.3	15.9
	57	43.1	4.7	43.1	43.1	38.5	32.1	25.7	19.2	39.7	5.1	39.7	39.7	35.4	29.0	22.6	16.3
1750	77	62.5	5.0	36.8	25.9	18.4	-	-	-	56.8	5.4	37.4	24.8	16.5	-	-	-
	72	56.0	4.9	43.0	35.6	28.1	20.7	-	-	50.6	5.3	40.8	33.5	26.1	18.7	-	-
	67	49.5	4.8	49.1	45.3	37.8	30.4	23.0	-	44.3	5.2	44.3	43.0	35.7	28.3	20.9	-
	62	46.3	4.7	46.3	46.3	42.9	35.5	28.1	20.7	42.5	5.1	42.5	42.5	38.8	31.4	24.1	16.7
	57	44.5	4.7	44.5	44.5	42.6	35.1	27.7	20.3	40.9	5.1	40.9	40.9	39.2	31.8	24.5	17.1
2000	77	64.5	5.0	44.1	28.6	20.2	-	-	-	58.5	5.5	45.1	28.4	18.1	-	-	-
	72	57.8	5.0	47.6	39.2	30.8	22.4	-	-	52.1	5.4	45.4	37.0	28.6	20.3	-	-
	67	51.1	4.9	51.1	49.8	41.4	33.0	24.6	-	45.6	5.3	45.6	45.6	39.2	30.8	22.4	-
	62	47.8	4.8	47.8	47.8	47.0	38.6	30.2	21.8	43.8	5.2	43.8	43.8	42.6	34.2	25.9	17.5
	57	45.9	4.8	45.9	45.9	46.6	38.2	29.8	21.4	42.2	5.2	42.2	42.2	42.2	34.7	26.3	17.9
2250	72	58.7	5.0	51.8	42.5	33.3	24.0	-	-	52.7	5.4	49.5	40.2	31.0	21.8	-	-
	67	51.9	4.9	51.9	51.3	44.7	35.5	26.2	-	46.2	5.3	46.2	46.2	42.4	33.1	23.9	-
	62	48.6	4.8	48.6	48.6	48.2	38.9	29.6	20.4	44.3	5.2	44.3	44.3	43.7	34.5	25.3	16.1
	57	46.7	4.8	46.7	46.7	47.0	37.7	28.5	19.2	42.7	5.2	42.7	42.7	42.7	33.9	24.7	15.5
2500	72	59.6	5.0	55.9	45.8	35.7	25.6	-	-	53.4	5.4	53.4	43.4	33.4	23.3	-	-
	67	52.7	4.9	52.7	52.7	48.0	37.9	27.7	-	46.8	5.3	46.8	46.8	45.6	35.5	25.4	-
	62	49.3	4.8	49.3	49.3	49.3	39.2	29.1	19.0	44.9	5.2	44.9	44.9	44.9	34.8	24.7	14.6
	57	47.4	4.8	47.4	47.4	47.4	37.3	27.1	17.0	43.3	5.2	43.3	43.3	43.3	33.2	23.1	13.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ078 (6.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1625	77	106.7	4.6	46.4	38.6	31.0	-	-	-	98.2	5.1	42.4	35.0	27.6	-	-	-
	72	97.0	4.5	57.0	49.4	41.7	34.1	-	-	89.3	5.0	53.2	45.8	38.4	31.0	-	-
	67	87.2	4.5	67.6	60.1	52.4	44.8	37.2	-	80.3	5.0	63.9	56.5	49.1	41.7	34.3	-
	62	78.3	4.6	78.3	71.0	62.1	54.4	46.8	39.1	72.1	5.0	72.1	67.6	57.7	50.3	42.9	35.5
1950	77	109.7	4.6	50.9	42.2	33.4	-	-	-	101.0	5.1	47.1	38.5	30.0	-	-	-
	72	99.7	4.6	62.4	53.7	45.0	36.2	-	-	91.8	5.1	58.7	50.2	41.7	33.2	-	-
	67	89.6	4.5	73.9	65.2	56.5	47.8	39.1	-	82.6	5.0	70.4	61.9	53.3	44.8	36.3	-
	62	80.4	4.6	80.4	75.6	66.9	58.1	49.4	40.7	74.1	5.0	74.1	71.1	62.6	54.1	45.6	37.1
	57	83.1	4.6	83.1	83.1	72.0	63.2	54.5	45.8	74.2	5.0	74.2	74.2	66.9	58.4	49.9	41.4
2275	77	112.6	4.6	55.3	45.7	35.9	-	-	-	103.8	5.1	51.7	42.0	32.4	-	-	-
	72	102.3	4.6	67.8	58.0	48.2	38.4	-	-	94.4	5.1	64.2	54.6	45.0	35.4	-	-
	67	92.1	4.5	80.3	70.4	60.6	50.8	41.0	-	84.9	5.0	76.8	67.2	57.6	47.9	38.3	-
	62	82.6	4.6	82.6	80.2	71.7	61.9	52.1	42.3	76.2	5.0	76.2	74.7	67.6	58.0	48.3	38.7
	57	85.3	4.6	85.3	85.3	77.1	67.3	57.5	47.7	76.3	5.0	76.3	76.3	72.2	62.6	53.0	43.4
2600	77	115.6	4.6	59.8	49.2	38.3	-	-	-	106.6	5.2	56.3	45.5	34.8	-	-	-
	72	105.0	4.6	73.2	62.3	51.4	40.6	-	-	96.9	5.1	69.8	59.0	48.3	37.6	-	-
	67	94.5	4.5	86.6	75.5	64.6	53.7	42.9	-	87.2	5.1	83.3	72.5	61.8	51.1	40.3	-
	62	84.8	4.6	84.8	84.8	76.5	65.6	54.7	43.8	78.2	5.1	78.2	78.2	72.6	61.8	51.1	40.3
	57	87.6	4.6	87.6	87.6	82.3	71.4	60.6	49.7	78.4	5.0	78.4	78.4	77.6	66.8	56.1	45.3
2925	72	107.5	4.6	78.5	66.6	54.8	43.0	-	-	99.1	5.1	74.7	63.0	51.4	39.7	-	-
	67	96.7	4.6	92.7	80.7	68.8	57.0	45.2	-	89.2	5.1	87.2	77.4	65.7	54.1	42.5	-
	62	86.7	4.6	86.7	86.7	82.6	70.8	58.9	47.1	80.0	5.1	80.0	80.0	77.2	65.5	53.9	42.2
	57	89.6	4.6	89.6	89.6	87.0	75.2	63.3	51.5	80.1	5.1	80.1	80.1	79.7	68.1	56.4	44.8
3250	72	109.9	4.6	83.7	70.9	58.2	45.4	-	-	101.3	5.1	79.5	67.0	54.5	41.9	-	-
	67	98.8	4.6	98.8	85.8	73.1	60.3	47.5	-	91.2	5.1	91.2	82.2	69.7	57.2	44.6	-
	62	88.7	4.6	88.7	88.7	88.7	75.9	63.2	50.4	81.8	5.1	81.8	81.8	81.8	69.2	56.7	44.1
	57	91.6	4.6	91.6	91.6	91.6	78.9	66.1	53.3	81.9	5.1	81.9	81.9	81.9	69.3	56.8	44.3
		95°F								**105°F**							
1625	77	89.6	5.6	38.5	31.4	24.3	-	-	-	80.9	6.2	33.0	28.4	21.5	-	-	-
	72	81.5	5.5	49.3	42.2	35.0	27.9	-	-	73.1	6.1	45.5	38.6	31.8	25.0	-	-
	67	73.4	5.5	60.2	52.9	45.8	38.6	31.5	-	65.3	6.0	57.9	48.9	42.1	35.2	28.4	-
	62	65.8	5.4	65.8	64.2	53.3	46.1	39.0	31.8	58.3	5.9	58.3	57.5	47.9	41.1	34.2	27.4
1950	77	92.3	5.6	43.2	34.9	26.6	-	-	-	83.8	6.2	40.0	31.9	23.9	-	-	-
	72	84.0	5.6	55.0	46.7	38.4	30.1	-	-	75.7	6.1	51.4	43.3	35.3	27.2	-	-
	67	75.6	5.5	66.8	58.5	50.2	41.9	33.6	-	67.7	6.0	62.8	54.7	46.7	38.6	30.5	-
	62	67.8	5.5	67.8	66.7	58.4	50.1	41.8	33.5	60.4	5.9	60.4	59.9	53.1	45.0	37.0	28.9
	57	65.4	5.4	65.4	65.4	61.9	53.6	45.3	37.0	61.0	5.9	61.0	61.0	55.7	47.7	39.6	31.6
2275	77	95.0	5.7	48.0	38.4	29.0	-	-	-	86.7	6.3	46.9	35.5	26.2	-	-	-
	72	86.4	5.6	60.7	51.2	41.8	32.3	-	-	78.4	6.1	57.2	48.0	38.7	29.4	-	-
	67	77.8	5.5	73.4	64.0	54.6	45.1	35.7	-	70.1	6.0	67.6	60.5	51.2	42.0	32.7	-
	62	69.8	5.5	69.8	69.2	63.5	54.1	44.6	35.2	62.5	5.9	62.5	62.2	58.3	49.0	39.7	30.5
	57	67.2	5.5	67.2	67.2	67.3	57.9	48.4	39.0	63.2	6.0	63.2	63.2	61.2	51.9	42.6	33.4
2600	77	97.6	5.7	52.7	41.9	31.3	-	-	-	89.7	6.3	53.8	39.0	28.5	-	-	-
	72	88.8	5.6	66.4	55.8	45.1	34.5	-	-	81.0	6.2	63.1	52.6	42.2	31.7	-	-
	67	80.0	5.6	80.0	69.6	59.0	48.4	37.8	-	72.4	6.1	72.4	66.3	55.8	45.3	34.8	-
	62	71.7	5.5	71.7	71.7	68.7	58.1	47.5	36.8	64.6	6.0	64.6	64.6	63.5	53.0	42.5	32.0
	57	69.1	5.5	69.1	69.1	72.8	62.2	51.6	40.9	65.3	6.0	65.3	65.3	66.6	56.1	45.7	35.2
2925	72	90.7	5.7	70.9	59.4	47.9	36.5	-	-	82.6	6.2	67.2	55.9	44.7	33.4	-	-
	67	81.7	5.6	81.7	74.1	62.7	51.2	39.7	-	73.8	6.1	73.8	69.5	59.1	47.8	36.6	-
	62	73.3	5.5	73.3	73.3	71.7	60.3	48.8	37.4	65.9	6.0	65.9	65.9	65.3	54.0	42.7	31.5
	57	70.6	5.5	70.6	70.6	72.5	61.0	49.5	38.1	66.6	6.0	66.6	66.6	67.2	55.9	44.7	33.4
3250	72	92.7	5.7	75.4	63.1	50.7	38.4	-	-	84.2	6.2	71.3	59.2	47.2	35.1	-	-
	67	83.5	5.6	83.5	78.6	66.3	54.0	41.7	-	75.2	6.1	75.2	72.8	62.4	50.4	38.3	-
	62	74.8	5.5	74.8	74.8	74.8	62.5	50.2	37.9	67.1	6.0	67.1	67.1	67.1	55.1	43.0	30.9
	57	72.1	5.5	72.1	72.1	72.1	59.8	47.5	35.2	67.8	6.0	67.8	67.8	67.8	55.7	43.7	31.6

ZJ078 (6.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1625	77	72.1	6.8	27.6	25.3	18.8	-	-	-	63.3	7.3	26.5	21.1	16.1	-	-	-
	72	64.6	6.6	41.6	35.1	28.6	22.1	-	-	56.2	7.1	37.8	31.6	25.4	19.2	-	-
	67	57.2	6.4	55.6	44.9	38.4	31.9	25.4	-	49.1	6.9	49.1	40.9	34.7	28.5	22.3	-
	62	50.7	6.3	50.7	50.7	42.5	36.0	29.5	23.0	43.2	6.8	43.2	43.2	37.2	31.0	24.8	18.6
1950	77	75.3	6.8	36.7	28.9	21.1	-	-	-	66.8	7.4	36.3	25.9	18.4	-	-	-
	72	67.5	6.6	47.7	39.9	32.1	24.3	-	-	59.3	7.2	44.1	36.5	29.0	21.4	-	-
	67	59.8	6.5	58.7	50.9	43.1	35.3	27.5	-	51.8	7.0	51.8	47.1	39.6	32.1	24.5	-
	62	53.0	6.4	53.0	53.0	47.8	40.0	32.2	24.4	45.6	6.8	45.6	45.6	42.5	34.9	27.4	19.8
	57	56.6	6.4	56.6	56.6	49.6	41.8	34.0	26.2	52.3	6.9	52.3	52.3	43.4	35.9	28.4	20.8
2275	77	78.5	6.8	45.8	32.5	23.4	-	-	-	70.2	7.4	46.1	30.7	20.7	-	-	-
	72	70.4	6.7	53.8	44.7	35.6	26.6	-	-	62.4	7.2	50.3	41.5	32.6	23.7	-	-
	67	62.3	6.5	61.8	56.9	47.8	38.8	29.7	-	54.6	7.0	54.6	53.4	44.5	35.6	26.7	-
	62	55.3	6.4	55.3	55.3	53.0	43.9	34.9	25.8	48.0	6.8	48.0	48.0	47.8	38.9	30.0	21.1
	57	59.1	6.4	59.1	59.1	55.0	46.0	36.9	27.8	55.0	6.9	55.0	55.0	48.9	40.0	31.1	22.2
2600	77	81.7	6.9	54.9	36.1	25.7	-	-	-	73.7	7.5	56.0	35.5	23.0	-	-	-
	72	73.3	6.7	59.9	49.5	39.2	28.8	-	-	65.5	7.2	56.6	46.4	36.2	25.9	-	-
	67	64.9	6.6	64.9	62.9	52.6	42.2	31.9	-	57.3	7.0	57.3	57.3	49.4	39.1	28.9	-
	62	57.5	6.4	57.5	57.5	58.3	47.9	37.5	27.2	50.4	6.9	50.4	50.4	50.4	42.8	32.6	22.3
	57	61.5	6.5	61.5	61.5	60.5	50.1	39.7	29.4	57.6	7.0	57.6	57.6	54.3	44.1	33.8	23.6
2925	72	74.5	6.7	63.6	52.5	41.4	30.3	-	-	66.4	7.3	59.9	49.0	38.1	27.2	-	-
	67	65.9	6.6	65.9	65.0	55.6	44.5	33.4	-	58.0	7.1	58.0	58.0	52.0	41.1	30.2	-
	62	58.5	6.5	58.5	58.5	58.8	47.7	36.6	25.5	51.1	6.9	51.1	51.1	51.1	41.5	30.6	19.6
	57	62.5	6.5	62.5	62.5	62.0	50.9	39.8	28.7	58.4	7.0	58.4	58.4	56.8	45.8	34.9	24.0
3250	72	75.7	6.8	67.3	55.4	43.6	31.8	-	-	67.2	7.3	63.2	51.6	40.0	28.4	-	-
	67	67.0	6.6	67.0	67.0	58.5	46.7	34.9	-	58.8	7.1	58.8	58.8	54.7	43.1	31.5	-
	62	59.4	6.5	59.4	59.4	59.4	47.6	35.8	23.9	51.7	7.0	51.7	51.7	51.7	40.1	28.5	16.9
	57	63.5	6.5	63.5	63.5	63.5	51.7	39.8	28.0	59.2	7.1	59.2	59.2	59.2	47.6	36.0	24.4

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ090 (7.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1875	77	125.0	5.7	53.1	44.4	35.6	-	-	-	116.4	6.3	49.2	40.5	31.7	-	-	-
	72	113.1	5.6	65.8	57.1	48.3	39.5	-	-	105.3	6.2	62.2	53.5	44.7	36.0	-	-
	67	101.1	5.6	78.5	69.8	61.0	52.2	43.5	-	94.3	6.1	75.2	66.5	57.7	49.0	40.3	-
	62	88.8	5.5	88.8	88.8	73.3	64.6	55.8	47.0	83.0	6.1	83.0	83.0	70.3	61.5	52.8	44.0
2250	77	131.0	5.7	59.5	49.2	39.0	-	-	-	121.4	6.4	55.1	45.0	34.8	-	-	-
	72	118.5	5.7	73.4	63.2	52.9	42.7	-	-	109.8	6.3	69.4	59.2	49.0	38.8	-	-
	67	106.0	5.6	87.3	77.1	66.8	56.6	46.4	-	98.3	6.2	83.6	73.4	63.3	53.1	42.9	-
	62	93.1	5.6	93.1	93.1	80.4	70.2	59.9	49.7	86.5	6.1	86.5	86.5	77.0	66.8	56.6	46.4
	57	93.6	5.5	93.6	93.6	87.2	77.0	66.8	56.5	87.3	6.1	87.3	87.3	79.8	69.6	59.4	49.2
2625	77	137.0	5.7	65.8	54.1	42.4	-	-	-	126.3	6.4	61.1	49.4	37.8	-	-	-
	72	123.9	5.7	80.9	69.3	57.6	45.9	-	-	114.3	6.3	76.5	64.9	53.3	41.7	-	-
	67	110.8	5.6	96.1	84.4	72.7	61.0	49.3	-	102.3	6.2	92.0	80.4	68.8	57.1	45.5	-
	62	97.3	5.6	97.3	97.3	87.5	75.8	64.1	52.4	90.0	6.1	90.0	90.0	83.7	72.0	60.4	48.8
	57	97.8	5.6	97.8	97.8	94.9	83.2	71.5	59.8	90.9	6.1	90.9	90.9	86.8	75.1	63.5	51.9
3000	77	142.9	5.8	72.1	59.0	45.8	-	-	-	131.3	6.5	67.0	53.9	40.8	-	-	-
	72	129.3	5.7	88.5	75.4	62.2	49.1	-	-	118.8	6.4	83.7	70.6	57.6	44.5	-	-
	67	115.7	5.7	104.9	91.7	78.6	65.4	52.3	-	106.3	6.3	100.4	87.4	74.3	61.2	48.1	-
	62	101.6	5.6	101.6	101.6	94.5	81.3	68.2	55.0	93.6	6.2	93.6	93.6	90.4	77.3	64.2	51.2
	57	102.1	5.6	102.1	102.1	102.5	89.4	76.2	63.1	94.5	6.2	94.5	94.5	93.7	80.6	67.6	54.5
3375	72	132.4	5.7	95.5	80.9	66.2	51.6	-	-	121.6	6.4	90.7	76.2	61.6	47.0	-	-
	67	118.4	5.7	113.0	98.3	83.7	69.0	54.4	-	108.8	6.3	105.8	94.1	79.5	65.0	50.4	-
	62	104.0	5.6	104.0	104.0	100.5	85.8	71.2	56.6	95.7	6.2	95.7	95.7	94.1	79.6	65.0	50.5
	57	104.6	5.6	104.6	104.6	104.8	90.1	75.5	60.9	96.7	6.2	96.7	96.7	96.3	81.7	67.2	52.6
3750	72	135.5	5.7	102.5	86.4	70.3	54.2	-	-	124.3	6.4	97.7	81.7	65.7	49.6	-	-
	67	121.2	5.7	121.2	104.8	88.7	72.7	56.6	-	111.2	6.3	111.2	100.8	84.7	68.7	52.7	-
	62	106.4	5.6	106.4	106.4	106.4	90.3	74.2	58.2	97.9	6.2	97.9	97.9	97.9	81.9	65.8	49.8
	57	107.0	5.6	107.0	107.0	107.0	90.9	74.8	58.7	98.8	6.2	98.8	98.8	98.8	82.8	66.8	50.7
		95°F								**105°F**							
1875	77	107.8	7.0	45.3	36.6	27.9	-	-	-	99.1	7.6	39.5	33.4	24.8	-	-	-
	72	97.6	6.9	58.6	49.9	41.2	32.5	-	-	89.4	7.5	55.1	46.5	37.9	29.3	-	-
	67	87.4	6.7	71.9	63.2	54.5	45.8	37.1	-	79.6	7.3	70.7	59.6	51.0	42.4	33.8	-
	62	77.1	6.6	77.1	77.1	67.2	58.4	49.7	41.0	70.5	7.1	70.5	70.5	63.1	54.5	45.9	37.3
2250	77	111.8	7.1	50.8	40.7	30.5	-	-	-	102.3	7.7	47.3	37.3	27.3	-	-	-
	72	101.2	6.9	65.4	55.2	45.1	35.0	-	-	92.2	7.5	61.7	51.7	41.7	31.6	-	-
	67	90.6	6.8	79.9	69.8	59.7	49.5	39.4	-	82.2	7.3	76.1	66.0	56.0	46.0	36.0	-
	62	79.9	6.7	79.9	79.9	73.5	63.4	53.2	43.1	72.7	7.2	72.7	72.7	69.3	59.3	49.3	39.3
	57	81.1	6.6	81.1	81.1	72.4	62.2	52.1	42.0	75.0	7.2	75.0	75.0	66.9	56.9	46.9	36.9
2625	77	115.7	7.1	56.3	44.7	33.2	-	-	-	105.4	7.8	55.1	41.1	29.7	-	-	-
	72	104.8	7.0	72.1	60.6	49.0	37.4	-	-	95.1	7.6	68.3	56.8	45.4	34.0	-	-
	67	93.8	6.8	88.0	76.4	64.8	53.3	41.7	-	84.7	7.4	81.4	72.5	61.1	49.6	38.2	-
	62	82.8	6.7	82.8	82.8	79.9	68.3	56.8	45.2	75.0	7.2	75.0	75.0	75.5	64.1	52.7	41.2
	57	84.0	6.7	84.0	84.0	78.6	67.1	55.5	43.9	77.3	7.2	77.3	77.3	72.9	61.5	50.1	38.6
3000	77	119.7	7.2	61.8	48.8	35.8	-	-	-	108.6	7.8	62.9	45.0	32.2	-	-	-
	72	108.3	7.0	78.9	65.9	52.9	39.9	-	-	97.9	7.6	74.8	62.0	49.1	36.3	-	-
	67	97.0	6.9	96.0	83.0	70.0	57.0	44.0	-	87.3	7.4	86.7	79.0	66.1	53.3	40.4	-
	62	85.6	6.8	85.6	85.6	86.3	73.3	60.3	47.3	77.2	7.3	77.2	77.2	81.8	68.9	56.0	43.2
	57	86.8	6.7	86.8	86.8	84.9	71.9	58.9	45.9	79.6	7.3	79.6	79.6	78.9	66.1	53.2	40.4
3375	72	110.7	7.0	86.0	71.5	57.0	42.5	-	-	99.7	7.7	81.7	67.4	53.0	38.6	-	-
	67	99.2	6.9	98.6	89.9	75.4	60.9	46.4	-	88.9	7.5	88.6	83.6	71.3	57.0	42.6	-
	62	87.5	6.8	87.5	87.5	87.8	73.3	58.8	44.3	78.7	7.3	78.7	78.7	80.9	66.6	52.2	37.9
	57	88.8	6.7	88.8	88.8	87.8	73.3	58.8	44.3	81.1	7.3	81.1	81.1	80.7	66.4	52.0	37.7
3750	72	113.1	7.0	93.0	77.0	61.0	45.0	-	-	101.6	7.7	88.6	72.8	56.9	41.0	-	-
	67	101.3	6.9	101.3	96.7	80.7	64.7	48.7	-	90.5	7.5	90.5	88.2	76.5	60.7	44.8	-
	62	89.4	6.8	89.4	89.4	89.4	73.4	57.4	41.4	80.1	7.3	80.1	80.1	80.1	64.3	48.4	32.5
	57	90.7	6.8	90.7	90.7	90.7	74.7	58.7	42.7	82.5	7.3	82.5	82.5	82.5	66.7	50.8	34.9

ZJ090 (7.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1875	77	90.4	8.3	33.6	30.2	21.8	-	-	-	81.7	8.9	32.0	25.5	18.7	-	-	-
	72	81.1	8.0	51.6	43.1	34.6	26.2	-	-	72.9	8.6	48.1	39.7	31.4	23.0	-	-
	67	71.9	7.8	69.5	56.0	47.5	39.0	30.6	-	64.1	8.3	64.1	52.4	44.0	35.7	27.3	-
	62	63.9	7.6	63.9	63.9	59.0	50.5	42.0	33.6	57.3	8.1	57.3	57.3	57.3	46.5	38.2	29.8
2250	77	92.7	8.3	43.8	33.9	24.0	-	-	-	83.2	9.0	43.2	30.5	20.7	-	-	-
	72	83.2	8.1	58.0	48.1	38.2	28.3	-	-	74.3	8.7	54.3	44.5	34.8	25.0	-	-
	67	73.7	7.9	72.2	62.3	52.4	42.5	32.6	-	65.3	8.4	65.3	58.5	48.8	39.0	29.3	-
	62	65.6	7.7	65.6	65.6	65.1	55.2	45.3	35.4	58.4	8.2	58.4	58.4	58.4	51.1	41.3	31.6
	57	68.8	7.7	68.8	68.8	61.5	51.6	41.7	31.8	62.7	8.3	62.7	62.7	56.0	46.3	36.5	26.8
2625	77	95.1	8.4	53.9	37.5	26.3	-	-	-	84.8	9.1	54.4	35.5	22.8	-	-	-
	72	85.4	8.2	64.4	53.1	41.8	30.5	-	-	75.7	8.8	60.5	49.3	38.2	27.0	-	-
	67	75.6	7.9	74.8	68.6	57.3	46.0	34.7	-	66.5	8.5	66.5	64.7	53.5	42.4	31.2	-
	62	67.2	7.7	67.2	67.2	71.2	59.9	48.6	37.3	59.5	8.2	59.5	59.5	59.5	55.6	44.5	33.3
	57	70.6	7.8	70.6	70.6	67.2	55.9	44.6	33.3	63.9	8.4	63.9	63.9	61.5	50.4	39.2	28.0
3000	77	97.5	8.5	64.0	41.2	28.5	-	-	-	86.4	9.1	65.7	40.5	24.8	-	-	-
	72	87.5	8.2	70.8	58.1	45.4	32.6	-	-	77.1	8.8	66.7	54.1	41.6	29.0	-	-
	67	77.5	8.0	77.5	74.9	62.2	49.5	36.8	-	67.8	8.6	67.8	67.8	58.3	45.8	33.2	-
	62	68.9	7.8	68.9	68.9	77.2	64.5	51.8	39.1	60.6	8.3	60.6	60.6	60.6	60.2	47.6	35.0
	57	72.3	7.9	72.3	72.3	73.0	60.3	47.6	34.8	65.1	8.4	65.1	65.1	65.1	54.4	41.9	29.3
3375	72	88.7	8.3	77.5	63.3	49.1	34.8	-	-	77.7	8.9	73.3	59.2	45.1	31.0	-	-
	67	78.6	8.0	78.6	77.3	67.3	53.1	38.8	-	68.3	8.6	68.3	68.3	63.3	49.2	35.1	-
	62	69.9	7.8	69.9	69.9	74.1	59.8	45.6	31.4	61.1	8.4	61.1	61.1	61.1	53.1	39.0	24.9
	57	73.4	7.9	73.4	73.4	73.7	59.5	45.2	31.0	65.7	8.5	65.7	65.7	65.7	52.5	38.4	24.3
3750	72	90.0	8.3	84.3	68.5	52.8	37.0	-	-	78.4	8.9	78.4	64.3	48.6	33.0	-	-
	67	79.7	8.1	79.7	79.7	72.4	56.6	40.9	-	68.9	8.6	68.9	68.9	68.2	52.6	37.0	-
	62	70.9	7.9	70.9	70.9	70.9	55.1	39.4	23.6	61.6	8.4	61.6	61.6	61.6	46.0	30.4	14.8
	57	74.4	7.9	74.4	74.4	74.4	58.7	42.9	27.2	66.3	8.5	66.3	66.3	66.3	50.6	35.0	19.4

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ102 (8.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
2125	77	136.0	6.1	61.5	49.5	38.6	-	-	-	127.6	6.8	56.3	45.7	35.0	-	-	-
	72	124.0	6.0	74.1	63.2	52.4	41.5	-	-	116.0	6.7	70.2	59.6	48.9	38.3	-	-
	67	112.1	5.9	86.7	77.0	66.1	55.3	44.4	-	104.3	6.6	84.1	73.5	62.8	52.2	41.5	-
	62	99.3	6.2	99.3	95.1	77.6	66.8	55.9	45.0	91.6	6.7	91.6	89.5	74.0	63.3	52.7	42.0
2550	77	141.0	6.1	67.2	54.7	42.3	-	-	-	132.1	6.8	63.0	50.7	38.4	-	-	-
	72	128.6	6.0	82.2	69.8	57.4	44.9	-	-	120.0	6.7	78.2	65.9	53.6	41.3	-	-
	67	116.2	5.9	97.3	84.9	72.5	60.0	47.6	-	107.9	6.6	93.5	81.2	68.9	56.6	44.3	-
	62	102.9	6.2	102.9	100.1	85.0	72.6	60.1	47.7	94.8	6.7	94.8	93.4	81.1	68.8	56.5	44.2
	57	99.4	8.7	99.4	99.4	91.2	78.7	66.3	53.8	93.6	6.5	93.6	93.6	85.3	73.0	60.7	48.4
2975	77	146.0	6.1	72.8	60.0	46.0	-	-	-	136.5	6.8	69.7	55.7	41.8	-	-	-
	72	133.1	6.0	90.4	76.4	62.4	48.4	-	-	124.0	6.7	86.3	72.3	58.4	44.4	-	-
	67	120.3	5.9	107.9	92.8	78.8	64.8	50.8	-	111.6	6.6	102.9	88.9	75.0	61.0	47.0	-
	62	106.5	6.1	106.5	105.1	92.4	78.4	64.4	50.4	98.0	6.7	98.0	97.3	88.3	74.3	60.4	46.4
	57	102.9	8.7	102.9	102.9	99.1	85.1	71.1	57.1	96.7	6.5	96.7	96.7	92.9	78.9	65.0	51.0
3400	77	151.0	6.0	78.5	65.2	49.7	-	-	-	141.0	6.8	76.4	60.8	45.2	-	-	-
	72	137.7	5.9	98.5	82.9	67.4	51.8	-	-	128.1	6.7	94.3	78.7	63.1	47.5	-	-
	67	124.4	5.8	118.5	100.6	85.1	69.5	53.9	-	115.2	6.6	112.3	96.6	81.0	65.4	49.8	-
	62	110.2	6.1	110.2	110.2	99.8	84.3	68.7	53.1	101.2	6.8	101.2	101.2	95.4	79.8	64.2	48.6
	57	106.5	8.7	106.5	106.5	107.0	91.5	75.9	60.3	99.9	6.5	99.9	99.9	100.4	84.8	69.2	53.6
3825	72	141.1	6.0	105.2	88.2	71.1	54.0	-	-	131.1	6.7	101.2	84.1	67.1	50.0	-	-
	67	127.5	5.9	124.6	106.8	89.8	72.7	55.6	-	117.9	6.6	116.4	103.2	86.1	69.1	52.0	-
	62	112.9	6.2	112.9	112.9	107.7	90.6	73.6	56.5	103.5	6.8	103.5	103.5	100.7	83.6	66.5	49.5
	57	109.1	8.7	109.1	109.1	109.4	92.3	75.2	58.2	102.2	6.6	102.2	102.2	102.4	85.4	68.3	51.3
4250	72	144.5	6.1	112.0	93.4	74.8	56.3	-	-	134.0	6.8	108.0	89.5	71.0	52.5	-	-
	67	130.6	6.0	130.6	113.0	94.5	75.9	57.3	-	120.6	6.7	120.6	109.7	91.2	72.7	54.2	-
	62	115.6	6.2	115.6	115.6	115.6	97.0	78.4	59.9	105.9	6.8	105.9	105.9	105.9	87.4	68.9	50.4
	57	111.7	8.8	111.7	111.7	111.7	93.2	74.6	56.0	104.5	6.6	104.5	104.5	104.5	86.0	67.5	49.0
		95°F								**105°F**							
2125	77	119.3	7.4	51.1	41.8	31.4	-	-	-	108.3	8.2	44.7	38.5	28.3	-	-	-
	72	107.9	7.3	66.3	55.9	45.4	35.0	-	-	97.7	8.0	62.2	52.0	41.8	31.6	-	-
	67	96.5	7.2	81.5	69.9	59.5	49.1	38.6	-	87.1	7.8	79.6	65.5	55.3	45.1	34.9	-
	62	84.0	7.3	84.0	84.0	70.3	59.9	49.5	39.1	77.3	7.9	77.3	77.3	65.1	54.9	44.7	34.5
2550	77	123.1	7.5	58.8	46.7	34.5	-	-	-	111.8	8.2	55.2	43.2	31.2	-	-	-
	72	111.4	7.4	74.2	62.1	49.9	37.7	-	-	100.9	8.1	70.1	58.1	46.2	34.2	-	-
	67	99.7	7.2	89.7	77.5	65.3	53.1	41.0	-	90.0	7.9	85.0	73.0	61.1	49.1	37.2	-
	62	86.7	7.3	86.7	86.7	77.2	65.1	52.9	40.7	79.8	7.9	79.8	79.8	71.9	60.0	48.0	36.1
	57	87.7	7.1	87.7	87.7	79.5	67.4	55.2	43.0	80.7	7.8	80.7	80.7	72.5	60.5	48.6	36.6
2975	77	127.0	7.5	66.6	51.5	37.6	-	-	-	115.3	8.3	65.6	47.9	34.2	-	-	-
	72	114.9	7.4	82.2	68.3	54.4	40.5	-	-	104.1	8.1	78.0	64.3	50.6	36.9	-	-
	67	102.8	7.3	97.8	85.1	71.2	57.2	43.3	-	92.8	7.9	90.3	80.6	66.9	53.2	39.5	-
	62	89.5	7.4	89.5	89.5	84.1	70.2	56.3	42.4	82.3	7.9	82.3	82.3	78.8	65.1	51.4	37.6
	57	90.5	7.2	90.5	90.5	86.6	72.7	58.8	44.9	83.2	7.8	83.2	83.2	79.4	65.7	51.9	38.2
3400	77	130.9	7.6	74.3	56.3	40.7	-	-	-	118.9	8.3	76.1	52.6	37.2	-	-	-
	72	118.5	7.4	90.2	74.5	58.8	43.2	-	-	107.3	8.1	85.9	70.4	55.0	39.5	-	-
	67	106.0	7.3	106.0	92.7	77.0	61.3	45.7	-	95.7	8.0	95.7	88.2	72.7	57.3	41.8	-
	62	92.2	7.4	92.2	92.2	91.0	75.4	59.7	44.1	84.8	8.0	84.8	84.8	85.6	70.2	54.7	39.2
	57	93.3	7.2	93.3	93.3	93.8	78.1	62.4	46.8	85.8	7.8	85.8	85.8	86.3	70.8	55.3	39.9
3825	72	121.0	7.5	97.1	80.1	63.0	46.0	-	-	109.5	8.2	92.8	75.9	59.0	42.1	-	-
	67	108.3	7.3	108.3	99.5	82.5	65.4	48.4	-	97.7	8.0	97.7	92.9	78.1	61.2	44.3	-
	62	94.2	7.4	94.2	94.2	93.6	76.5	59.5	42.5	86.6	8.0	86.6	86.6	87.0	70.1	53.2	36.3
	57	95.3	7.2	95.3	95.3	95.5	78.5	61.4	44.4	87.5	7.9	87.5	87.5	87.8	70.9	54.0	37.1
4250	72	123.5	7.5	104.1	85.6	67.2	48.8	-	-	111.7	8.2	99.6	81.3	63.0	44.7	-	-
	67	110.5	7.4	110.5	106.4	87.9	69.5	51.1	-	99.6	8.0	99.6	97.6	83.4	65.1	46.8	-
	62	96.2	7.5	96.2	96.2	96.2	77.7	59.3	40.8	88.4	8.0	88.4	88.4	88.4	70.1	51.7	33.4
	57	97.3	7.3	97.3	97.3	97.3	78.8	60.4	41.9	89.3	7.9	89.3	89.3	89.3	71.0	52.7	34.4

ZJ102 (8.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
2125	77	97.3	9.0	38.3	35.1	25.1	-	-	-	86.3	9.7	39.4	29.5	21.9	-	-	-
	72	87.5	8.7	58.0	48.0	38.1	28.1	-	-	77.4	9.4	53.9	44.1	34.4	24.6	-	-
	67	77.8	8.5	77.8	61.0	51.1	41.1	31.1	-	68.4	9.1	68.4	56.6	46.8	37.1	27.4	-
	62	70.6	8.4	70.6	70.6	59.8	49.8	39.8	29.9	63.9	9.0	63.9	63.9	54.5	44.8	35.0	25.3
2550	77	100.5	9.0	51.5	39.7	28.0	-	-	-	89.1	9.8	52.8	36.2	24.7	-	-	-
	72	90.4	8.8	65.9	54.1	42.4	30.7	-	-	79.9	9.5	61.7	50.2	38.7	27.1	-	-
	67	80.3	8.5	80.3	68.6	56.9	45.1	33.4	-	70.6	9.2	70.6	64.2	52.6	41.1	29.6	-
	62	72.9	8.4	72.9	72.9	66.6	54.9	43.1	31.4	66.0	9.0	66.0	66.0	61.3	49.8	38.2	26.7
	57	73.6	8.4	73.6	73.6	65.4	53.7	41.9	30.2	66.6	10.4	66.6	66.6	58.3	46.8	35.3	23.8
2975	77	103.6	9.1	64.7	44.3	30.8	-	-	-	91.9	9.8	66.2	42.9	27.4	-	-	-
	72	93.2	8.8	73.7	60.2	46.7	33.2	-	-	82.4	9.5	69.5	56.2	42.9	29.6	-	-
	67	82.8	8.6	82.8	76.2	62.7	49.2	35.7	-	72.8	9.2	72.8	71.7	58.4	45.2	31.9	-
	62	75.2	8.5	75.2	75.2	73.4	59.9	46.4	32.9	68.0	9.0	68.0	68.0	68.0	54.7	41.5	28.2
	57	75.9	8.4	75.9	75.9	72.1	58.6	45.1	31.6	68.7	10.4	68.7	68.7	64.8	51.5	38.2	24.9
3400	77	106.8	9.1	77.9	48.9	33.7	-	-	-	94.7	9.9	79.6	49.5	30.2	-	-	-
	72	96.1	8.9	81.6	66.3	51.1	35.8	-	-	84.9	9.6	77.3	62.3	47.2	32.1	-	-
	67	85.3	8.6	85.3	83.8	68.5	53.2	38.0	-	75.0	9.3	75.0	75.0	64.2	49.2	34.1	-
	62	77.5	8.5	77.5	77.5	80.2	64.9	49.7	34.4	70.1	9.1	70.1	70.1	70.1	59.7	44.7	29.6
	57	78.3	8.4	78.3	78.3	78.8	63.5	48.2	33.0	70.7	10.5	70.7	70.7	70.7	56.2	41.1	26.1
3825	72	98.0	8.9	88.4	71.7	55.0	38.2	-	-	86.5	9.6	84.0	67.5	50.9	34.4	-	-
	67	87.0	8.7	87.0	86.3	73.7	57.0	40.3	-	76.4	9.3	76.4	76.4	69.3	52.8	36.2	-
	62	79.0	8.6	79.0	79.0	80.4	63.7	46.9	30.2	71.4	9.1	71.4	71.4	71.4	57.2	40.7	24.1
	57	79.8	8.5	79.8	79.8	80.1	63.4	46.6	29.9	72.1	10.5	72.1	72.1	72.1	55.8	39.2	22.7
4250	72	99.9	8.9	95.2	77.0	58.8	40.7	-	-	88.1	9.7	88.1	72.7	54.7	36.6	-	-
	67	88.8	8.7	88.8	88.8	78.9	60.7	42.5	-	77.9	9.4	77.9	77.9	74.4	56.3	38.3	-
	62	80.6	8.6	80.6	80.6	80.6	62.4	44.2	26.0	72.8	9.2	72.8	72.8	72.8	54.7	36.7	18.6
	57	81.4	8.5	81.4	81.4	81.4	63.2	45.0	26.9	73.5	10.6	73.5	73.5	73.5	55.4	37.4	19.3

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ120 (10 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
2500	77	159.5	7.3	63.5	52.6	41.7	-	-	-	148.2	8.2	61.1	50.3	39.4	-	-	-
	72	145.9	7.2	83.1	72.2	61.3	50.4	-	-	136.1	8.1	80.2	69.3	58.4	47.6	-	-
	67	132.2	7.1	102.7	91.8	80.9	70.0	59.1	-	124.0	8.0	99.3	88.4	77.5	66.6	55.8	-
	62	123.1	7.0	123.1	118.4	99.0	88.1	77.2	66.3	114.8	7.9	114.8	112.5	95.6	84.8	73.9	63.0
3000	77	164.8	7.4	71.2	58.4	45.5	-	-	-	153.7	8.2	68.6	55.9	43.1	-	-	-
	72	150.7	7.2	92.6	79.8	67.0	54.2	-	-	141.1	8.1	89.5	76.7	64.0	51.3	-	-
	67	136.6	7.1	114.0	101.2	88.4	75.6	62.8	-	128.6	8.0	110.4	97.6	84.9	72.2	59.5	-
	62	127.2	7.0	127.2	124.1	108.2	95.4	82.6	69.8	119.0	7.9	119.0	117.5	104.8	92.1	79.3	66.6
	57	125.9	7.0	125.9	125.9	113.4	100.6	87.8	75.0	118.5	7.9	118.5	118.5	107.1	94.4	81.7	69.0
3500	77	170.1	7.4	78.9	64.2	49.4	-	-	-	159.1	8.2	76.0	61.5	46.9	-	-	-
	72	155.5	7.3	102.1	87.4	72.7	57.9	-	-	146.1	8.1	98.7	84.2	69.6	55.0	-	-
	67	140.9	7.1	125.4	110.6	95.9	81.2	66.5	-	133.1	8.1	121.5	106.9	92.3	77.7	63.2	-
	62	131.2	7.1	131.2	129.7	117.5	102.7	88.0	73.3	123.3	8.0	123.3	122.5	113.9	99.3	84.8	70.2
	57	129.9	7.0	129.9	129.9	123.1	108.3	93.6	78.9	122.7	7.9	122.7	122.7	116.5	101.9	87.3	72.8
4000	77	175.4	7.4	86.6	70.0	53.3	-	-	-	164.5	8.3	83.5	67.1	50.7	-	-	-
	72	160.3	7.3	111.7	95.0	78.4	61.7	-	-	151.1	8.2	108.0	91.6	75.2	58.8	-	-
	67	145.3	7.2	136.7	120.1	103.4	86.8	70.1	-	137.6	8.1	132.5	116.1	99.7	83.3	66.9	-
	62	135.3	7.1	135.3	135.3	126.7	110.0	93.4	76.7	127.5	8.0	127.5	127.5	123.0	106.6	90.2	73.8
	57	133.9	7.1	133.9	133.9	132.7	116.1	99.4	82.8	126.9	8.0	126.9	126.9	125.8	109.4	93.0	76.6
4500	72	164.1	7.4	118.0	100.1	82.2	64.4	-	-	154.0	8.2	115.6	97.7	79.8	61.9	-	-
	67	148.7	7.2	144.4	126.4	108.5	90.7	72.8	-	140.3	8.1	137.7	123.7	105.8	87.9	70.1	-
	62	138.4	7.1	138.4	138.4	134.1	116.3	98.4	80.5	129.9	8.0	129.9	129.9	127.7	109.8	91.9	74.0
	57	137.0	7.1	137.0	137.0	136.4	118.6	100.7	82.8	129.3	8.0	129.3	129.3	128.8	110.9	93.0	75.1
5000	72	167.8	7.4	124.3	105.2	86.1	67.0	-	-	156.8	8.2	123.1	103.7	84.4	65.0	-	-
	67	152.0	7.3	152.0	132.7	113.6	94.5	75.5	-	142.9	8.1	142.9	131.3	111.9	92.6	73.2	-
	62	141.6	7.2	141.6	141.6	141.6	122.5	103.4	84.3	132.3	8.0	132.3	132.3	132.3	112.9	93.6	74.2
	57	140.1	7.2	140.1	140.1	140.1	121.0	101.9	82.9	131.7	8.0	131.7	131.7	131.7	112.4	93.0	73.7
		95°F								**105°F**							
2500	77	136.9	9.0	58.8	47.9	37.1	-	-	-	125.0	10.0	52.9	44.3	33.5	-	-	-
	72	126.4	8.9	77.3	66.5	55.6	44.8	-	-	115.5	10.0	73.3	62.5	51.7	40.9	-	-
	67	115.8	8.9	95.9	85.0	74.1	63.3	52.4	-	105.9	10.0	93.6	80.7	69.9	59.1	48.3	-
	62	106.6	8.8	106.6	106.6	92.2	81.4	70.5	59.7	98.2	9.9	98.2	98.2	86.0	75.2	64.5	53.7
3000	77	142.5	9.0	66.0	53.4	40.7	-	-	-	131.1	10.1	62.3	49.7	37.2	-	-	-
	72	131.5	9.0	86.3	73.7	61.1	48.5	-	-	121.1	10.0	82.5	69.9	57.3	44.7	-	-
	67	120.5	8.9	106.7	94.1	81.4	68.8	56.2	-	111.1	10.0	102.6	90.0	77.5	64.9	52.3	-
	62	110.9	8.8	110.9	110.9	101.3	88.7	76.0	63.4	102.9	9.9	102.9	102.9	95.3	82.7	70.2	57.6
	57	111.2	8.8	111.2	111.2	100.9	88.2	75.6	63.0	103.1	9.9	103.1	103.1	93.2	80.6	68.0	55.5
3500	77	148.1	9.1	73.2	58.8	44.4	-	-	-	137.1	10.1	71.7	55.1	40.8	-	-	-
	72	136.7	9.0	95.4	80.9	66.5	52.1	-	-	126.7	10.1	91.6	77.3	62.9	48.5	-	-
	67	125.3	9.0	117.5	103.1	88.7	74.3	59.9	-	116.2	10.1	111.6	99.4	85.0	70.7	56.3	-
	62	115.3	8.9	115.3	115.3	110.4	96.0	81.6	67.2	107.7	10.0	107.7	107.7	104.6	90.3	75.9	61.5
	57	115.6	8.9	115.6	115.6	109.9	95.5	81.1	66.7	107.9	9.9	107.9	107.9	102.3	87.9	73.5	59.2
4000	77	153.7	9.1	80.4	64.2	48.0	-	-	-	143.2	10.2	81.1	60.5	44.4	-	-	-
	72	141.9	9.0	104.4	88.2	72.0	55.8	-	-	132.3	10.2	100.8	84.7	68.5	52.3	-	-
	67	130.0	9.0	128.3	112.2	96.0	79.8	63.7	-	121.4	10.1	120.5	108.8	92.6	76.4	60.3	-
	62	119.6	8.9	119.6	119.6	119.4	103.3	87.1	70.9	112.5	10.0	112.5	112.5	113.9	97.8	81.6	65.4
	57	120.0	8.9	120.0	120.0	118.9	102.7	86.6	70.4	112.6	10.0	112.6	112.6	111.3	95.2	79.0	62.8
4500	72	143.9	9.1	113.1	95.2	77.3	59.4	-	-	133.6	10.1	109.0	91.2	73.5	55.7	-	-
	67	131.8	9.0	131.0	121.0	103.1	85.2	67.3	-	122.6	10.1	122.2	115.3	99.4	81.6	63.8	-
	62	121.3	8.9	121.3	121.3	121.2	103.3	85.4	67.5	113.6	10.0	113.6	113.6	114.3	96.6	78.8	61.1
	57	121.7	8.9	121.7	121.7	121.1	103.2	85.3	67.5	113.8	10.0	113.8	113.8	113.1	95.4	77.6	59.8
5000	72	145.9	9.1	121.9	102.3	82.7	63.1	-	-	134.9	10.1	117.2	97.8	78.5	59.1	-	-
	67	133.7	9.0	133.7	129.8	110.2	90.6	71.0	-	123.8	10.1	123.8	121.9	106.1	86.8	67.4	-
	62	123.0	8.9	123.0	123.0	123.0	103.4	83.8	64.2	114.7	10.0	114.7	114.7	114.7	95.4	76.1	56.7
	57	123.4	8.9	123.4	123.4	123.4	103.7	84.1	64.5	114.9	10.0	114.9	114.9	114.9	95.5	76.2	56.8

ZJ120 (10 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
2500	77	113.0	11.0	47.0	40.7	30.0	-	-	-	101.1	12.1	44.1	37.0	26.4	-	-	-
	72	104.5	11.0	69.2	58.5	47.8	37.1	-	-	93.6	12.1	65.1	54.5	43.9	33.3	-	-
	67	96.0	11.0	91.4	76.3	65.6	55.0	44.3	-	86.1	12.1	86.1	72.0	61.4	50.8	40.2	-
	62	89.7	11.0	89.7	89.7	79.8	69.1	58.4	47.7	81.3	12.1	81.3	81.3	74.1	63.0	52.3	41.7
3000	77	119.6	11.1	58.6	46.1	33.6	-	-	-	108.1	12.1	57.2	42.5	30.0	-	-	-
	72	110.6	11.1	78.6	66.1	53.5	41.0	-	-	100.1	12.2	74.7	62.2	49.8	37.3	-	-
	67	101.6	11.1	98.5	86.0	73.5	61.0	48.5	-	92.1	12.2	92.1	82.0	69.5	57.1	44.6	-
	62	94.9	11.0	94.9	94.9	89.3	76.8	64.3	51.8	87.0	12.2	87.0	87.0	83.3	70.9	58.4	46.0
	57	94.9	11.0	94.9	94.9	85.5	73.0	60.5	47.9	86.7	12.0	86.7	86.7	77.8	65.3	52.9	40.4
3500	77	126.1	11.2	70.2	51.5	37.2	-	-	-	115.1	12.2	70.3	47.9	33.6	-	-	-
	72	116.6	11.2	87.9	73.6	59.3	44.9	-	-	106.6	12.3	84.2	69.9	55.6	41.3	-	-
	67	107.2	11.2	105.6	95.7	81.4	67.0	52.7	-	98.1	12.3	98.1	92.0	77.7	63.4	49.1	-
	62	100.1	11.1	100.1	100.1	98.9	84.6	70.2	55.9	92.6	12.3	92.6	92.6	92.6	78.8	64.6	50.3
	57	100.1	11.0	100.1	100.1	94.6	80.3	66.0	51.6	92.3	12.1	92.3	92.3	87.0	72.7	58.4	44.1
4000	77	132.7	11.3	81.8	56.9	40.8	-	-	-	122.2	12.3	83.4	53.3	37.1	-	-	-
	72	122.7	11.3	97.3	81.1	65.0	48.8	-	-	113.1	12.4	93.7	77.6	61.5	45.3	-	-
	67	112.7	11.3	112.7	105.4	89.2	73.1	56.9	-	104.1	12.4	104.1	102.0	85.8	69.7	53.6	-
	62	105.3	11.2	105.3	105.3	108.4	92.3	76.1	60.0	98.2	12.4	98.2	98.2	98.2	86.8	70.7	54.5
	57	105.3	11.1	105.3	105.3	103.7	87.6	71.5	55.3	98.0	12.2	98.0	98.0	96.2	80.0	63.9	47.8
4500	72	123.4	11.2	104.9	87.3	69.6	52.0	-	-	113.1	12.3	100.8	83.3	65.8	48.3	-	-
	67	113.3	11.2	113.3	109.7	95.6	78.0	60.4	-	104.1	12.3	104.1	104.0	91.9	74.4	56.9	-
	62	105.9	11.2	105.9	105.9	107.5	89.8	72.2	54.6	98.2	12.3	98.2	98.2	98.2	83.1	65.6	48.1
	57	105.9	11.1	105.9	105.9	105.1	87.5	69.9	52.2	98.0	12.2	98.0	98.0	97.1	79.6	62.1	44.6
5000	72	124.0	11.2	112.5	93.4	74.3	55.2	-	-	113.1	12.3	107.8	89.0	70.1	51.3	-	-
	67	113.9	11.2	113.9	113.9	102.0	82.9	63.8	-	104.1	12.3	104.1	104.1	97.9	79.1	60.3	-
	62	106.5	11.2	106.5	106.5	106.5	87.4	68.3	49.2	98.2	12.3	98.2	98.2	98.2	79.4	60.6	41.7
	57	106.4	11.1	106.4	106.4	106.4	87.3	68.3	49.2	98.0	12.1	98.0	98.0	98.0	79.1	60.3	41.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ150 (12.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
3125	77	191.5	9.8	80.3	66.9	53.5	-	-	-	184.5	10.7	76.0	62.6	49.3	-	-	-
	72	178.7	9.5	103.3	89.9	76.4	63.0	-	-	171.3	10.5	99.0	85.7	72.3	59.0	-	-
	67	165.9	9.2	126.3	112.8	99.4	86.0	72.6	-	158.1	10.2	122.1	108.8	95.4	82.1	68.7	-
	62	149.9	9.1	149.9	139.5	122.9	109.5	96.1	82.7	143.1	10.1	143.1	135.8	117.5	104.2	90.8	77.5
3750	77	201.3	9.8	89.4	74.2	58.9	-	-	-	193.5	10.7	85.1	69.8	54.5	-	-	-
	72	187.9	9.5	114.7	99.5	84.2	69.0	-	-	179.6	10.5	110.6	95.3	80.0	64.6	-	-
	67	174.5	9.3	140.0	124.8	109.5	94.3	79.1	-	165.8	10.3	136.1	120.8	105.5	90.1	74.8	-
	62	157.6	9.1	157.6	150.7	135.4	120.2	105.0	89.7	150.1	10.1	150.1	145.2	129.9	114.6	99.3	83.9
	57	152.3	9.1	152.3	152.3	140.7	125.5	110.2	95.0	145.8	10.1	145.8	145.8	134.0	118.7	103.3	88.0
4375	77	211.1	9.8	98.5	81.5	64.4	-	-	-	202.4	10.8	94.2	76.9	59.6	-	-	-
	72	197.0	9.6	126.2	109.1	92.0	75.0	-	-	187.9	10.6	122.1	104.9	87.6	70.3	-	-
	67	183.0	9.3	153.8	136.7	119.7	102.6	85.5	-	173.5	10.3	150.1	132.8	115.5	98.2	80.9	-
	62	165.3	9.1	165.3	161.8	148.0	130.9	113.8	96.8	157.0	10.1	157.0	154.6	142.3	125.0	107.7	90.4
	57	159.7	9.1	159.7	159.7	153.7	136.6	119.6	102.5	152.6	10.2	152.6	152.6	146.7	129.4	112.2	94.9
5000	77	221.0	9.9	107.6	88.8	69.9	-	-	-	211.4	10.9	103.3	84.1	64.8	-	-	-
	72	206.2	9.6	137.6	118.7	99.8	80.9	-	-	196.3	10.6	133.7	114.4	95.2	75.9	-	-
	67	191.5	9.3	167.5	148.7	129.8	110.9	92.0	-	181.2	10.4	164.1	144.8	125.5	106.3	87.0	-
	62	173.0	9.1	173.0	173.0	160.5	141.6	122.7	103.8	164.0	10.2	164.0	164.0	154.6	135.4	116.1	96.9
	57	167.2	9.1	167.2	167.2	166.7	147.8	129.0	110.1	159.3	10.2	159.3	159.3	159.5	140.2	121.0	101.7
5625	72	215.4	9.6	150.0	129.1	108.3	87.5	-	-	204.6	10.7	146.0	124.7	103.5	82.2	-	-
	67	200.0	9.3	185.5	161.6	140.8	119.9	99.1	-	188.8	10.4	179.0	157.7	136.5	115.2	93.9	-
	62	180.7	9.2	180.7	180.7	174.4	153.6	132.8	111.9	170.9	10.2	170.9	170.9	166.3	145.0	123.7	102.4
	57	174.6	9.1	174.6	174.6	174.4	153.5	132.7	111.9	166.1	10.3	166.1	166.1	166.2	144.9	123.6	102.3
6250	72	224.6	9.6	162.3	139.5	116.7	94.0	-	-	212.9	10.7	158.4	135.1	111.7	88.4	-	-
	67	208.5	9.3	203.5	174.5	151.8	129.0	106.2	-	196.5	10.5	194.0	170.7	147.4	124.1	100.8	-
	62	188.4	9.2	188.4	188.4	188.4	165.6	142.8	120.0	177.9	10.3	177.9	177.9	177.9	154.6	131.3	108.0
	57	182.0	9.2	182.0	182.0	182.0	159.2	136.5	113.7	172.8	10.3	172.8	172.8	172.8	149.5	126.2	102.9
		95°F								**105°F**							
3125	77	177.5	11.6	71.6	58.3	45.1	-	-	-	168.0	12.8	67.5	55.1	42.0	-	-	-
	72	163.9	11.4	94.8	81.5	68.2	55.0	-	-	154.2	12.7	90.8	77.7	64.5	51.4	-	-
	67	150.3	11.2	118.0	104.7	91.4	78.1	64.9	-	140.3	12.6	114.2	100.2	87.1	73.9	60.8	-
	62	136.4	11.0	136.4	132.1	112.1	98.9	85.6	72.3	128.6	12.4	128.6	126.4	106.8	93.6	80.5	67.3
3750	77	185.6	11.7	80.8	65.4	50.0	-	-	-	175.2	12.9	77.1	61.9	46.7	-	-	-
	72	171.4	11.5	106.5	91.1	75.7	60.3	-	-	160.8	12.8	102.2	86.9	71.7	56.5	-	-
	67	157.2	11.3	132.2	116.8	101.4	86.0	70.6	-	146.4	12.7	127.2	112.0	96.8	81.6	66.4	-
	62	142.6	11.1	142.6	139.7	124.3	109.0	93.6	78.2	134.1	12.5	134.1	132.7	118.7	103.5	88.2	73.0
	57	139.4	11.1	139.4	139.4	127.2	111.8	96.5	81.1	131.5	12.5	131.5	131.5	118.9	103.7	88.5	73.3
4375	77	193.7	11.8	89.9	72.4	54.9	-	-	-	182.4	13.0	86.7	68.6	51.3	-	-	-
	72	178.9	11.6	118.1	100.6	83.1	65.6	-	-	167.4	12.9	113.5	96.2	78.9	61.6	-	-
	67	164.0	11.4	146.4	128.8	111.3	93.8	76.3	-	152.4	12.8	140.3	123.8	106.5	89.2	71.9	-
	62	148.8	11.2	148.8	147.4	136.6	119.1	101.5	84.0	139.6	12.6	139.6	138.9	130.6	113.3	96.0	78.7
	57	145.4	11.2	145.4	145.4	139.7	122.2	104.7	87.2	136.9	12.6	136.9	136.9	130.9	113.6	96.3	79.0
5000	77	201.8	11.9	99.1	79.4	59.8	-	-	-	189.6	13.1	96.3	75.4	56.0	-	-	-
	72	186.3	11.7	129.8	110.2	90.5	70.9	-	-	174.0	13.0	124.8	105.5	86.1	66.8	-	-
	67	170.8	11.5	160.6	140.9	121.3	101.7	82.0	-	158.5	12.9	153.3	135.6	116.2	96.9	77.5	-
	62	155.0	11.3	155.0	155.0	148.8	129.2	109.5	89.9	145.1	12.7	145.1	145.1	142.5	123.2	103.8	84.5
	57	151.5	11.3	151.5	151.5	152.2	132.6	113.0	93.4	142.3	12.7	142.3	142.3	142.8	123.4	104.1	84.7
5625	72	193.8	11.8	142.1	120.4	98.6	76.9	-	-	180.7	13.1	136.9	115.4	94.0	72.5	-	-
	67	177.7	11.6	172.5	153.9	132.1	110.4	88.7	-	164.5	13.0	161.9	148.3	126.8	105.3	83.9	-
	62	161.2	11.3	161.2	161.2	158.1	136.4	114.6	92.9	150.7	12.8	150.7	150.7	149.3	127.9	106.4	84.9
	57	157.6	11.4	157.6	157.6	157.9	136.2	114.5	92.7	147.8	12.8	147.8	147.8	148.0	126.5	105.0	83.6
6250	72	201.2	11.9	154.4	130.6	106.7	82.9	-	-	187.3	13.2	149.0	125.4	101.8	78.2	-	-
	67	184.5	11.7	184.5	166.8	143.0	119.2	95.3	-	170.5	13.1	170.5	161.0	137.4	113.8	90.2	-
	62	167.4	11.4	167.4	167.4	167.4	143.6	119.7	95.9	156.2	12.9	156.2	156.2	156.2	132.6	109.0	85.4
	57	163.6	11.5	163.6	163.6	163.6	139.8	116.0	92.1	153.2	12.9	153.2	153.2	153.2	129.6	106.0	82.4

ZJ150 (12.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
3125	77	158.4	14.0	63.3	51.9	38.9	-	-	-	148.8	15.3	56.6	48.7	35.8	-	-	-
	72	144.4	14.0	86.9	73.8	60.8	47.8	-	-	134.6	15.3	82.9	70.0	57.1	44.2	-	-
	67	130.4	14.0	110.4	95.8	82.7	69.7	56.7	-	120.4	15.4	106.6	91.3	78.4	65.5	52.6	-
	62	120.7	13.8	120.7	120.7	101.4	88.4	75.3	62.3	112.9	15.2	112.9	112.9	96.0	83.1	70.2	57.3
3750	77	164.8	14.1	73.4	58.4	43.3	-	-	-	154.3	15.4	69.8	54.9	40.0	-	-	-
	72	150.2	14.1	97.9	82.8	67.8	52.7	-	-	139.6	15.4	93.6	78.7	63.8	48.9	-	-
	67	135.6	14.1	122.3	107.3	92.2	77.2	62.1	-	124.8	15.5	117.4	102.5	87.6	72.7	57.9	-
	62	125.6	13.9	125.6	125.6	113.0	98.0	82.9	67.9	117.1	15.3	117.1	117.1	107.3	92.5	77.6	62.7
	57	123.7	13.9	123.7	123.7	110.6	95.6	80.5	65.5	115.8	15.3	115.8	115.8	102.3	87.4	72.5	57.7
4375	77	171.1	14.2	83.5	64.8	47.8	-	-	-	159.8	15.5	82.9	61.1	44.2	-	-	-
	72	156.0	14.2	108.8	91.8	74.7	57.7	-	-	144.5	15.5	104.2	87.4	70.5	53.7	-	-
	67	140.8	14.2	134.2	118.7	101.7	84.6	67.6	-	129.2	15.6	128.1	113.7	96.9	80.0	63.2	-
	62	130.4	14.0	130.4	130.4	124.6	107.6	90.5	73.4	121.2	15.4	121.2	121.2	118.6	101.8	85.0	68.1
	57	128.4	14.0	128.4	128.4	122.0	104.9	87.9	70.8	119.9	15.5	119.9	119.9	113.1	96.3	79.4	62.6
5000	77	177.5	14.4	93.6	71.3	52.2	-	-	-	165.3	15.6	96.0	67.2	48.5	-	-	-
	72	161.8	14.3	119.8	100.8	81.7	62.6	-	-	149.5	15.7	114.8	96.1	77.3	58.5	-	-
	67	146.1	14.3	146.1	130.2	111.2	92.1	73.0	-	133.7	15.7	133.7	124.9	106.1	87.3	68.5	-
	62	135.3	14.1	135.3	135.3	136.2	117.2	98.1	79.0	125.4	15.5	125.4	125.4	125.4	111.1	92.4	73.6
	57	133.2	14.1	133.2	133.2	133.3	114.3	95.2	76.1	124.1	15.6	124.1	124.1	123.9	105.1	86.3	67.5
5625	72	167.6	14.4	131.7	110.5	89.3	68.1	-	-	154.5	15.8	126.5	105.6	84.6	63.6	-	-
	67	151.3	14.4	151.3	142.7	121.5	100.3	79.0	-	138.1	15.8	138.1	137.1	116.1	95.2	74.2	-
	62	140.1	14.2	140.1	140.1	140.6	119.4	98.1	76.9	129.6	15.6	129.6	129.6	129.6	110.9	89.9	68.9
	57	138.0	14.2	138.0	138.0	138.0	116.8	95.6	74.4	128.2	15.7	128.2	128.2	128.1	107.1	86.1	65.2
6250	72	173.4	14.5	143.6	120.2	96.9	73.5	-	-	159.4	15.9	138.2	115.1	91.9	68.8	-	-
	67	156.5	14.5	156.5	155.2	131.8	108.4	85.0	-	142.5	15.9	142.5	142.5	126.2	103.0	79.9	-
	62	145.0	14.3	145.0	145.0	145.0	121.6	98.2	74.8	133.7	15.7	133.7	133.7	133.7	110.6	87.4	64.3
	57	142.7	14.3	142.7	142.7	142.7	119.4	96.0	72.6	132.3	15.8	132.3	132.3	132.3	109.1	86.0	62.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR037-150 Cooling and Reheat Capacities

ZR037 (3.0 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
750	77	48.2	0.2	20.1	16.2	13.0	-	-	-	43.5	1.6	17.0	13.9	10.7	-	-	-
	72	43.9	0.8	24.6	21.3	18.1	14.9	-	-	39.8	1.8	22.2	19.1	16.0	12.8	-	-
	67	39.6	1.3	29.0	26.5	23.3	20.1	16.8	-	36.0	2.0	27.5	24.3	21.2	18.1	14.9	-
	62	35.5	1.1	35.5	32.6	28.4	25.1	21.9	18.7	31.4	1.9	31.4	29.6	24.7	21.6	18.4	15.3
900	77	50.4	0.5	22.1	18.2	14.3	-	-	-	45.5	1.7	19.7	15.9	12.1	-	-	-
	72	45.9	1.1	27.8	23.9	20.0	16.1	-	-	41.6	1.9	25.6	21.8	18.0	14.2	-	-
	67	41.4	1.6	33.4	29.5	25.6	21.7	17.8	-	37.6	2.1	31.5	27.7	23.9	20.1	16.3	-
	62	37.1	1.4	37.1	35.2	31.3	27.4	23.5	19.6	32.8	2.0	32.8	31.6	27.8	24.0	20.2	16.4
	57	33.3	1.3	33.3	33.4	30.5	26.6	22.7	18.8	29.7	1.9	29.7	29.7	26.4	22.6	18.8	15.0
1050	77	52.7	0.8	24.1	20.3	15.7	-	-	-	47.4	1.8	22.3	17.9	13.4	-	-	-
	72	47.9	1.3	31.0	26.4	21.8	17.2	-	-	43.3	2.0	28.9	24.4	20.0	15.5	-	-
	67	43.2	1.9	37.8	32.5	27.9	23.4	18.8	-	39.2	2.1	35.4	31.0	26.5	22.1	17.6	-
	62	38.7	1.7	38.7	37.8	34.2	29.6	25.0	20.5	34.2	2.1	34.2	33.6	30.9	26.4	21.9	17.5
	57	34.7	1.6	34.7	34.8	33.3	28.8	24.2	19.6	31.0	1.9	31.0	31.0	29.3	24.9	20.4	15.9
1200	77	54.9	1.0	26.1	22.3	17.0	-	-	-	49.4	1.9	25.0	19.9	14.8	-	-	-
	72	50.0	1.6	34.2	28.9	23.6	18.4	-	-	45.1	2.1	32.2	27.1	22.0	16.8	-	-
	67	45.1	2.2	42.2	35.5	30.3	25.0	19.8	-	40.9	2.2	39.4	34.3	29.2	24.0	18.9	-
	62	40.4	2.0	40.4	40.4	37.1	31.8	26.6	21.3	35.6	2.2	35.6	35.6	34.0	28.8	23.7	18.6
	57	36.2	1.8	36.2	36.2	36.2	30.9	25.7	20.4	32.3	2.0	32.3	32.3	32.3	27.1	22.0	16.9
1350	72	50.0	1.4	36.8	31.0	25.2	19.5	-	-	45.0	2.0	34.6	28.9	23.2	17.5	-	-
	67	45.0	2.0	43.6	38.2	32.3	26.6	20.8	-	40.8	2.1	40.1	36.5	30.8	25.1	19.4	-
	62	40.4	1.8	40.4	40.4	38.7	33.0	27.2	21.5	35.5	2.1	35.5	35.5	34.7	29.0	23.3	17.6
	57	36.2	1.6	36.2	36.2	36.2	30.4	24.7	18.9	32.2	1.9	32.2	32.2	32.2	26.5	20.8	15.1
1500	72	49.9	1.2	39.3	33.1	26.8	20.6	-	-	45.0	1.9	36.9	30.6	24.4	18.1	-	-
	67	45.0	1.8	45.0	40.9	34.4	28.2	21.9	-	40.7	2.1	40.7	38.6	32.4	26.1	19.9	-
	62	40.3	1.6	40.3	40.3	40.3	34.1	27.8	21.6	35.5	2.0	35.5	35.5	35.5	29.2	23.0	16.7
	57	36.2	1.5	36.2	36.2	36.2	29.9	23.7	17.4	32.1	1.9	32.1	32.1	32.1	25.9	19.6	13.4
		95°F								**105°F**							
750	77	38.8	3.1	13.9	11.6	8.5	-	-	-	36.4	2.7	12.7	11.2	8.3	-	-	-
	72	35.6	2.8	19.9	16.9	13.8	10.8	-	-	32.8	2.7	19.0	16.1	13.1	10.2	-	-
	67	32.5	2.6	25.9	22.2	19.1	16.1	13.0	-	29.2	2.6	25.3	20.9	17.9	15.0	12.1	-
	62	27.3	2.7	27.3	26.6	21.0	18.0	14.9	11.9	25.0	2.6	25.0	24.7	19.5	16.5	13.6	10.7
900	77	40.5	3.0	17.2	13.5	9.8	-	-	-	37.5	2.7	16.5	13.0	9.4	-	-	-
	72	37.2	2.7	23.4	19.7	16.0	12.3	-	-	33.8	2.7	22.0	18.4	14.9	11.3	-	-
	67	33.9	2.5	29.5	25.8	22.1	18.4	14.7	-	30.1	2.6	27.5	23.9	20.3	16.8	13.2	-
	62	28.5	2.7	28.5	28.0	24.3	20.6	16.9	13.2	25.8	2.6	25.8	25.5	22.1	18.5	14.9	11.4
	57	26.2	2.4	26.2	26.0	22.3	18.6	14.9	11.2	24.9	2.4	24.9	24.9	21.4	17.8	14.2	10.6
1050	77	42.2	2.8	20.6	15.5	11.2	-	-	-	38.6	2.7	20.4	14.7	10.5	-	-	-
	72	38.7	2.6	26.8	22.5	18.1	13.8	-	-	34.8	2.7	25.0	20.8	16.6	12.4	-	-
	67	35.3	2.4	33.1	29.4	25.1	20.7	16.4	-	31.0	2.6	29.7	26.9	22.7	18.5	14.3	-
	62	29.7	2.6	29.7	29.4	27.6	23.2	18.9	14.5	26.5	2.6	26.5	26.4	24.7	20.5	16.3	12.1
	57	27.2	2.3	27.2	27.2	25.3	21.0	16.6	12.3	25.6	2.5	25.6	25.6	23.9	19.6	15.4	11.2
1200	77	43.9	2.7	23.9	17.5	12.5	-	-	-	39.7	2.7	24.2	16.4	11.6	-	-	-
	72	40.3	2.5	30.3	25.3	20.3	15.3	-	-	35.8	2.7	28.0	23.2	18.4	13.5	-	-
	67	36.7	2.3	36.7	33.1	28.1	23.1	18.1	-	31.9	2.6	31.9	30.0	25.1	20.3	15.4	-
	62	30.8	2.5	30.8	30.8	30.8	25.8	20.8	15.8	27.3	2.6	27.3	27.3	27.3	22.5	17.6	12.8
	57	28.3	2.2	28.3	28.3	28.3	23.3	18.3	13.3	26.4	2.5	26.4	26.4	26.4	21.5	16.7	11.8
1350	72	40.1	2.5	32.4	26.7	21.1	15.5	-	-	35.8	2.6	30.4	24.9	19.5	14.0	-	-
	67	36.5	2.3	36.5	34.7	29.2	23.6	17.9	-	31.9	2.6	31.9	30.9	26.7	21.2	15.7	-
	62	30.7	2.5	30.7	30.7	30.7	25.1	19.5	13.8	27.3	2.5	27.3	27.3	27.3	21.9	16.4	10.9
	57	28.2	2.2	28.2	28.2	28.2	22.6	17.0	11.3	26.4	2.4	26.4	26.4	26.4	20.9	15.5	10.0
1500	72	40.0	2.5	34.4	28.2	21.9	15.6	-	-	35.8	2.6	32.7	26.7	20.6	14.5	-	-
	67	36.4	2.3	36.4	36.4	30.3	24.1	17.8	-	31.9	2.5	31.9	31.9	28.2	22.1	16.0	-
	62	30.6	2.5	30.6	30.6	30.6	24.3	18.1	11.8	27.3	2.5	27.3	27.3	27.3	21.2	15.2	9.1
	57	28.1	2.2	28.1	28.1	28.1	21.8	15.6	9.3	26.4	2.4	26.4	26.4	26.4	20.3	14.2	8.2

ZR037 (3.0 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
750	77	34.0	2.4	11.6	10.9	8.1	-	-	-	31.5	2.1	11.5	9.9	7.9	-	-	-
	72	30.0	2.5	18.1	15.3	12.4	9.6	-	-	27.2	2.3	17.2	14.5	11.7	9.0	-	-
	67	26.0	2.6	24.6	19.6	16.8	13.9	11.1	-	22.8	2.6	22.8	18.3	15.6	12.9	10.1	-
	62	22.8	2.4	22.8	22.8	18.0	15.1	12.3	9.5	20.5	2.2	20.5	20.5	16.5	13.7	11.0	8.3
900	77	34.5	2.5	15.9	12.4	9.0	-	-	-	31.4	2.3	15.9	11.8	8.5	-	-	-
	72	30.4	2.6	20.7	17.2	13.8	10.3	-	-	27.1	2.5	19.3	16.0	12.7	9.3	-	-
	67	26.4	2.7	25.5	22.0	18.6	15.1	11.7	-	22.7	2.8	22.7	20.1	16.8	13.5	10.2	-
	62	23.1	2.5	23.1	23.1	19.9	16.5	13.0	9.6	20.4	2.4	20.4	20.4	17.7	14.4	11.1	7.7
	57	23.7	2.5	23.7	23.7	20.4	17.0	13.5	10.1	22.5	2.5	22.5	22.5	19.5	16.2	12.8	9.5
1050	77	35.0	2.6	20.1	13.9	9.8	-	-	-	31.3	2.5	20.3	13.7	9.2	-	-	-
	72	30.9	2.7	23.2	19.2	15.1	11.0	-	-	26.9	2.8	21.4	17.5	13.6	9.7	-	-
	67	26.8	2.8	26.3	24.4	20.4	16.3	12.2	-	22.6	3.0	22.6	21.9	18.0	14.1	10.2	-
	62	23.4	2.6	23.4	23.4	21.8	17.8	13.7	9.6	20.3	2.6	20.3	20.3	19.0	15.0	11.1	7.2
	57	24.0	2.6	24.0	24.0	22.4	18.3	14.3	10.2	22.5	2.7	22.5	22.5	21.0	17.0	13.1	9.2
1200	77	35.4	2.7	24.4	15.4	10.7	-	-	-	31.2	2.7	24.7	15.6	9.8	-	-	-
	72	31.3	2.8	25.8	21.1	16.4	11.8	-	-	26.8	3.0	23.6	19.0	14.5	10.0	-	-
	67	27.2	2.9	27.2	26.9	22.2	17.5	12.8	-	22.4	3.3	22.4	22.4	19.2	14.7	10.2	-
	62	23.8	2.7	23.8	23.8	23.8	19.1	14.4	9.7	20.2	2.8	20.2	20.2	20.2	15.7	11.2	6.7
	57	24.4	2.7	24.4	24.4	24.4	19.7	15.0	10.3	22.4	2.9	22.4	22.4	22.4	17.9	13.4	8.9
1350	72	31.5	2.7	28.4	23.1	17.9	12.6	-	-	27.1	2.9	26.5	21.4	16.3	11.2	-	-
	67	27.3	2.9	27.3	27.1	24.1	18.8	13.6	-	22.7	3.1	22.7	22.7	21.6	16.5	11.4	-
	62	23.9	2.6	23.9	23.9	23.9	18.6	13.3	8.1	20.5	2.7	20.5	20.5	20.5	15.4	10.3	5.2
	57	24.5	2.6	24.5	24.5	24.5	19.2	14.0	8.7	22.7	2.8	22.7	22.7	22.7	17.6	12.5	7.4
1500	72	31.6	2.7	31.1	25.2	19.3	13.4	-	-	27.4	2.7	27.4	23.7	18.0	12.3	-	-
	67	27.4	2.8	27.4	27.4	26.0	20.2	14.3	-	23.0	3.0	23.0	23.0	23.0	18.2	12.6	-
	62	24.0	2.5	24.0	24.0	24.0	18.1	12.3	6.4	20.7	2.6	20.7	20.7	20.7	15.0	9.3	3.7
	57	24.6	2.5	24.6	24.6	24.6	18.8	12.9	7.0	22.9	2.7	22.9	22.9	22.9	17.2	11.5	5.9

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR037 (3.0 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil					
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)
CFM	WB (°F)			Return Dry Bulb (°F)			Return Dry Bulb (°F)
				75			75
		40 °F			**50 °F**		
	62.5	14.1	1.3	8.9	19.7	2.0	8.9
1050	64	15.3	1.3	8.1	21.3	2.0	7.5
	65.3	17.0	1.4	7.1	22.5	2.0	6.2
	62.5	14.9	1.3	9.7	20.3	2.0	9.8
1200	64	15.6	1.3	8.7	21.2	2.0	8.3
	65.3	16.1	1.3	7.8	23.1	2.0	7.1
	62.5	21.7	1.9	11.1	21.6	2.0	10.9
1350	64	22.3	1.9	9.3	23.1	2.0	9.7
	65.3	22.5	1.8	8.0	24.7	2.0	8.2
		60 °F			**70 °F**		
	62.5	18.5	2.0	8.1	17.0	2.1	6.8
1050	64	19.7	2.0	6.6	18.4	2.1	5.5
	65.3	20.9	2.0	5.4	19.6	2.1	4.4
	62.5	19.2	2.0	9.0	17.0	2.1	7.9
1200	64	20.3	2.0	7.6	18.5	2.1	6.6
	65.3	22.2	2.0	6.3	19.9	2.1	5.5
	62.5	19.8	2.0	9.8	16.1	2.1	8.4
1350	64	21.1	2.0	8.4	17.3	2.1	6.8
	62	22.3	2.0	7.2	18.8	2.1	5.7
		75 °F			**80 °F**		
	62.5	16.3	2.1	7.2	15.0	2.1	5.9
1050	64	17.6	2.1	5.5	16.2	2.1	4.5
	65.3	18.8	2.1	4.0	16.6	2.1	3.6
	62.5	16.6	2.1	7.4	14.9	2.1	6.7
1200	64	18.0	2.1	6.1	16.1	2.1	5.5
	65.3	18.9	2.1	5.0	17.2	2.1	3.9
	62.5	15.8	2.1	7.8	14.4	2.1	7.1
1350	64	17.3	2.1	6.7	15.6	2.1	5.8
	65.3	18.5	2.1	5.2	16.7	2.1	4.4
		85 °F			**95 °F**		
	62.5	12.0	2.2	4.5	7.5	2.3	1.7
1050	64	12.5	2.2	3.1	8.5	2.3	0.5
	65.3	13.4	2.2	1.9	9.3	2.4	-0.9
	62.5	11.8	2.2	5.0	8.8	2.3	-0.6
1200	64	12.9	2.2	3.7	8.0	2.3	0.6
	65.3	13.9	2.2	2.3	8.2	2.4	-0.9
	62.5	11.7	2.2	5.6	6.0	2.3	1.9
1350	64	12.6	2.2	4.0	6.7	2.3	0.6
	62	13.6	2.2	2.7	7.7	2.3	-0.7

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR049 (4.0 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1000	77	70.8	1.6	27.3	22.8	18.2	-	-	-	61.5	3.0	26.1	21.6	17.2	-	-	-
	72	62.1	2.0	34.1	29.5	24.9	20.3	-	-	55.0	3.0	32.3	27.8	23.4	18.9	-	-
	67	53.5	2.4	40.8	36.2	31.6	27.0	22.4	-	48.5	2.9	38.5	34.1	29.6	25.2	20.7	-
	62	48.3	2.0	48.3	46.8	37.7	33.1	28.5	23.9	43.1	2.9	43.1	42.3	35.8	31.3	26.9	22.4
1200	77	73.1	1.8	30.4	25.1	19.9	-	-	-	63.8	3.0	29.0	23.9	18.7	-	-	-
	72	64.2	2.2	37.7	32.5	27.3	22.0	-	-	57.1	3.0	35.8	30.7	25.5	20.4	-	-
	67	55.3	2.6	45.1	39.9	34.6	29.4	24.2	-	50.3	2.9	42.6	37.5	32.3	27.2	22.0	-
	62	50.0	2.2	50.0	48.9	41.3	36.1	30.9	25.6	44.7	2.9	44.7	44.2	39.1	33.9	28.8	23.6
	57	48.7	2.2	48.7	48.7	44.1	38.9	33.7	28.4	44.1	2.9	44.1	44.1	40.5	35.4	30.2	25.1
1400	77	75.5	2.1	33.4	27.5	21.6	-	-	-	66.1	3.0	32.0	26.1	20.3	-	-	-
	72	66.3	2.4	41.4	35.5	29.6	23.8	-	-	59.1	3.0	39.3	33.5	27.7	21.8	-	-
	67	57.1	2.8	49.4	43.5	37.6	31.8	25.9	-	52.2	2.9	46.7	40.9	35.0	29.2	23.3	-
	62	51.6	2.4	51.6	51.1	44.9	39.0	33.1	27.3	46.3	2.9	46.3	46.1	42.3	36.5	30.6	24.8
	57	50.2	2.4	50.2	50.2	48.0	42.1	36.2	30.3	45.7	2.9	45.7	45.7	43.9	38.1	32.2	26.4
1600	77	77.9	2.3	36.5	29.9	23.4	-	-	-	68.4	3.0	34.9	28.4	21.9	-	-	-
	72	68.4	2.6	45.1	38.6	32.0	25.5	-	-	61.2	3.0	42.9	36.3	29.8	23.3	-	-
	67	58.9	3.0	53.7	47.2	40.7	34.1	27.6	-	54.0	2.9	50.8	44.3	37.7	31.2	24.7	-
	62	53.2	2.6	53.2	53.2	48.5	42.0	35.4	28.9	47.9	2.9	47.9	47.9	45.6	39.1	32.5	26.0
	57	51.8	2.6	51.8	51.8	51.8	45.3	38.7	32.2	47.3	2.9	47.3	47.3	47.3	40.7	34.2	27.7
1800	72	70.3	2.4	48.1	40.9	33.7	26.6	-	-	62.2	3.0	46.1	38.9	31.7	24.5	-	-
	67	60.5	2.8	57.9	50.0	42.8	35.7	28.5	-	54.8	2.9	53.3	47.3	40.2	33.0	25.8	-
	62	54.7	2.4	54.7	54.7	52.3	45.1	38.0	30.8	48.7	2.9	48.7	48.7	47.5	40.3	33.2	26.0
	57	53.2	2.4	53.2	53.2	53.2	46.1	38.9	31.7	48.0	2.9	48.0	48.0	48.0	40.9	33.7	26.5
2000	72	72.1	2.2	51.0	43.2	35.4	27.7	-	-	63.1	3.0	49.3	41.5	33.6	25.8	-	-
	67	62.1	2.6	62.1	52.8	45.0	37.2	29.4	-	55.7	2.9	55.7	50.4	42.6	34.8	27.0	-
	62	56.1	2.2	56.1	56.1	56.1	48.3	40.5	32.7	49.5	2.9	49.5	49.5	49.5	41.6	33.8	26.0
	57	54.7	2.2	54.7	54.7	54.7	46.9	39.1	31.3	48.8	2.9	48.8	48.8	48.8	41.0	33.1	25.3
		95°F								**105°F**							
1000	77	52.2	4.4	24.8	20.5	16.1	-	-	-	51.3	4.2	21.3	18.4	14.1	-	-	-
	72	47.9	3.9	30.5	26.2	21.9	17.6	-	-	45.4	3.9	28.4	24.1	19.9	15.6	-	-
	67	43.6	3.4	36.3	31.9	27.6	23.3	19.0	-	39.6	3.6	35.5	29.8	25.6	21.3	17.1	-
	62	37.9	3.9	37.9	37.9	33.9	29.5	25.2	20.9	34.1	3.8	34.1	34.1	29.2	25.0	20.7	16.5
1200	77	54.4	4.2	27.7	22.6	17.5	-	-	-	52.8	4.1	25.3	20.4	15.4	-	-	-
	72	49.9	3.7	33.9	28.8	23.8	18.7	-	-	46.8	3.8	31.6	26.6	21.7	16.7	-	-
	67	45.4	3.2	40.1	35.1	30.0	25.0	19.9	-	40.8	3.5	37.8	32.9	27.9	22.9	18.0	-
	62	39.5	3.6	39.5	39.5	36.8	31.7	26.7	21.6	35.1	3.7	35.1	35.1	31.9	26.9	22.0	17.0
	57	39.6	3.6	39.6	39.6	36.9	31.8	26.8	21.7	35.7	3.7	35.7	35.7	32.4	27.5	22.5	17.6
1400	77	56.6	4.0	30.5	24.7	18.9	-	-	-	54.3	4.0	29.4	22.4	16.7	-	-	-
	72	51.9	3.5	37.3	31.5	25.7	19.9	-	-	48.2	3.7	34.8	29.1	23.5	17.8	-	-
	67	47.3	3.0	44.0	38.2	32.4	26.6	20.8	-	42.0	3.4	40.2	35.9	30.2	24.6	18.9	-
	62	41.1	3.4	41.1	41.1	39.7	33.9	28.1	22.3	36.2	3.6	36.2	36.2	34.6	28.9	23.2	17.5
	57	41.2	3.4	41.2	41.2	39.8	34.0	28.2	22.4	36.8	3.6	36.8	36.8	35.1	29.5	23.8	18.1
1600	77	58.8	3.7	33.4	26.9	20.3	-	-	-	55.8	3.9	33.5	24.4	18.0	-	-	-
	72	54.0	3.3	40.7	34.1	27.6	21.0	-	-	49.5	3.6	38.0	31.7	25.3	18.9	-	-
	67	49.1	2.9	47.9	41.3	34.8	28.3	21.7	-	43.2	3.4	42.6	39.0	32.6	26.2	19.8	-
	62	42.7	3.2	42.7	42.7	42.7	36.1	29.6	23.1	37.2	3.5	37.2	37.2	37.2	30.8	24.5	18.1
	57	42.8	3.2	42.8	42.8	42.8	36.2	29.7	23.1	37.9	3.5	37.9	37.9	37.9	31.5	25.1	18.7
1800	72	54.1	3.5	44.1	36.9	29.7	22.5	-	-	49.9	3.7	41.5	34.4	27.3	20.3	-	-
	67	49.2	3.1	48.6	44.7	37.5	30.3	23.1	-	43.5	3.5	43.2	41.1	35.2	28.1	21.1	-
	62	42.7	3.4	42.7	42.7	42.7	35.5	28.4	21.2	37.5	3.6	37.5	37.5	37.5	30.4	23.4	16.3
	57	42.8	3.4	42.8	42.8	42.8	35.6	28.4	21.3	38.1	3.6	38.1	38.1	38.1	31.1	24.0	16.9
2000	72	54.2	3.7	47.5	39.7	31.8	24.0	-	-	50.3	3.9	44.9	37.1	29.4	21.6	-	-
	67	49.3	3.3	49.3	48.0	40.2	32.3	24.5	-	43.8	3.6	43.8	43.2	37.9	30.1	22.4	-
	62	42.8	3.7	42.8	42.8	42.8	35.0	27.1	19.3	37.8	3.7	37.8	37.8	37.8	30.0	22.3	14.5
	57	42.9	3.7	42.9	42.9	42.9	35.1	27.2	19.4	38.4	3.7	38.4	38.4	38.4	30.7	22.9	15.2

ZR049 (4.0 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1000	77	50.4	4.0	17.7	16.3	12.1	-	-	-	49.5	3.7	16.5	12.8	10.1	-	-	-
	72	43.0	3.9	26.2	22.0	17.8	13.6	-	-	40.5	3.9	24.0	19.9	15.8	11.7	-	-
	67	35.6	3.8	34.6	27.7	23.5	19.3	15.2	-	31.5	4.0	31.5	25.6	21.5	17.4	13.3	-
	62	30.3	3.7	30.3	30.3	24.6	20.5	16.3	12.1	26.5	3.6	26.5	26.5	20.0	15.9	11.8	7.7
1200	77	51.2	4.0	23.0	18.1	13.3	-	-	-	49.6	3.9	22.4	15.9	11.2	-	-	-
	72	43.7	3.9	29.3	24.4	19.5	14.7	-	-	40.6	4.0	26.9	22.2	17.4	12.7	-	-
	67	36.1	3.8	35.5	30.7	25.8	20.9	16.1	-	31.5	4.1	31.5	28.4	23.7	18.9	14.2	-
	62	30.8	3.7	30.8	30.8	27.0	22.1	17.3	12.4	26.5	3.8	26.5	26.5	22.1	17.4	12.6	7.8
	57	31.9	3.8	31.9	31.9	28.0	23.2	18.3	13.4	28.1	3.8	28.1	28.1	23.6	18.8	14.1	9.3
1400	77	52.0	4.0	28.3	20.0	14.5	-	-	-	49.7	4.0	28.4	19.0	12.2	-	-	-
	72	44.4	3.9	32.3	26.8	21.3	15.7	-	-	40.6	4.1	29.9	24.5	19.0	13.6	-	-
	67	36.7	3.8	36.4	33.6	28.1	22.5	17.0	-	31.4	4.2	31.4	31.3	25.9	20.5	15.1	-
	62	31.3	3.7	31.3	31.3	29.4	23.8	18.3	12.8	26.4	3.9	26.4	26.4	24.2	18.8	13.4	8.0
	57	32.4	3.8	32.4	32.4	30.5	24.9	19.4	13.8	28.1	3.9	28.1	28.1	25.8	20.4	15.0	9.6
1600	77	52.9	4.0	33.6	21.9	15.6	-	-	-	49.9	4.2	34.3	22.2	13.3	-	-	-
	72	45.1	3.9	35.4	29.2	23.0	16.8	-	-	40.6	4.3	32.8	26.8	20.7	14.6	-	-
	67	37.3	3.8	37.3	36.6	30.3	24.1	17.9	-	31.3	4.3	31.3	31.3	28.1	22.0	15.9	-
	62	31.8	3.8	31.8	31.8	31.8	25.5	19.3	13.1	26.3	4.0	26.3	26.3	26.3	20.2	14.2	8.1
	57	32.9	3.8	32.9	32.9	32.9	26.7	20.5	14.3	28.0	4.1	28.0	28.0	28.0	22.0	15.9	9.8
1800	72	45.7	3.9	38.8	31.9	24.9	18.0	-	-	41.6	4.2	36.2	29.4	22.6	15.7	-	-
	67	37.8	3.9	37.8	37.5	32.9	26.0	19.0	-	32.2	4.3	32.2	32.2	30.6	23.8	17.0	-
	62	32.2	3.8	32.2	32.2	32.2	25.3	18.4	11.4	27.0	3.9	27.0	27.0	27.0	20.2	13.4	6.6
	57	33.5	3.8	33.5	33.5	33.5	26.5	19.6	12.6	28.8	4.0	28.8	28.8	28.8	21.9	15.1	8.3
2000	72	46.4	4.0	42.2	34.6	26.9	19.3	-	-	42.6	4.1	39.5	32.0	24.4	16.9	-	-
	67	38.4	3.9	38.4	38.4	35.5	27.9	20.2	-	33.0	4.2	33.0	33.0	33.0	25.6	18.1	-
	62	32.7	3.8	32.7	32.7	32.7	25.1	17.4	9.8	27.7	3.8	27.7	27.7	27.7	20.1	12.6	5.0
	57	34.0	3.8	34.0	34.0	34.0	26.3	18.6	11.0	29.5	3.9	29.5	29.5	29.5	21.9	14.4	6.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR049 (4.0 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil					
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)
CFM	WB (°F)			Return Dry Bulb (°F)			Return Dry Bulb (°F)
				75			75
		40 °F			**50 °F**		
	62.5	24.5	2.5	9.1	22.9	2.6	8.0
1200	64	25.7	2.5	7.4	26.9	2.7	7.2
	65.3	26.6	2.5	6.1	27.1	2.6	5.5
	62.5	24.0	2.5	12.4	24.5	2.6	11.2
1600	64	25.8	2.5	10.0	26.7	2.6	9.2
	65.3	27.1	2.5	8.3	28.5	2.6	7.7
	62.5	24.3	2.5	12.9	22.7	2.6	11.6
2000	64	26.2	2.5	11.1	24.7	2.6	10.0
	65.3	27.1	2.5	9.2	26.5	2.6	8.5
		60 °F			**70 °F**		
	62.5	21.8	2.6	7.1	19.8	2.7	6.2
1200	64	25.3	2.7	6.3	23.0	2.8	0.0
	65.3	26.9	2.7	4.8	23.5	2.7	2.9
	62.5	22.7	2.7	9.9	20.6	2.7	8.8
1600	64	25.4	2.7	8.8	22.4	2.8	6.8
	65.3	26.9	2.7	7.5	24.4	2.8	5.9
	62.5	20.1	2.6	10.2	18.2	2.7	8.9
2000	64	22.3	2.6	8.6	20.5	2.7	7.7
	62	23.7	2.6	6.9	21.4	2.7	5.3
		75 °F			**80 °F**		
	62.5	19.0	2.7	5.5	17.6	2.8	4.7
1200	64	21.5	2.8	5.1	20.9	2.9	3.7
	65.3	22.2	2.8	2.8	21.5	2.9	2.3
	62.5	19.3	2.8	8.1	17.9	2.9	7.5
1600	64	21.3	2.8	6.3	19.9	2.9	5.7
	65.3	22.6	2.8	4.7	21.1	2.9	4.1
	62.5	16.9	2.7	7.9	15.1	2.8	7.1
2000	64	18.2	2.7	6.3	16.7	2.8	5.6
	65.3	19.9	2.8	4.8	18.3	2.8	4.0
		85 °F			**95 °F**		
	62.5	17.7	2.9	5.0	12.8	3.1	3.5
1200	64	19.0	2.9	3.4	13.8	3.2	-0.2
	65.3	20.4	2.9	2.1	14.0	3.1	-1.5
	62.5	16.2	2.9	6.4	9.7	3.1	2.4
1600	64	18.2	3.0	5.0	10.8	3.2	1.0
	65.3	19.6	3.0	3.1	12.2	3.2	-0.7
	62.5	13.3	2.9	6.6	6.2	3.0	1.4
2000	64	14.8	2.9	4.7	7.2	3.0	-0.1
	62	15.8	2.9	3.1	8.0	3.0	-1.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR061 (5.0 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1250	77	81.7	5.9	33.6	27.7	21.9	-	-	-	76.2	4.8	32.2	26.5	20.8	-	-	-
	72	72.8	5.0	41.9	36.1	30.2	24.3	-	-	67.8	4.3	40.1	34.3	28.6	22.9	-	-
	67	64.0	4.0	50.2	44.4	38.5	32.6	26.7	-	59.4	3.8	47.9	42.1	36.4	30.7	25.0	-
	62	57.0	3.6	57.0	57.0	45.7	39.9	33.9	28.1	52.5	3.8	52.5	52.5	43.6	37.8	32.1	26.4
1500	77	85.0	5.4	37.9	31.1	24.3	-	-	-	79.0	4.6	36.2	29.6	23.0	-	-	-
	72	75.8	4.5	47.1	40.4	33.6	26.8	-	-	70.3	4.1	44.8	38.2	31.6	25.0	-	-
	67	66.6	3.6	56.4	49.6	42.9	36.1	29.3	-	61.6	3.7	53.4	46.8	40.2	33.6	27.0	-
	62	59.3	3.2	59.3	59.3	50.9	44.1	37.4	30.6	54.5	3.6	54.5	54.5	48.1	41.4	34.8	28.2
	57	58.1	4.1	58.1	58.1	52.1	45.3	38.6	31.8	53.9	4.1	53.9	53.9	48.7	42.1	35.4	28.8
1750	77	88.3	4.9	42.1	34.4	26.8	-	-	-	81.9	4.3	40.1	32.6	25.1	-	-	-
	72	78.7	4.1	52.3	44.6	37.0	29.4	-	-	72.9	3.9	49.5	42.0	34.5	27.0	-	-
	67	69.2	3.2	62.5	54.8	47.2	39.5	31.9	-	63.9	3.5	59.0	51.5	43.9	36.4	28.9	-
	62	61.6	2.8	61.6	61.6	56.0	48.4	40.7	33.1	56.4	3.4	56.4	56.4	52.5	45.0	37.5	30.0
	57	60.4	3.7	60.4	60.4	57.3	49.7	42.1	34.4	55.8	3.9	55.8	55.8	53.2	45.7	38.2	30.7
2000	77	91.6	4.4	46.3	37.8	29.3	-	-	-	84.7	4.1	44.0	35.6	27.2	-	-	-
	72	81.7	3.6	57.5	48.9	40.4	31.9	-	-	75.4	3.7	54.3	45.9	37.5	29.1	-	-
	67	71.8	2.8	68.6	60.1	51.5	43.0	34.5	-	66.1	3.3	64.5	56.1	47.7	39.3	30.9	-
	62	63.9	2.5	63.9	63.9	61.2	52.7	44.1	35.6	58.4	3.2	58.4	58.4	57.0	48.6	40.2	31.8
	57	62.6	3.2	62.6	62.6	62.6	54.1	45.6	37.0	57.8	3.6	57.8	57.8	57.8	49.4	41.0	32.6
2250	72	82.5	3.9	60.8	51.6	42.4	33.2	-	-	75.9	3.9	57.9	48.8	39.7	30.6	-	-
	67	72.5	3.0	70.9	63.3	54.1	44.9	35.8	-	66.5	3.5	65.7	59.6	50.5	41.4	32.3	-
	62	64.5	2.6	64.5	64.5	63.2	54.0	44.8	35.6	58.8	3.5	58.8	58.8	58.1	49.0	39.9	30.8
	57	63.3	3.5	63.3	63.3	63.3	54.1	44.9	35.7	58.2	3.9	58.2	58.2	58.2	49.1	39.9	30.8
2500	72	83.4	4.2	64.2	54.3	44.5	34.6	-	-	76.4	4.1	61.6	51.7	41.9	32.1	-	-
	67	73.2	3.3	73.2	66.6	56.7	46.9	37.1	-	66.9	3.7	66.9	63.2	53.4	43.5	33.7	-
	62	65.2	2.8	65.2	65.2	65.2	55.3	45.5	35.6	59.2	3.7	59.2	59.2	59.2	49.3	39.5	29.7
	57	63.9	3.7	63.9	63.9	63.9	54.0	44.2	34.4	58.5	4.1	58.5	58.5	58.5	48.7	38.9	29.1
		95°F								**105°F**							
1250	77	70.7	3.7	30.8	25.3	19.7	-	-	-	65.8	4.9	25.3	21.7	16.5	-	-	-
	72	62.8	3.7	38.2	32.6	27.0	21.5	-	-	57.8	4.6	35.2	29.7	24.3	18.9	-	-
	67	54.8	3.7	45.5	39.9	34.3	28.8	23.2	-	49.8	4.3	45.1	37.8	32.1	26.6	21.2	-
	62	48.1	4.0	48.1	48.1	41.4	35.8	30.3	24.7	43.0	4.6	43.0	43.0	35.7	30.3	24.8	19.4
1500	77	73.1	3.8	34.5	28.0	21.6	-	-	-	67.2	4.8	31.0	24.5	18.1	-	-	-
	72	64.9	3.7	42.5	36.0	29.5	23.1	-	-	59.0	4.5	39.4	33.0	26.6	20.2	-	-
	67	56.7	3.7	50.5	44.0	37.5	31.1	24.6	-	50.8	4.3	47.7	41.5	35.1	28.7	22.3	-
	62	49.7	4.0	49.7	49.7	45.2	38.8	32.3	25.8	43.9	4.6	43.9	43.9	39.1	32.7	26.3	19.9
	57	49.7	4.0	49.7	49.7	45.3	38.8	32.3	25.9	44.9	4.6	44.9	44.9	39.9	33.5	27.1	20.8
1750	77	75.5	3.8	38.2	30.8	23.4	-	-	-	68.6	4.7	36.8	27.3	19.7	-	-	-
	72	67.0	3.7	46.8	39.4	32.1	24.7	-	-	60.3	4.5	43.6	36.2	28.9	21.6	-	-
	67	58.5	3.7	55.4	48.1	40.7	33.3	26.0	-	51.9	4.2	50.4	45.2	38.1	30.8	23.5	-
	62	51.3	4.0	51.3	51.3	49.1	41.7	34.3	27.0	44.9	4.5	44.9	44.9	42.5	35.1	27.8	20.4
	57	51.3	4.0	51.3	51.3	49.1	41.7	34.4	27.0	45.9	4.5	45.9	45.9	43.4	36.0	28.7	21.4
2000	77	77.9	3.8	41.8	33.5	25.2	-	-	-	70.0	4.7	42.5	30.0	21.2	-	-	-
	72	69.1	3.8	51.1	42.8	34.6	26.3	-	-	61.5	4.4	47.8	39.5	31.2	22.9	-	-
	67	60.4	3.7	60.4	52.2	43.9	35.6	27.3	-	53.0	4.1	53.0	48.9	41.2	32.9	24.6	-
	62	52.9	4.0	52.9	52.9	52.9	44.6	36.4	28.1	45.8	4.4	45.8	45.8	45.8	37.5	29.2	21.0
	57	52.9	4.1	52.9	52.9	52.9	44.7	36.4	28.1	46.8	4.4	46.8	46.8	46.8	38.5	30.3	22.0
2250	72	69.3	3.9	55.0	46.0	37.0	27.9	-	-	61.6	4.6	51.5	42.5	33.4	24.3	-	-
	67	60.5	3.9	60.5	56.0	46.9	37.9	28.9	-	53.1	4.3	53.1	50.8	44.1	35.0	26.0	-
	62	53.0	4.3	53.0	53.0	53.0	44.0	35.0	25.9	45.9	4.6	45.9	45.9	45.9	36.8	27.7	18.7
	57	53.1	4.3	53.1	53.1	53.1	44.0	35.0	26.0	46.9	4.7	46.9	46.9	46.9	37.8	28.7	19.7
2500	72	69.4	4.1	58.9	49.1	39.4	29.6	-	-	61.6	4.8	55.3	45.5	35.6	25.8	-	-
	67	60.7	4.1	60.7	59.8	50.0	40.2	30.4	-	53.1	4.5	53.1	52.7	47.0	37.2	27.3	-
	62	53.2	4.5	53.2	53.2	53.2	43.4	33.6	23.8	45.9	4.8	45.9	45.9	45.9	36.1	26.2	16.4
	57	53.2	4.5	53.2	53.2	53.2	43.4	33.6	23.8	46.9	4.9	46.9	46.9	46.9	37.1	27.2	17.4

ZR061 (5.0 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1250	77	60.8	6.1	19.8	18.1	13.3	-	-	-	55.9	7.3	18.9	12.5	10.1	-	-	-
	72	52.8	5.6	32.2	26.9	21.6	16.2	-	-	47.8	6.5	29.2	24.0	18.8	13.6	-	-
	67	44.7	5.0	44.7	35.7	29.8	24.5	19.1	-	39.6	5.7	39.6	34.3	27.5	22.3	17.1	-
	62	37.9	5.3	37.9	37.9	30.0	24.7	19.4	14.0	32.9	5.9	32.9	32.9	24.3	19.1	13.9	8.7
1500	77	61.3	5.9	27.6	20.9	14.6	-	-	-	55.4	7.0	27.2	17.4	11.1	-	-	-
	72	53.2	5.4	36.3	30.0	23.6	17.3	-	-	47.3	6.2	33.2	27.0	20.7	14.4	-	-
	67	45.0	4.8	45.0	39.0	32.7	26.4	20.0	-	39.2	5.4	39.2	36.5	30.3	24.0	17.8	-
	62	38.2	5.1	38.2	38.2	32.9	26.6	20.3	14.0	32.5	5.7	32.5	32.5	26.8	20.5	14.3	8.0
	57	40.1	5.2	40.1	40.1	34.6	28.3	22.0	15.6	35.4	5.8	35.4	35.4	29.3	23.0	16.8	10.5
1750	77	61.7	5.7	35.4	23.8	15.9	-	-	-	54.8	6.7	35.6	22.3	12.2	-	-	-
	72	53.5	5.2	40.4	33.1	25.7	18.4	-	-	46.8	5.9	37.2	29.9	22.6	15.3	-	-
	67	45.3	4.7	45.3	42.3	35.6	28.3	20.9	-	38.8	5.2	38.8	38.8	33.0	25.7	18.4	-
	62	38.5	4.9	38.5	38.5	35.8	28.5	21.2	13.9	32.1	5.4	32.1	32.1	29.2	21.9	14.7	7.4
	57	40.4	5.0	40.4	40.4	37.7	30.3	23.0	15.7	35.0	5.5	35.0	35.0	31.9	24.7	17.4	10.1
2000	77	62.2	5.5	43.2	26.6	17.2	-	-	-	54.3	6.4	43.9	27.2	13.2	-	-	-
	72	53.9	5.0	44.4	36.1	27.8	19.5	-	-	46.3	5.7	41.1	32.8	24.5	16.1	-	-
	67	45.7	4.5	45.7	45.7	38.5	30.1	21.8	-	38.3	4.9	38.3	38.3	35.7	27.4	19.1	-
	62	38.8	4.8	38.8	38.8	38.8	30.4	22.1	13.8	31.7	5.1	31.7	31.7	31.7	23.4	15.0	6.7
	57	40.7	4.8	40.7	40.7	40.7	32.4	24.1	15.8	34.6	5.2	34.6	34.6	34.6	26.3	18.0	9.6
2250	72	53.9	5.2	48.1	38.9	29.8	20.7	-	-	46.2	5.9	44.6	35.4	26.3	17.1	-	-
	67	45.6	4.7	45.6	45.6	41.2	32.1	23.0	-	38.2	5.1	38.2	38.2	38.2	29.3	20.1	-
	62	38.7	5.0	38.7	38.7	38.7	29.6	20.5	11.4	31.6	5.4	31.6	31.6	31.6	22.4	13.3	4.1
	57	40.7	5.1	40.7	40.7	40.7	31.6	22.5	13.4	34.5	5.5	34.5	34.5	34.5	25.3	16.2	7.1
2500	72	53.8	5.5	51.7	41.8	31.9	22.0	-	-	46.0	6.1	46.0	38.1	28.1	18.2	-	-
	67	45.6	4.9	45.6	45.6	44.0	34.1	24.2	-	38.1	5.3	38.1	38.1	38.1	31.1	21.2	-
	62	38.7	5.2	38.7	38.7	38.7	28.8	18.9	9.0	31.5	5.6	31.5	31.5	31.5	21.5	11.5	1.6
	57	40.6	5.3	40.6	40.6	40.6	30.7	20.8	10.9	34.4	5.7	34.4	34.4	34.4	24.4	14.5	4.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR061 (5.0 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil					
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) (- indicates heating)
CFM	WB (°F)			Return Dry Bulb (°F)			Return Dry Bulb (°F)
				75			75
		40 °F			**50 °F**		
1750	62.5	26.8	3.1	8.4	29.3	3.2	10.7
	64	28.9	3.1	6.4	32.4	3.2	9.2
	65.3	30.0	3.1	4.8	34.7	3.2	7.3
2000	62.5	29.2	3.1	11.0	30.3	3.2	11.9
	64	30.8	3.1	8.6	32.3	3.2	9.9
	65.3	31.4	3.1	5.8	35.3	3.2	8.4
2250	62.5	29.8	3.1	10.5	29.6	3.2	11.1
	64	31.2	3.1	7.6	32.1	3.2	8.5
	65.3	31.4	3.1	6.0	34.5	3.2	6.2
		60 °F			**70 °F**		
1750	62.5	26.7	3.3	9.2	24.5	3.4	8.0
	64	28.9	3.3	6.9	27.0	3.4	6.4
	65.3	31.6	3.3	5.4	28.7	3.4	4.3
2000	62.5	27.9	3.3	10.9	25.0	3.4	9.0
	64	31.0	3.3	8.4	27.3	3.4	6.9
	65.3	32.9	3.3	6.7	29.6	3.4	4.9
2250	62.5	26.8	3.3	9.5	23.6	3.4	7.3
	64	29.5	3.3	6.9	26.1	3.4	4.7
	62	31.7	3.3	4.5	28.2	3.4	2.7
		75 °F			**80 °F**		
1750	62.5	22.8	3.5	7.1	21.3	3.5	6.3
	64	25.5	3.5	5.1	23.9	3.5	4.6
	65.3	27.8	3.5	3.3	25.8	3.5	2.7
2000	62.5	23.2	3.5	8.0	21.3	3.5	7.3
	64	25.7	3.5	5.9	23.7	3.5	5.3
	65.3	27.8	3.5	4.3	25.7	3.5	3.6
2250	62.5	21.6	3.4	6.8	19.5	3.5	5.6
	64	23.8	3.5	4.5	22.0	3.5	3.1
	65.3	26.1	3.5	1.9	24.1	3.5	1.0
		85 °F			**95 °F**		
1750	62.5	17.4	3.5	3.9	8.3	3.8	-1.8
	64	19.7	3.6	2.0	9.8	3.8	-3.9
	65.3	21.6	3.6	-0.3	11.2	3.9	-5.3
2000	62.5	17.3	3.6	5.0	7.1	3.8	-0.9
	64	19.4	3.6	2.5	8.8	3.8	-3.0
	65.3	20.9	3.6	0.5	10.3	3.9	-5.2
2250	62.5	16.0	3.5	3.5	5.0	3.8	-3.3
	64	18.0	3.6	0.4	6.1	3.8	-6.2
	62	19.4	3.6	-1.7	8.3	3.9	-8.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR078 (6.5 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
1625	77	99.9	5.1	39.3	33.2	27.1	-	-	-	90.5	5.8	36.9	30.8	24.7	-	-	-
	72	91.5	5.0	50.3	44.2	38.1	32.1	-	-	83.7	5.7	48.0	41.8	35.7	29.6	-	-
	67	83.0	5.0	61.3	55.2	49.2	43.1	37.0	-	76.9	5.7	59.0	52.9	46.8	40.7	34.5	-
	62	72.4	4.9	72.4	70.1	60.9	54.9	48.8	42.7	68.7	5.7	68.7	66.7	57.6	51.5	45.4	39.3
1950	77	106.5	5.1	45.5	37.9	30.3	-	-	-	96.8	5.9	42.8	35.2	27.7	-	-	-
	72	97.5	5.1	57.8	50.2	42.6	35.1	-	-	89.5	5.8	55.1	47.6	40.0	32.5	-	-
	67	88.5	5.1	70.1	62.5	54.9	47.4	39.8	-	82.2	5.8	67.5	60.0	52.4	44.9	37.3	-
	62	77.2	5.0	77.2	75.6	68.1	60.5	52.9	45.4	73.4	5.7	73.4	72.1	64.6	57.0	49.5	41.9
	57	78.2	5.0	78.2	78.2	72.6	65.0	57.5	49.9	70.6	5.7	70.6	70.6	65.6	58.0	50.5	43.0
2275	77	113.1	5.2	51.6	42.6	33.5	-	-	-	103.0	5.9	48.6	39.6	30.7	-	-	-
	72	103.5	5.2	65.2	56.2	47.1	38.0	-	-	95.2	5.9	62.3	53.3	44.4	35.4	-	-
	67	93.9	5.1	78.8	69.8	60.7	51.6	42.6	-	87.5	5.8	76.0	67.0	58.1	49.1	40.1	-
	62	81.9	5.1	81.9	81.2	75.2	66.2	57.1	48.0	78.1	5.8	78.1	77.5	71.5	62.6	53.6	44.6
	57	83.1	5.1	83.1	83.1	80.3	71.2	62.1	53.1	75.2	5.8	75.2	75.2	72.7	63.7	54.7	45.8
2600	77	119.7	5.3	57.8	47.3	36.7	-	-	-	109.3	6.0	54.4	44.0	33.6	-	-	-
	72	109.5	5.2	72.7	62.2	51.6	41.0	-	-	101.0	6.0	69.5	59.1	48.7	38.3	-	-
	67	99.4	5.2	87.6	77.0	66.5	55.9	45.3	-	92.8	5.9	84.5	74.1	63.7	53.3	42.9	-
	62	86.7	5.1	86.7	86.7	82.4	71.8	61.3	50.7	82.9	5.9	82.9	82.9	78.5	68.1	57.7	47.3
	57	87.9	5.2	87.9	87.9	87.9	77.4	66.8	56.2	79.7	5.9	79.7	79.7	79.7	69.3	59.0	48.6
2925	72	109.6	5.2	74.8	64.0	53.1	42.2	-	-	100.2	5.9	71.6	60.8	50.0	39.3	-	-
	67	99.5	5.1	91.9	79.3	68.4	57.5	46.7	-	92.0	5.9	87.0	76.3	65.5	54.7	44.0	-
	62	86.8	5.1	86.8	86.8	84.6	73.8	62.9	52.0	82.2	5.8	82.2	82.2	80.0	69.3	58.5	47.7
	57	88.0	5.1	88.0	88.0	88.0	77.1	66.2	55.3	79.1	5.8	79.1	79.1	79.1	68.3	57.6	46.8
3250	72	109.7	5.1	76.9	65.7	54.6	43.4	-	-	99.4	5.8	73.7	62.5	51.4	40.3	-	-
	67	99.6	5.1	96.1	81.5	70.3	59.1	48.0	-	91.3	5.8	89.5	78.4	67.3	56.1	45.0	-
	62	86.9	5.0	86.9	86.9	86.9	75.7	64.5	53.4	81.5	5.8	81.5	81.5	81.5	70.4	59.3	48.1
	57	88.0	5.0	88.0	88.0	88.0	76.8	65.6	54.4	78.5	5.8	78.5	78.5	78.5	67.3	56.2	45.1
		95°F								**105°F**							
1625	77	81.2	6.5	34.6	28.4	22.3	-	-	-	76.9	7.3	31.0	26.2	20.1	-	-	-
	72	75.9	6.5	45.6	39.5	33.3	27.2	-	-	70.8	7.3	43.2	37.1	31.0	24.8	-	-
	67	70.7	6.4	56.7	50.5	44.4	38.2	32.1	-	64.7	7.2	55.3	47.9	41.8	35.7	29.6	-
	62	64.9	6.4	64.9	63.3	54.3	48.1	42.0	35.8	59.4	7.2	59.4	58.5	49.9	43.8	37.7	31.6
1950	77	87.0	6.6	40.1	32.5	25.0	-	-	-	81.8	7.4	37.4	30.0	22.6	-	-	-
	72	81.4	6.5	52.5	45.0	37.5	30.0	-	-	75.3	7.4	49.6	42.2	34.8	27.4	-	-
	67	75.8	6.5	64.9	57.4	49.9	42.4	34.9	-	68.8	7.3	61.8	54.4	47.0	39.6	32.1	-
	62	69.7	6.4	69.7	68.6	61.0	53.5	46.0	38.5	63.2	7.3	63.2	62.6	56.1	48.7	41.3	33.9
	57	63.0	6.5	63.0	63.0	58.6	51.1	43.5	36.0	61.6	7.3	61.6	61.4	55.5	48.1	40.6	33.2
2275	77	92.9	6.7	45.5	36.7	27.8	-	-	-	86.7	7.5	43.8	33.8	25.1	-	-	-
	72	87.0	6.6	59.3	50.5	41.6	32.8	-	-	79.8	7.5	56.0	47.3	38.6	29.9	-	-
	67	81.0	6.6	73.2	64.3	55.4	46.6	37.7	-	73.0	7.4	68.3	60.9	52.2	43.5	34.7	-
	62	74.4	6.5	74.4	73.8	67.8	59.0	50.1	41.2	67.0	7.3	67.0	66.7	62.3	53.6	44.9	36.2
	57	67.3	6.5	67.3	67.3	65.1	56.2	47.3	38.5	65.2	7.4	65.2	65.1	61.6	52.9	44.2	35.5
2600	77	98.8	6.7	51.0	40.8	30.6	-	-	-	91.6	7.6	50.2	37.6	27.6	-	-	-
	72	92.5	6.7	66.2	56.0	45.8	35.6	-	-	84.3	7.6	62.5	52.5	42.5	32.5	-	-
	67	86.1	6.6	81.4	71.2	61.0	50.8	40.5	-	77.1	7.5	74.7	67.3	57.3	47.3	37.3	-
	62	79.1	6.6	79.1	79.1	74.6	64.4	54.2	43.9	70.8	7.4	70.8	70.8	68.5	58.5	48.5	38.5
	57	71.5	6.6	71.5	71.5	71.5	61.3	51.1	40.9	68.9	7.4	68.9	68.9	67.7	57.7	47.7	37.7
2925	72	90.8	6.6	68.3	57.6	47.0	36.3	-	-	83.1	7.5	64.7	54.2	43.8	33.3	-	-
	67	84.5	6.6	82.2	73.2	62.6	51.9	41.3	-	75.9	7.4	74.8	69.1	59.1	48.7	38.2	-
	62	77.6	6.5	77.6	77.6	75.4	64.7	54.1	43.4	69.7	7.4	69.7	69.7	68.6	58.1	47.7	37.2
	57	70.2	6.6	70.2	70.2	70.2	59.6	48.9	38.3	67.9	7.4	67.9	67.9	67.3	56.8	46.4	35.9
3250	72	89.1	6.6	70.4	59.3	48.2	37.1	-	-	81.8	7.4	66.9	56.0	45.1	34.2	-	-
	67	83.0	6.5	83.0	75.3	64.2	53.1	42.0	-	74.8	7.4	74.8	70.9	60.9	50.0	39.1	-
	62	76.2	6.5	76.2	76.2	76.2	65.1	54.0	42.9	68.6	7.3	68.6	68.6	68.6	57.7	46.8	35.9
	57	68.9	6.5	68.9	68.9	68.9	57.8	46.8	35.7	66.9	7.3	66.9	66.9	66.9	56.0	45.1	34.2

ZR078 (6.5 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
1625	77	72.6	8.1	27.5	24.0	18.0	-	-	-	68.3	9.0	24.0	21.5	15.8	-	-	-
	72	65.6	8.1	40.7	34.7	28.6	22.5	-	-	60.4	8.9	38.3	32.2	26.2	20.2	-	-
	67	58.6	8.1	54.0	45.3	39.2	33.1	27.1	-	52.6	8.9	52.6	42.6	36.6	30.6	24.6	-
	62	53.8	8.0	53.8	53.8	45.6	39.5	33.4	27.4	48.2	8.8	48.2	48.2	41.2	35.2	29.2	23.1
1950	77	76.5	8.2	34.8	27.5	20.2	-	-	-	71.2	9.1	33.0	25.0	17.8	-	-	-
	72	69.1	8.2	46.7	39.4	32.1	24.8	-	-	63.0	9.0	43.9	36.6	29.4	22.2	-	-
	67	61.8	8.2	58.7	51.4	44.0	36.7	29.4	-	54.7	9.0	54.7	48.3	41.1	33.9	26.7	-
	62	56.7	8.1	56.7	56.7	51.2	43.9	36.6	29.3	50.2	8.9	50.2	50.2	46.3	39.1	31.9	24.7
	57	60.1	8.1	60.1	59.7	52.4	45.1	37.7	30.4	58.7	8.9	58.7	58.0	49.3	42.1	34.8	27.6
2275	77	80.4	8.4	42.1	31.0	22.4	-	-	-	74.1	9.2	42.0	28.4	19.7	-	-	-
	72	72.7	8.3	52.7	44.2	35.6	27.1	-	-	65.5	9.2	49.4	41.0	32.6	24.2	-	-
	67	64.9	8.3	63.4	57.4	48.9	40.3	31.8	-	56.9	9.1	56.9	54.0	45.6	37.2	28.8	-
	62	59.6	8.2	59.6	59.6	56.8	48.3	39.7	31.2	52.2	9.0	52.2	52.2	51.4	43.0	34.6	26.2
	57	63.2	8.2	63.2	63.0	58.1	49.6	41.0	32.5	61.2	9.0	61.2	60.8	54.7	46.3	37.9	29.5
2600	77	84.3	8.5	49.4	34.4	24.6	-	-	-	77.1	9.3	51.0	31.8	21.6	-	-	-
	72	76.2	8.4	58.8	49.0	39.2	29.4	-	-	68.1	9.3	55.0	45.4	35.9	26.3	-	-
	67	68.1	8.4	68.1	63.5	53.7	43.9	34.1	-	59.1	9.2	59.1	59.1	50.1	40.5	30.9	-
	62	62.5	8.3	62.5	62.5	62.5	52.7	42.9	33.1	54.2	9.1	54.2	54.2	54.2	46.8	37.2	27.7
	57	66.3	8.3	66.3	66.3	63.9	54.1	44.3	34.5	63.6	9.1	63.6	63.6	60.0	50.5	40.9	31.3
2925	72	75.4	8.3	61.1	50.8	40.6	30.3	-	-	67.6	9.2	57.5	47.4	37.4	27.3	-	-
	67	67.3	8.3	67.3	65.0	55.7	45.4	35.1	-	58.7	9.2	58.7	58.7	52.2	42.1	32.1	-
	62	61.8	8.2	61.8	61.8	61.8	51.5	41.3	31.0	53.8	9.0	53.8	53.8	53.8	44.9	34.9	24.8
	57	65.5	8.2	65.5	65.5	64.3	54.1	43.8	33.6	63.2	9.0	63.2	63.2	61.4	51.3	41.3	31.2
3250	72	74.5	8.3	63.4	52.7	42.0	31.3	-	-	67.2	9.1	59.9	49.4	38.9	28.3	-	-
	67	66.6	8.2	66.6	66.6	57.6	46.9	36.2	-	58.4	9.1	58.4	58.4	54.3	43.7	33.2	-
	62	61.1	8.1	61.1	61.1	61.1	50.4	39.7	28.9	53.5	8.9	53.5	53.5	53.5	43.0	32.5	22.0
	57	64.8	8.1	64.8	64.8	64.8	54.1	43.4	32.7	62.7	9.0	62.7	62.7	62.7	52.2	41.7	31.2

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR078 (6.5 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil														
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65
		35°F							**45°F**						
1625	72	31.6	4.5	1.6	1.5	1.5	-	-	34.9	5.1	-	-	-	-	-
	67	32.2	4.6	1.5	1.5	1.4	1.4	-	35.2	4.9	2.5	2.2	1.9	1.7	-
	62	28.5	4.4	1.6	1.6	1.5	1.5	1.4	32.0	4.9	5.2	4.9	4.6	4.4	4.1
1950	72	36.1	4.3	2.2	1.6	0.9	-	-	37.2	4.9	-	-	-	-	-
	67	36.7	4.5	6.6	5.9	5.3	4.6	-	37.6	4.7	6.2	5.6	4.9	4.2	-
	62	32.6	4.3	10.8	10.1	9.4	8.8	8.1	34.2	4.7	13.0	12.4	11.7	11.1	10.4
	57	34.2	4.4	17.1	16.4	15.8	15.1	14.5	34.5	4.7	18.2	17.6	16.9	16.3	15.6
2275	72	40.5	4.2	2.9	1.7	0.4	-	-	39.6	4.7	-	-	-	-	-
	67	41.2	4.3	11.6	10.4	9.1	7.8	-	39.9	4.5	9.9	8.9	7.9	6.8	-
	62	36.7	4.2	19.9	18.6	17.4	16.1	14.8	36.3	4.5	20.9	19.8	18.8	17.8	16.7
	57	38.3	4.2	29.8	29.5	28.2	26.9	25.7	36.6	4.5	28.5	28.2	27.2	26.1	25.1
2600	72	45.0	4.1	3.6	1.7	-0.1	-	-	41.9	4.5	-	-	-	-	-
	67	45.7	4.2	16.7	14.8	12.9	11.1	-	42.3	4.3	13.7	12.3	10.8	9.4	-
	62	40.8	4.0	29.0	27.1	25.3	23.4	21.6	38.4	4.3	28.7	27.3	25.9	24.5	23.1
	57	42.5	4.1	42.5	42.5	40.6	38.7	36.9	38.8	4.4	38.8	38.8	37.4	36.0	34.5
2925	72	42.5	4.0	4.6	2.8	1.0	-	-	40.8	4.6	-	-	-	-	-
	67	43.2	4.1	17.5	15.7	13.9	12.1	-	41.1	4.4	15.2	13.7	12.2	10.8	-
	62	38.5	4.0	31.6	29.1	27.3	25.5	23.7	37.4	4.4	32.0	30.5	29.1	27.6	26.1
	57	40.2	4.0	40.2	40.2	38.3	36.5	34.7	37.7	4.4	37.7	37.7	36.2	34.8	33.3
3250	72	40.0	3.9	5.7	3.9	2.1	-	-	39.6	4.6	-	-	-	-	-
	67	40.6	4.0	18.4	16.6	14.8	13.0	-	40.0	4.4	16.7	15.2	13.6	12.1	-
	62	36.2	3.9	34.2	31.1	29.3	27.5	25.8	36.3	4.4	35.3	33.8	32.3	30.7	29.2
	57	37.9	4.0	37.9	37.9	36.1	34.3	32.5	36.7	4.5	36.7	36.7	35.1	33.6	32.0
		55°F							**65°F**						
1625	72	38.2	5.7	-	-	-	-	-	36.3	5.7	-	-	-	-	-
	67	38.2	5.1	3.4	2.9	2.4	1.9	-	36.2	5.3	2.4	2.1	1.8	1.5	-
	62	35.5	5.3	8.8	8.3	7.8	7.3	6.7	33.1	5.2	6.5	6.2	5.9	5.6	5.3
1950	72	38.4	5.5	-	-	-	-	-	36.8	5.6	-	-	-	-	-
	67	38.4	4.9	5.8	5.2	4.5	3.9	-	36.7	5.2	4.9	4.3	3.8	3.2	-
	62	35.7	5.1	15.3	14.7	14.0	13.3	12.7	33.5	5.0	13.9	13.3	12.7	12.2	11.6
	57	34.7	5.1	19.4	18.7	18.1	17.4	16.8	32.9	5.0	17.0	16.5	15.9	15.3	14.8
2275	72	38.6	5.2	-	-	-	-	-	37.3	5.4	-	-	-	-	-
	67	38.6	4.7	8.3	7.5	6.6	5.8	-	37.2	5.0	7.4	6.6	5.8	5.0	-
	62	35.9	4.9	21.9	21.0	20.2	19.4	18.6	34.0	4.9	21.2	20.4	19.6	18.8	18.0
	57	34.9	4.8	27.2	26.9	26.1	25.3	24.5	33.4	4.9	25.4	25.2	24.3	23.5	22.7
2600	72	38.8	5.0	-	-	-	-	-	37.8	5.3	-	-	-	-	-
	67	38.9	4.4	10.7	9.7	8.8	7.8	-	37.7	4.9	9.9	8.9	7.8	6.8	-
	62	36.1	4.6	28.4	27.4	26.5	25.5	24.6	34.4	4.8	28.5	27.5	26.4	25.3	24.3
	57	35.1	4.6	35.1	35.1	34.1	33.2	32.2	33.8	4.8	33.8	33.8	32.8	31.7	30.7
2925	72	39.0	5.2	-	-	-	-	-	38.0	5.4	-	-	-	-	-
	67	39.1	4.6	12.9	11.7	10.6	9.5	-	38.0	5.0	12.2	10.9	9.7	8.4	-
	62	36.3	4.8	32.4	32.0	30.8	29.7	28.6	34.6	4.9	31.7	31.2	29.9	28.7	27.4
	57	35.3	4.8	35.3	35.3	34.2	33.0	31.9	34.1	4.9	34.1	34.1	32.8	31.6	30.3
3250	72	39.2	5.3	-	-	-	-	-	38.2	5.5	-	-	-	-	-
	67	39.3	4.8	15.0	13.7	12.5	11.2	-	38.2	5.0	14.4	13.0	11.6	10.1	-
	62	36.5	5.0	36.5	36.5	35.2	33.9	32.6	34.8	4.9	34.8	34.8	33.4	32.0	30.5
	57	35.5	5.0	35.5	35.5	34.2	32.9	31.6	34.3	4.9	34.3	34.3	32.8	31.4	29.9

ZR078 (6.5 Ton) Reheat (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)				
CFM	WB (°F)			85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
1625	72	34.3	5.7	-	-	-	-	-	32.4	5.6	-	-	-	-	-
	67	34.2	5.4	1.3	1.2	1.1	1.0	-	32.2	5.6	0.3	0.4	0.5	0.6	-
	62	30.6	5.0	4.3	4.2	4.1	4.0	3.9	28.2	4.8	2.1	2.2	2.2	2.3	2.4
1950	72	35.1	5.7	-	-	-	-	-	33.5	5.8	-	-	-	-	-
	67	35.0	5.4	4.0	3.5	3.0	2.6	-	33.3	5.7	3.0	2.7	2.3	1.9	-
	62	31.3	5.0	12.4	12.0	11.5	11.0	10.6	29.1	4.9	11.0	10.6	10.3	9.9	9.5
	57	31.2	5.0	14.6	14.2	13.7	13.3	12.8	29.4	4.9	12.2	11.9	11.5	11.2	10.8
2275	72	35.9	5.7	-	-	-	-	-	34.5	5.9	-	-	-	-	-
	67	35.8	5.4	6.6	5.8	5.0	4.2	-	34.4	5.8	5.7	4.9	4.1	3.3	-
	62	32.0	5.0	20.5	19.7	18.9	18.1	17.3	30.1	5.1	19.9	19.1	18.3	17.4	16.6
	57	31.9	5.0	23.6	23.4	22.6	21.8	21.0	30.4	5.0	21.8	21.6	20.8	20.0	19.2
2600	72	36.7	5.7	-	-	-	-	-	35.6	6.0	-	-	-	-	-
	67	36.6	5.4	9.2	8.1	6.9	5.7	-	35.5	5.9	8.5	7.2	6.0	4.7	-
	62	32.7	5.0	28.7	27.5	26.3	25.2	24.0	31.0	5.2	28.8	27.5	26.3	25.0	23.8
	57	32.6	5.0	32.6	32.6	31.4	30.3	29.1	31.3	5.2	31.3	31.3	30.1	28.8	27.6
2925	72	37.0	5.6	-	-	-	-	-	35.9	5.8	-	-	-	-	-
	67	36.9	5.4	11.5	10.2	8.8	7.4	-	35.8	5.8	10.9	9.4	7.9	6.4	-
	62	33.0	4.9	30.9	30.4	29.0	27.6	26.2	31.3	5.0	30.2	29.6	28.0	26.5	25.0
	57	32.8	4.9	32.8	32.8	31.5	30.1	28.7	31.6	5.0	31.6	31.6	30.1	28.6	27.1
3250	72	37.2	5.6	-	-	-	-	-	36.2	5.7	-	-	-	-	-
	67	37.1	5.3	13.9	12.3	10.7	9.1	-	36.1	5.6	13.3	11.5	9.8	8.0	-
	62	33.2	4.9	33.2	33.2	31.6	30.0	28.4	31.6	4.9	31.6	31.6	29.8	28.1	26.3
	57	33.1	4.9	33.1	33.1	31.5	29.9	28.3	31.9	4.9	31.9	31.9	30.1	28.4	26.6

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR090 (7.5 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
1875	77	95.3	5.1	41.7	33.4	25.0	-	-	-	98.4	5.8	42.5	34.5	26.4	-	-	-
	72	88.9	5.0	49.7	41.3	33.0	24.6	-	-	91.0	5.8	52.7	44.7	36.7	28.6	-	-
	67	82.4	4.9	57.7	49.3	41.0	32.6	24.2	-	83.6	5.7	63.0	54.9	46.9	38.9	30.8	-
	62	72.3	4.9	72.3	63.4	49.7	41.3	32.9	24.6	74.5	5.7	74.5	70.1	57.5	49.5	41.5	33.4
2250	77	104.3	5.1	50.1	40.6	31.2	-	-	-	104.3	5.9	49.0	39.9	30.7	-	-	-
	72	97.2	5.0	60.3	50.9	41.4	32.0	-	-	96.4	5.8	60.9	51.8	42.6	33.5	-	-
	67	90.1	5.0	70.6	61.1	51.7	42.2	32.8	-	88.5	5.8	72.8	63.7	54.5	45.4	36.3	-
	62	79.1	4.9	79.1	73.2	62.8	53.3	43.9	34.4	79.0	5.7	79.0	76.0	66.9	57.8	48.6	39.5
	57	76.9	4.9	76.9	74.8	63.8	54.3	44.9	35.4	77.6	5.7	77.6	76.5	67.4	58.3	49.1	40.0
2625	77	113.3	5.2	58.4	47.9	37.4	-	-	-	110.2	5.9	55.5	45.3	35.0	-	-	-
	72	105.5	5.1	70.9	60.4	49.9	39.4	-	-	101.9	5.8	69.1	58.9	48.6	38.4	-	-
	67	97.8	5.0	83.4	72.9	62.4	51.9	41.3	-	93.5	5.8	82.7	72.4	62.2	52.0	41.7	-
	62	85.9	5.0	85.9	82.9	75.8	65.3	54.8	44.3	83.4	5.7	83.4	82.0	76.3	66.1	55.8	45.6
	57	83.6	5.0	83.6	82.5	77.0	66.5	55.9	45.4	82.0	5.7	82.0	81.4	76.9	66.6	56.4	46.2
3000	77	122.2	5.2	66.8	55.2	43.6	-	-	-	116.0	5.9	62.0	50.7	39.4	-	-	-
	72	113.8	5.1	81.6	69.9	58.3	46.7	-	-	107.3	5.9	77.3	65.9	54.6	43.3	-	-
	67	105.4	5.1	96.3	84.7	73.1	61.5	49.9	-	98.5	5.8	92.5	81.2	69.9	58.5	47.2	-
	62	92.7	5.0	92.7	92.7	88.9	77.3	65.7	54.1	87.9	5.8	87.9	87.9	85.7	74.3	63.0	51.7
	57	90.2	5.0	90.2	90.2	90.2	78.6	67.0	55.4	86.3	5.8	86.3	86.3	86.3	75.0	63.7	52.3
3375	72	116.9	5.2	86.8	74.3	61.8	49.4	-	-	109.2	5.9	82.5	70.2	58.0	45.8	-	-
	67	108.2	5.1	103.7	89.9	77.5	65.0	52.5	-	100.3	5.8	97.3	86.4	74.2	62.0	49.7	-
	62	95.1	5.1	95.1	95.1	93.3	80.8	68.4	55.9	89.4	5.8	89.4	89.4	88.3	76.1	63.9	51.6
	57	92.7	5.1	92.7	92.7	92.7	80.2	67.7	55.3	87.9	5.8	87.9	87.9	87.9	75.6	63.4	51.2
3750	72	119.9	5.2	92.0	78.7	65.3	52.0	-	-	111.1	5.9	87.7	74.5	61.4	48.3	-	-
	67	111.0	5.1	111.0	95.2	81.9	68.5	55.2	-	102.0	5.8	102.0	91.7	78.5	65.4	52.3	-
	62	97.6	5.1	97.6	97.6	97.6	84.3	71.0	57.7	91.0	5.8	91.0	91.0	91.0	77.9	64.7	51.6
	57	95.1	5.1	95.1	95.1	95.1	81.8	68.4	55.1	89.4	5.8	89.4	89.4	89.4	76.3	63.1	50.0
		95°F								105°F							
1875	77	101.5	6.6	43.2	35.6	27.9	-	-	-	94.5	7.5	39.4	33.0	25.5	-	-	-
	72	93.1	6.6	55.7	48.0	40.3	32.7	-	-	86.4	7.5	52.8	45.3	37.7	30.2	-	-
	67	84.7	6.5	68.2	60.5	52.8	45.1	37.4	-	78.3	7.5	66.2	57.5	50.0	42.5	34.9	-
	62	76.8	6.5	76.8	76.8	65.4	57.7	50.0	42.3	71.2	7.4	71.2	71.2	60.6	53.1	45.5	38.0
2250	77	104.3	6.6	47.9	39.1	30.3	-	-	-	96.9	7.5	45.1	36.4	27.7	-	-	-
	72	95.7	6.6	61.5	52.7	43.9	35.0	-	-	88.5	7.5	58.4	49.7	41.0	32.3	-	-
	67	87.0	6.5	75.0	66.2	57.4	48.6	39.8	-	80.2	7.4	71.7	63.0	54.3	45.6	36.9	-
	62	78.9	6.5	78.9	78.9	71.0	62.2	53.4	44.6	73.0	7.4	73.0	73.0	65.8	57.1	48.4	39.7
	57	78.3	6.5	78.3	78.3	71.1	62.2	53.4	44.6	73.0	7.4	73.0	73.0	66.1	57.4	48.7	40.0
2625	77	107.1	6.6	52.6	42.6	32.7	-	-	-	99.2	7.5	50.7	39.7	29.8	-	-	-
	72	98.2	6.6	67.2	57.3	47.4	37.4	-	-	90.6	7.5	63.9	54.1	44.2	34.3	-	-
	67	89.3	6.5	81.9	72.0	62.0	52.1	42.1	-	82.1	7.4	77.1	68.4	58.6	48.7	38.8	-
	62	81.0	6.5	81.0	81.0	76.7	66.8	56.9	46.9	74.7	7.4	74.7	74.7	70.9	61.1	51.2	41.4
	57	80.4	6.5	80.4	80.4	76.7	66.8	56.9	46.9	74.8	7.4	74.8	74.8	71.3	61.4	51.6	41.7
3000	77	109.9	6.6	57.3	46.2	35.1	-	-	-	101.5	7.5	56.4	43.0	32.0	-	-	-
	72	100.7	6.6	73.0	61.9	50.9	39.8	-	-	92.7	7.5	69.5	58.5	47.4	36.4	-	-
	67	91.6	6.5	88.7	77.7	66.6	55.6	44.5	-	84.0	7.4	82.6	73.9	62.8	51.8	40.8	-
	62	83.1	6.5	83.1	83.1	82.4	71.4	60.3	49.2	76.5	7.4	76.5	76.5	76.1	65.1	54.1	43.0
	57	82.4	6.5	82.4	82.4	82.4	71.4	60.3	49.3	76.5	7.4	76.5	76.5	76.5	65.5	54.4	43.4
3375	72	101.5	6.6	78.2	66.2	54.2	42.2	-	-	93.0	7.4	74.7	62.7	50.8	38.8	-	-
	67	92.3	6.5	90.9	82.9	70.9	58.9	46.9	-	84.3	7.4	83.5	78.0	67.3	55.3	43.4	-
	62	83.7	6.5	83.7	83.7	83.4	71.4	59.4	47.4	76.7	7.4	76.7	76.7	76.5	64.6	52.6	40.6
	57	83.1	6.5	83.1	83.1	83.1	71.1	59.1	47.1	76.7	7.4	76.7	76.7	76.7	64.8	52.8	40.8
3750	72	102.3	6.6	83.3	70.4	57.5	44.5	-	-	93.3	7.4	79.9	67.0	54.1	41.2	-	-
	67	93.0	6.6	93.0	88.2	75.2	62.3	49.4	-	84.5	7.4	84.5	82.1	71.7	58.8	46.0	-
	62	84.3	6.5	84.3	84.3	84.3	71.4	58.5	45.5	76.9	7.4	76.9	76.9	76.9	64.0	51.1	38.2
	57	83.7	6.5	83.7	83.7	83.7	70.7	57.8	44.9	76.9	7.4	76.9	76.9	76.9	64.0	51.1	38.3

ZR090 (7.5 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
1875	77	87.6	8.4	35.5	30.5	23.1	-	-	-	80.6	9.2	30.9	27.9	20.7	-	-	-
	72	79.7	8.4	49.9	42.5	35.1	27.8	-	-	73.0	9.2	47.0	39.8	32.5	25.3	-	-
	67	71.9	8.4	64.3	54.6	47.2	39.8	32.4	-	65.5	9.3	62.3	51.6	44.4	37.2	29.9	-
	62	65.7	8.3	65.7	65.7	55.8	48.4	41.1	33.7	60.2	9.3	60.2	60.2	51.0	43.8	36.6	29.4
2250	77	89.4	8.3	42.2	33.6	25.0	-	-	-	82.0	9.2	39.3	30.9	22.4	-	-	-
	72	81.4	8.3	55.2	46.7	38.1	29.5	-	-	74.3	9.2	52.1	43.7	35.2	26.7	-	-
	67	73.4	8.4	68.3	59.7	51.1	42.6	34.0	-	66.6	9.3	64.9	56.5	48.0	39.5	31.1	-
	62	67.1	8.3	67.1	67.1	60.5	51.9	43.3	34.7	61.2	9.2	61.2	61.2	55.2	46.7	38.3	29.8
	57	67.8	8.3	67.8	67.8	61.1	52.5	43.9	35.4	62.5	9.2	62.5	62.5	56.1	47.7	39.2	30.7
2625	77	91.2	8.3	48.9	36.8	27.0	-	-	-	83.3	9.2	47.7	33.8	24.1	-	-	-
	72	83.1	8.3	60.6	50.8	41.0	31.2	-	-	75.5	9.2	57.3	47.6	37.9	28.2	-	-
	67	74.9	8.3	72.3	64.9	55.1	45.3	35.5	-	67.7	9.2	67.6	61.3	51.6	41.9	32.2	-
	62	68.5	8.3	68.5	68.5	65.2	55.4	45.6	35.8	62.2	9.2	62.2	62.2	59.4	49.7	40.0	30.2
	57	69.2	8.3	69.2	69.2	65.8	56.0	46.3	36.5	63.6	9.2	63.6	63.6	60.4	50.7	40.9	31.2
3000	77	93.1	8.3	55.5	39.9	28.9	-	-	-	84.7	9.2	56.1	36.7	25.8	-	-	-
	72	84.7	8.3	66.0	55.0	44.0	33.0	-	-	76.7	9.2	62.4	51.5	40.5	29.6	-	-
	67	76.4	8.3	76.4	70.0	59.1	48.1	37.1	-	68.8	9.2	68.8	66.2	55.3	44.3	33.4	-
	62	69.8	8.3	69.8	69.8	69.8	58.8	47.9	36.9	63.2	9.2	63.2	63.2	63.2	52.6	41.6	30.7
	57	70.6	8.3	70.6	70.6	70.6	59.6	48.6	37.6	64.6	9.2	64.6	64.6	64.6	53.6	42.7	31.7
3375	72	84.5	8.3	71.2	59.3	47.4	35.5	-	-	76.0	9.2	67.8	55.9	44.0	32.1	-	-
	67	76.2	8.3	76.2	73.0	63.6	51.7	39.8	-	68.1	9.2	68.1	68.1	60.0	48.1	36.2	-
	62	69.6	8.3	69.6	69.6	69.6	57.7	45.8	33.9	62.6	9.2	62.6	62.6	62.6	50.9	39.0	27.1
	57	70.4	8.3	70.4	70.4	70.4	58.4	46.5	34.6	64.0	9.1	64.0	64.0	64.0	52.1	40.3	28.4
3750	72	84.3	8.3	76.5	63.7	50.8	38.0	-	-	75.3	9.1	73.1	60.3	47.5	34.7	-	-
	67	76.0	8.3	76.0	76.0	68.2	55.4	42.5	-	67.5	9.2	67.5	67.5	64.7	51.9	39.1	-
	62	69.5	8.3	69.5	69.5	69.5	56.6	43.8	30.9	62.0	9.2	62.0	62.0	62.0	49.2	36.4	23.6
	57	70.2	8.2	70.2	70.2	70.2	57.3	44.5	31.6	63.4	9.1	63.4	63.4	63.4	50.6	37.8	25.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR090 (7.5 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		35°F								45°F							
1875	77	57.4	4.6	-	-	-	-	-	-	58.7	4.9	-	-	-	-	-	-
	72	54.9	4.4	7.7	6.3	4.9	3.5	-	-	54.6	4.7	5.8	4.5	3.2	1.9	-	-
	67	52.4	4.3	14.9	13.5	12.1	10.7	9.3	-	50.5	4.5	13.7	12.4	11.1	9.9	8.6	-
	62	48.7	4.1	21.7	20.3	18.9	17.5	16.1	14.7	46.6	4.3	21.9	20.7	19.4	18.1	16.8	15.5
2250	77	62.8	4.5	-	-	-	-	-	-	62.7	4.8	-	-	-	-	-	-
	72	60.0	4.4	11.2	9.1	7.0	4.9	-	-	58.3	4.6	8.3	6.4	4.6	2.7	-	-
	67	57.2	4.2	22.2	20.1	18.0	15.9	13.8	-	53.9	4.4	19.6	17.7	15.9	14.0	12.1	-
	62	53.0	4.0	32.6	30.5	28.4	26.3	24.2	22.1	49.8	4.2	31.3	29.4	27.6	25.7	23.8	22.0
	57	49.6	4.0	37.1	35.0	32.9	30.8	28.7	26.6	47.9	4.2	36.2	34.3	32.5	30.6	28.8	26.9
2625	77	68.1	4.5	-	-	-	-	-	-	66.6	4.8	-	-	-	-	-	-
	72	65.0	4.3	14.8	12.0	9.2	6.4	-	-	62.0	4.6	10.8	8.4	5.9	3.5	-	-
	67	61.9	4.2	29.5	26.7	23.9	21.1	18.3	-	57.3	4.4	25.4	23.0	20.6	18.1	15.7	-
	62	57.4	4.0	43.6	40.8	38.0	35.2	32.4	29.6	53.0	4.2	40.6	38.2	35.8	33.3	30.9	28.5
	57	53.7	3.9	47.5	46.4	44.0	41.2	38.4	35.6	50.9	4.1	45.1	44.1	42.1	39.7	37.3	34.8
3000	77	73.4	4.5	-	-	-	-	-	-	70.6	4.8	-	-	-	-	-	-
	72	70.0	4.3	18.4	14.9	11.4	7.9	-	-	65.7	4.6	13.3	10.3	7.3	4.3	-	-
	67	66.6	4.2	36.8	33.3	29.8	26.3	22.8	-	60.8	4.4	31.3	28.3	25.3	22.3	19.3	-
	62	61.8	4.0	54.5	51.0	47.5	44.0	40.5	37.0	56.1	4.2	50.0	47.0	44.0	40.9	37.9	34.9
	57	57.8	3.9	57.8	57.8	55.1	51.6	48.1	44.6	54.0	4.1	54.0	54.0	51.8	48.8	45.8	42.8
3375	72	71.8	4.3	18.9	15.5	12.1	8.6	-	-	67.4	4.6	14.3	11.1	7.9	4.7	-	-
	67	68.3	4.2	37.5	34.0	30.6	27.2	23.8	-	62.3	4.4	33.7	30.5	27.3	24.1	20.9	-
	62	63.3	4.0	58.3	53.2	48.3	44.9	41.4	38.0	57.6	4.2	53.8	50.6	47.4	44.2	41.0	37.8
	57	59.3	3.9	59.3	59.3	57.9	54.5	51.1	47.6	55.3	4.1	55.3	55.3	54.3	51.1	47.9	44.7
3750	72	73.5	4.3	19.4	16.1	12.7	9.4	-	-	69.1	4.6	15.2	11.8	8.4	5.1	-	-
	67	69.9	4.2	38.2	34.8	31.4	28.1	24.7	-	63.9	4.4	36.0	32.6	29.3	25.9	22.5	-
	62	64.9	4.0	62.1	55.3	49.1	45.7	42.4	39.0	59.0	4.2	57.6	54.3	50.9	47.5	44.1	40.7
	57	60.7	3.9	60.7	60.7	60.7	57.4	54.0	50.6	56.7	4.1	56.7	56.7	56.7	53.3	50.0	46.6
		55°F								65°F							
1875	77	59.9	5.1	-	-	-	-	-	-	57.9	5.4	-	-	-	-	-	-
	72	54.2	4.9	3.9	2.7	1.6	-	-	-	51.6	5.2	1.5	-	-	-	-	-
	67	48.5	4.7	12.6	11.4	10.2	9.0	7.9	-	45.3	5.0	11.0	10.0	9.0	7.9	6.9	-
	62	44.6	4.5	22.2	21.0	19.9	18.7	17.5	16.4	42.1	4.8	22.4	21.4	20.4	19.3	18.3	17.3
2250	77	62.6	5.1	-	-	-	-	-	-	59.7	5.4	-	-	-	-	-	-
	72	56.6	4.9	5.4	3.7	2.1	-	-	-	53.2	5.2	2.2	-	-	-	-	-
	67	50.7	4.7	17.0	15.4	13.7	12.1	10.5	-	46.6	4.9	14.3	12.9	11.6	10.2	8.9	-
	62	46.6	4.5	29.9	28.3	26.7	25.1	23.5	21.8	43.4	4.7	28.8	27.5	26.1	24.7	23.4	22.0
	57	46.2	4.4	35.3	33.7	32.1	30.4	28.8	27.2	42.7	4.7	33.5	32.2	30.8	29.4	28.1	26.7
2625	77	65.2	5.1	-	-	-	-	-	-	61.4	5.4	-	-	-	-	-	-
	72	59.0	4.9	6.8	4.7	2.7	-	-	-	54.7	5.1	2.9	1.2	-	-	-	-
	67	52.8	4.6	21.4	19.3	17.3	15.2	13.1	-	48.0	4.9	17.6	15.9	14.2	12.5	10.8	-
	62	48.5	4.4	37.7	35.6	33.6	31.5	29.4	27.3	44.7	4.7	35.2	33.5	31.8	30.1	28.4	26.7
	57	48.1	4.4	42.7	41.9	40.3	38.2	36.1	34.1	43.9	4.6	39.3	38.7	37.6	35.9	34.2	32.5
3000	77	67.8	5.1	-	-	-	-	-	-	63.1	5.3	-	-	-	-	-	-
	72	61.4	4.8	8.2	5.7	3.2	-	-	-	56.2	5.1	3.6	1.5	-	-	-	-
	67	54.9	4.6	25.8	23.3	20.8	18.3	15.7	-	49.4	4.9	20.9	18.9	16.8	14.7	12.7	-
	62	50.5	4.4	45.4	42.9	40.4	37.9	35.4	32.8	45.9	4.7	41.7	39.6	37.6	35.5	33.5	31.4
	57	50.1	4.3	50.1	50.1	48.5	46.0	43.4	40.9	45.2	4.6	45.2	45.2	44.4	42.3	40.3	38.2
3375	72	63.0	4.8	9.6	6.6	3.7	-	-	-	57.9	5.1	4.1	1.5	-	-	-	-
	67	56.4	4.6	29.8	26.9	23.9	21.0	18.0	-	50.8	4.9	25.7	23.2	20.6	18.0	15.5	-
	62	51.8	4.4	49.3	48.0	46.5	43.6	40.6	37.6	47.3	4.7	45.2	44.1	43.0	40.4	37.9	35.3
	57	51.4	4.3	51.4	51.4	50.6	47.6	44.7	41.7	46.5	4.6	46.5	46.5	46.1	43.6	41.0	38.4
3750	72	64.6	4.8	11.0	7.6	4.2	-	-	-	59.6	5.1	4.6	1.5	-	-	-	-
	67	57.9	4.6	33.9	30.5	27.1	23.7	20.3	-	52.3	4.9	30.5	27.5	24.4	21.3	18.2	-
	62	53.2	4.4	53.2	53.2	52.7	49.3	45.9	42.5	48.7	4.7	48.7	48.7	48.4	45.3	42.2	39.2
	57	52.7	4.3	52.7	52.7	52.7	49.3	45.9	42.5	47.9	4.6	47.9	47.9	47.9	44.8	41.7	38.6

ZR090 (7.5 Ton) Reheat (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
1875	77	56.0	5.7	-	-	-	-	-	-	54.0	6.0	-	-	-	-	-	-
	72	49.0	5.5	-	-	-	-	-	-	46.3	5.8	-	-	-	-	-	-
	67	42.0	5.2	9.4	8.6	7.7	6.8	6.0	-	38.7	5.5	7.8	7.1	6.4	5.8	5.1	-
	62	39.6	5.0	22.6	21.7	20.9	20.0	19.1	18.3	37.2	5.3	22.7	22.0	21.3	20.7	20.0	19.3
2250	77	56.8	5.7	-	-	-	-	-	-	53.9	6.0	-	-	-	-	-	-
	72	49.7	5.5	-	-	-	-	-	-	46.2	5.7	-	-	-	-	-	-
	67	42.6	5.2	11.6	10.5	9.4	8.3	7.2	-	38.6	5.5	8.9	8.1	7.3	6.4	5.6	-
	62	40.2	5.0	27.7	26.6	25.5	24.4	23.3	22.2	37.0	5.3	26.5	25.7	24.9	24.0	23.2	22.4
	57	39.2	4.9	31.7	30.6	29.5	28.4	27.3	26.2	35.6	5.2	30.0	29.1	28.3	27.4	26.6	25.8
2625	77	57.6	5.7	-	-	-	-	-	-	53.8	5.9	-	-	-	-	-	-
	72	50.4	5.4	-	-	-	-	-	-	46.1	5.7	-	-	-	-	-	-
	67	43.2	5.2	13.8	12.5	11.1	9.8	8.4	-	38.4	5.5	10.0	9.0	8.1	7.1	6.1	-
	62	40.8	5.0	32.8	31.5	30.1	28.8	27.4	26.1	36.9	5.3	30.4	29.4	28.4	27.4	26.4	25.5
	57	39.7	4.9	36.0	35.5	34.9	33.6	32.2	30.9	35.5	5.2	32.7	32.2	32.2	31.2	30.3	29.3
3000	77	58.4	5.6	-	-	-	-	-	-	53.6	5.9	-	-	-	-	-	-
	72	51.1	5.4	-	-	-	-	-	-	45.9	5.7	-	-	-	-	-	-
	67	43.8	5.2	16.0	14.4	12.8	11.2	9.7	-	38.2	5.4	11.1	10.0	8.9	7.7	6.6	-
	62	41.4	5.0	37.9	36.3	34.7	33.2	31.6	30.0	36.8	5.3	34.2	33.0	31.9	30.8	29.7	28.5
	57	40.3	4.9	40.3	40.3	40.3	38.7	37.1	35.5	35.4	5.2	35.4	35.4	35.4	35.0	33.9	32.8
3375	72	52.8	5.4	-	-	-	-	-	-	47.7	5.7	-	-	-	-	-	-
	67	45.3	5.2	21.6	19.4	17.3	15.1	12.9	-	39.7	5.4	17.5	15.7	13.9	12.2	10.4	-
	62	42.8	5.0	41.0	40.2	39.4	37.3	35.1	32.9	38.2	5.2	36.9	36.3	35.9	34.1	32.4	30.6
	57	41.6	4.9	41.6	41.6	41.6	39.5	37.3	35.1	36.7	5.2	36.7	36.7	36.7	35.4	33.6	31.8
3750	72	54.5	5.4	-	-	-	-	-	-	49.5	5.6	-	-	-	-	-	-
	67	46.8	5.1	27.2	24.4	21.7	18.9	16.2	-	41.2	5.4	23.9	21.4	19.0	16.6	14.1	-
	62	44.1	4.9	44.1	44.1	44.1	41.4	38.6	35.9	39.6	5.2	39.6	39.6	39.6	37.5	35.0	32.6
	57	43.0	4.9	43.0	43.0	43.0	40.2	37.5	34.7	38.1	5.1	38.1	38.1	38.1	35.7	33.3	30.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR102 (8.5 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
2125	77	121.9	6.4	54.3	43.2	32.9	-	-	-	118.7	7.4	52.3	42.1	32.0	-	-	-
	72	118.1	6.4	71.1	60.8	50.5	40.2	-	-	112.8	7.3	69.0	58.8	48.6	38.5	-	-
	67	114.3	6.3	87.8	78.4	68.1	57.8	47.5	-	106.9	7.2	85.6	75.4	65.3	55.1	45.0	-
	62	105.8	6.2	105.8	98.7	83.7	73.4	63.1	52.8	98.9	7.0	98.9	95.3	80.2	70.1	59.9	49.8
2550	77	126.3	6.5	59.7	47.9	36.1	-	-	-	122.9	7.4	58.7	46.9	35.2	-	-	-
	72	122.4	6.4	79.1	67.3	55.5	43.7	-	-	116.8	7.3	77.0	65.3	53.5	41.8	-	-
	67	118.4	6.4	98.4	86.6	74.8	63.0	51.2	-	110.7	7.2	95.3	83.6	71.9	60.1	48.4	-
	62	109.7	6.2	109.7	104.9	92.0	80.2	68.4	56.6	102.4	7.1	102.4	100.1	88.3	76.6	64.9	53.1
	57	107.0	6.3	107.0	107.0	97.1	85.3	73.5	61.7	99.6	7.1	99.6	99.6	90.0	78.3	66.5	54.8
2975	77	130.7	6.5	65.1	52.7	39.4	-	-	-	127.2	7.4	65.0	51.7	38.4	-	-	-
	72	126.6	6.4	87.0	73.7	60.5	47.2	-	-	120.9	7.3	85.0	71.7	58.4	45.1	-	-
	67	122.6	6.4	108.9	94.8	81.5	68.2	54.9	-	114.6	7.2	105.1	91.7	78.4	65.1	51.8	-
	62	113.5	6.3	113.5	111.1	100.2	86.9	73.6	60.3	106.0	7.1	106.0	104.8	96.4	83.1	69.8	56.5
	57	110.8	6.3	110.8	110.8	105.8	92.5	79.2	65.9	103.0	7.2	103.0	103.0	98.2	84.9	71.6	58.3
3400	77	135.1	6.5	70.6	57.4	42.6	-	-	-	131.4	7.4	71.4	56.5	41.7	-	-	-
	72	130.9	6.5	95.0	80.2	65.4	50.6	-	-	124.9	7.3	93.1	78.2	63.3	48.4	-	-
	67	126.7	6.4	119.5	103.0	88.2	73.4	58.6	-	118.4	7.2	114.8	99.9	85.0	70.1	55.2	-
	62	117.3	6.3	117.3	117.3	108.5	93.7	78.9	64.1	109.5	7.1	109.5	109.5	104.5	89.6	74.7	59.8
	57	114.5	6.4	114.5	114.5	114.5	99.7	84.9	70.1	106.5	7.2	106.5	106.5	106.5	91.6	76.7	61.8
3825	72	130.9	6.5	99.4	84.1	68.8	53.5	-	-	125.4	7.4	98.3	82.6	66.9	51.2	-	-
	67	126.8	6.4	123.1	108.1	92.8	77.5	62.2	-	118.8	7.3	117.0	105.4	89.7	74.0	58.4	-
	62	117.4	6.3	117.4	117.4	112.9	97.6	82.3	67.0	109.9	7.1	109.9	109.9	107.4	91.7	76.0	60.3
	57	114.5	6.4	114.5	114.5	114.5	99.2	83.9	68.6	106.9	7.2	106.9	106.9	106.9	91.2	75.5	59.8
4250	72	131.0	6.5	103.7	87.9	72.1	56.3	-	-	125.9	7.4	103.4	86.9	70.4	53.9	-	-
	67	126.8	6.5	126.8	113.1	97.3	81.5	65.7	-	119.3	7.3	119.3	111.0	94.5	78.0	61.5	-
	62	117.4	6.3	117.4	117.4	117.4	101.6	85.8	70.0	110.4	7.2	110.4	110.4	110.4	93.8	77.3	60.8
	57	114.6	6.4	114.6	114.6	114.6	98.8	83.0	67.2	107.3	7.2	107.3	107.3	107.3	90.7	74.2	57.7
		95°F								**105°F**							
2125	77	115.5	8.3	50.3	41.1	31.1	-	-	-	108.8	9.3	44.7	38.2	28.2	-	-	-
	72	107.5	8.1	66.9	56.8	46.8	36.8	-	-	100.5	9.1	63.5	53.6	43.7	33.8	-	-
	67	99.5	8.0	83.4	72.5	62.5	52.5	42.4	-	92.1	9.0	82.4	69.0	59.1	49.2	39.3	-
	62	91.9	7.9	91.9	91.9	76.8	66.8	56.7	46.7	85.2	8.9	85.2	85.2	70.3	60.4	50.5	40.6
2550	77	119.5	8.3	57.6	46.0	34.3	-	-	-	112.4	9.3	54.4	42.9	31.3	-	-	-
	72	111.3	8.2	75.0	63.3	51.6	39.9	-	-	103.8	9.2	71.5	60.0	48.4	36.8	-	-
	67	103.0	8.0	92.3	80.6	68.9	57.2	45.6	-	95.1	9.0	88.6	77.1	65.5	53.9	42.3	-
	62	95.2	7.9	95.2	95.2	84.7	73.0	61.3	49.7	88.0	8.9	88.0	88.0	77.9	66.3	54.7	43.1
	57	92.1	7.9	92.1	92.1	82.9	71.2	59.6	47.9	85.8	9.0	85.8	85.8	76.4	64.9	53.3	41.7
2975	77	123.6	8.3	64.9	50.8	37.5	-	-	-	115.9	9.4	64.2	47.5	34.3	-	-	-
	72	115.1	8.2	83.1	69.7	56.4	43.1	-	-	107.0	9.2	79.5	66.3	53.1	39.8	-	-
	67	106.5	8.0	101.2	88.7	75.3	62.0	48.7	-	98.1	9.0	94.9	85.1	71.8	58.6	45.4	-
	62	98.5	7.9	98.5	98.5	92.6	79.3	65.9	52.6	90.8	8.9	90.8	90.8	85.4	72.2	58.9	45.7
	57	95.2	8.0	95.2	95.2	90.7	77.3	64.0	50.7	88.5	9.0	88.5	88.5	83.8	70.6	57.4	44.1
3400	77	127.7	8.4	72.3	55.6	40.7	-	-	-	119.5	9.4	74.0	52.2	37.3	-	-	-
	72	118.9	8.2	91.2	76.2	61.2	46.3	-	-	110.3	9.2	87.6	72.7	57.8	42.9	-	-
	67	110.1	8.1	110.1	96.7	81.8	66.8	51.8	-	101.2	9.1	101.2	93.1	78.2	63.3	48.4	-
	62	101.7	8.0	101.7	101.7	100.5	85.5	70.6	55.6	93.6	8.9	93.6	93.6	93.0	78.1	63.2	48.3
	57	98.4	8.0	98.4	98.4	98.4	83.4	68.5	53.5	91.2	9.0	91.2	91.2	91.2	76.4	61.5	46.6
3825	72	119.8	8.3	97.1	81.0	64.9	48.8	-	-	111.2	9.3	93.4	77.4	61.3	45.3	-	-
	67	110.9	8.1	110.9	102.8	86.7	70.6	54.5	-	102.0	9.1	102.0	97.2	83.0	67.0	51.0	-
	62	102.5	8.0	102.5	102.5	101.9	85.8	69.7	53.6	94.3	9.0	94.3	94.3	94.0	78.0	61.9	45.9
	57	99.2	8.0	99.2	99.2	99.2	83.1	67.0	50.9	92.0	9.1	92.0	92.0	92.0	75.9	59.9	43.9
4250	72	120.8	8.3	103.1	85.9	68.6	51.4	-	-	112.1	9.3	99.2	82.1	64.9	47.7	-	-
	67	111.8	8.1	111.8	108.9	91.7	74.4	57.2	-	102.8	9.1	102.8	101.3	87.8	70.7	53.5	-
	62	103.3	8.0	103.3	103.3	103.3	86.1	68.9	51.6	95.1	9.0	95.1	95.1	95.1	77.9	60.7	43.5
	57	99.9	8.1	99.9	99.9	99.9	82.7	65.5	48.3	92.7	9.1	92.7	92.7	92.7	75.5	58.4	41.2

ZR102 (8.5 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
2125	77	102.2	10.3	39.0	35.2	25.4	-	-	-	95.6	11.4	36.2	31.0	22.6	-	-	-
	72	93.5	10.1	60.2	50.4	40.6	30.8	-	-	86.5	11.1	56.8	47.1	37.5	27.8	-	-
	67	84.8	10.0	81.3	65.5	55.8	46.0	36.2	-	77.4	10.9	77.4	62.1	52.4	42.7	33.1	-
	62	78.5	9.9	78.5	78.5	63.8	54.0	44.2	34.4	71.8	10.8	71.8	71.8	57.3	47.7	38.0	28.3
2550	77	105.2	10.4	51.2	39.7	28.3	-	-	-	98.0	11.4	49.9	36.6	25.3	-	-	-
	72	96.2	10.2	68.1	56.6	45.2	33.7	-	-	88.7	11.2	64.7	53.3	41.9	30.6	-	-
	67	87.3	10.0	85.0	73.5	62.0	50.6	39.1	-	79.4	11.0	79.4	70.0	58.6	47.3	35.9	-
	62	80.8	9.9	80.8	80.8	71.0	59.6	48.1	36.6	73.6	10.9	73.6	73.6	64.2	52.8	41.5	30.1
	57	79.6	10.0	79.6	79.6	69.9	58.5	47.0	35.5	73.3	11.0	73.3	73.3	63.4	52.1	40.7	29.3
2975	77	108.2	10.4	63.4	44.3	31.1	-	-	-	100.5	11.4	63.7	42.3	28.0	-	-	-
	72	99.0	10.2	76.0	62.9	49.7	36.6	-	-	90.9	11.2	72.5	59.5	46.4	33.4	-	-
	67	89.8	10.0	88.6	81.5	68.3	55.2	42.1	-	81.4	11.0	81.4	77.9	64.8	51.8	38.7	-
	62	83.1	9.9	83.1	83.1	78.2	65.1	51.9	38.8	75.4	10.9	75.4	75.4	71.0	58.0	44.9	31.9
	57	81.8	10.0	81.8	81.8	77.0	63.9	50.7	37.6	75.1	11.0	75.1	75.1	70.2	57.1	44.1	31.0
3400	77	111.2	10.4	75.7	48.8	34.0	-	-	-	102.9	11.4	77.4	47.9	30.7	-	-	-
	72	101.7	10.2	84.0	69.1	54.3	39.5	-	-	93.1	11.2	80.4	65.6	50.9	36.1	-	-
	67	92.3	10.0	92.3	89.5	74.6	59.8	45.0	-	83.3	11.0	83.3	83.3	71.1	56.3	41.6	-
	62	85.4	9.9	85.4	85.4	85.4	70.6	55.8	41.0	77.3	10.9	77.3	77.3	77.3	63.1	48.4	33.6
	57	84.1	10.0	84.1	84.1	84.1	69.3	54.5	39.6	77.0	11.0	77.0	77.0	77.0	62.2	47.5	32.7
3825	72	102.6	10.3	89.7	73.7	57.7	41.8	-	-	93.9	11.3	86.0	70.1	54.1	38.2	-	-
	67	93.0	10.1	93.0	91.6	79.3	63.3	47.4	-	84.0	11.1	84.0	84.0	75.6	59.7	43.8	-
	62	86.1	10.0	86.1	86.1	86.1	70.1	54.2	38.2	77.9	11.0	77.9	77.9	77.9	62.3	46.4	30.5
	57	84.8	10.1	84.8	84.8	84.8	68.8	52.8	36.9	77.6	11.1	77.6	77.6	77.6	61.7	45.8	29.8
4250	72	103.4	10.3	95.4	78.3	61.1	44.0	-	-	94.7	11.4	91.6	74.5	57.4	40.3	-	-
	67	93.8	10.1	93.8	93.8	84.0	66.9	49.7	-	84.7	11.1	84.7	84.7	80.2	63.1	46.0	-
	62	86.8	10.0	86.8	86.8	86.8	69.7	52.6	35.4	78.6	11.1	78.6	78.6	78.6	61.5	44.4	27.3
	57	85.5	10.1	85.5	85.5	85.5	68.3	51.2	34.1	78.2	11.2	78.2	78.2	78.2	61.2	44.1	27.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR102 (8.5 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65
		35°F							**45°F**						
2125	72	72.0	5.0	8.5	7.1	5.7	-	-	62.7	5.5	3.5	2.4	1.3	-	-
	67	74.0	4.9	11.6	10.2	8.8	7.3	-	61.5	5.3	9.5	8.4	7.2	6.1	-
	62	61.6	5.1	21.8	20.4	18.9	17.5	16.1	53.9	5.3	18.2	17.1	16.0	14.9	13.8
2550	72	73.3	4.9	13.4	11.3	9.2	-	-	64.8	5.5	5.6	3.8	2.1	-	-
	67	75.3	4.8	17.9	15.8	13.7	11.6	-	63.6	5.3	14.9	13.2	11.4	9.7	-
	62	62.6	5.0	33.6	31.5	29.4	27.3	25.2	55.8	5.2	28.7	26.9	25.2	23.4	21.7
	57	58.2	4.7	37.4	35.3	33.2	31.2	29.1	50.7	5.0	33.0	31.2	29.5	27.7	26.0
2975	72	74.5	4.8	18.2	15.5	12.7	-	-	66.9	5.4	7.6	5.2	2.8	-	-
	67	76.7	4.7	24.1	21.4	18.7	15.9	-	65.7	5.2	20.4	18.0	15.6	13.2	-
	62	63.6	5.0	45.3	42.6	39.9	37.1	34.4	57.6	5.2	39.2	36.8	34.4	32.0	29.6
	57	59.2	4.7	48.8	47.8	45.0	42.3	39.6	52.4	5.0	43.5	42.6	40.2	37.8	35.4
3400	72	75.7	4.7	23.0	19.6	16.2	-	-	69.1	5.3	9.7	6.6	3.6	-	-
	67	78.1	4.6	30.4	27.0	23.6	20.2	-	67.8	5.1	25.8	22.8	19.7	16.7	-
	62	64.7	4.9	57.1	53.7	50.4	47.0	43.6	59.5	5.1	49.7	46.6	43.6	40.5	37.5
	57	60.2	4.6	60.2	60.2	56.8	53.5	50.1	54.0	4.9	54.0	54.0	51.0	47.9	44.9
3825	72	73.9	4.7	25.8	22.4	18.9	-	-	70.1	5.3	10.9	7.5	4.2	-	-
	67	76.5	4.6	33.7	30.2	26.8	23.3	-	68.7	5.1	29.2	25.8	22.5	19.1	-
	62	63.0	4.9	62.0	60.1	56.7	53.2	49.8	60.3	5.1	55.4	52.9	49.5	46.1	42.8
	57	58.8	4.6	58.8	58.8	55.4	51.9	48.4	54.8	4.9	54.8	54.8	51.4	48.1	44.7
4250	72	72.0	4.7	28.7	25.1	21.6	-	-	71.0	5.3	12.1	8.4	4.7	-	-
	67	75.0	4.6	37.0	33.5	29.9	26.4	-	69.7	5.1	32.5	28.9	25.2	21.5	-
	62	61.4	4.9	61.4	61.4	61.4	59.5	55.9	61.2	5.1	61.2	59.1	55.4	51.7	48.0
	57	57.4	4.6	57.4	57.4	53.9	50.4	46.8	55.6	4.9	55.6	55.6	51.9	48.2	44.5
		55°F							**65°F**						
2125	72	53.3	6.1	-	-	-	-	-	48.0	6.2	-	-	-	-	-
	67	49.0	5.8	7.3	6.5	5.7	4.9	-	42.2	6.1	4.4	4.0	3.5	3.1	-
	62	46.3	5.4	14.6	13.9	13.1	12.3	11.5	39.1	5.8	9.5	9.1	8.6	8.2	7.7
2550	72	56.3	6.0	-	-	-	-	-	53.6	6.1	-	-	-	-	-
	67	51.8	5.7	11.9	10.5	9.1	7.7	-	47.0	6.1	9.1	8.0	6.9	5.8	-
	62	49.0	5.4	23.8	22.4	21.0	19.6	18.1	43.5	5.7	20.2	19.1	18.0	16.9	15.8
	57	43.2	5.3	28.6	27.1	25.7	24.3	22.9	36.3	5.7	22.6	21.5	20.4	19.3	18.2
2975	72	59.4	6.0	-	-	-	-	-	59.2	6.1	-	-	-	-	-
	67	54.6	5.7	16.6	14.5	12.5	10.4	-	51.7	6.0	13.7	12.0	10.2	8.5	-
	62	51.6	5.4	33.0	31.0	28.9	26.8	24.8	47.8	5.7	30.9	29.1	27.4	25.7	23.9
	57	45.5	5.3	38.2	37.5	35.4	33.4	31.3	39.8	5.6	33.0	32.4	30.7	28.9	27.2
3400	72	62.4	6.0	-	-	-	-	-	64.8	6.1	-	-	-	-	-
	67	57.4	5.7	21.3	18.5	15.8	13.1	-	56.5	6.0	18.3	15.9	13.6	11.2	-
	62	54.3	5.3	42.2	39.5	36.8	34.1	31.4	52.2	5.7	41.6	39.2	36.8	34.4	32.0
	57	47.9	5.2	47.9	47.9	45.2	42.4	39.7	43.3	5.6	43.3	43.3	41.0	38.6	36.2
3825	72	66.2	5.9	-	-	-	-	-	67.4	6.0	-	-	-	-	-
	67	60.9	5.6	24.7	21.4	18.1	14.9	-	58.8	6.0	22.2	19.2	16.3	13.3	-
	62	57.6	5.3	48.8	45.6	42.3	39.0	35.8	54.4	5.6	47.7	45.5	42.6	39.6	36.6
	57	50.8	5.2	50.8	50.8	47.5	44.3	41.0	45.2	5.6	45.2	45.2	42.2	39.3	36.3
4250	72	70.1	5.9	-	-	-	-	-	70.0	6.0	-	-	-	-	-
	67	64.5	5.6	28.1	24.2	20.4	16.6	-	61.1	5.9	26.0	22.5	19.0	15.4	-
	62	60.9	5.3	55.5	51.6	47.8	44.0	40.2	56.5	5.6	53.8	51.9	48.3	44.8	41.2
	57	53.7	5.2	53.7	53.7	49.9	46.1	42.3	47.1	5.5	47.1	47.1	43.5	40.0	36.4

ZR102 (8.5 Ton) Reheat (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)				
CFM	WB (°F)			85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
2125	72	42.8	6.3	-	-	-	-	-	37.6	6.4	-	-	-	-	-
	67	35.4	6.5	1.6	1.5	1.4	1.2	-	28.6	6.8	-	-	-	-	-
	62	31.9	6.2	4.4	4.3	4.2	4.1	4.0	24.7	6.5	-	-	-	-	-
2550	72	50.9	6.2	-	-	-	-	-	48.3	6.4	-	-	-	-	-
	67	42.1	6.4	6.2	5.4	4.7	3.9	-	37.3	6.8	3.3	2.9	2.5	2.0	-
	62	38.0	6.1	16.6	15.8	15.0	14.3	13.5	32.5	6.5	13.0	12.5	12.1	11.6	11.2
	57	29.4	6.1	16.6	15.8	15.0	14.3	13.5	22.5	6.4	10.6	10.1	9.7	9.3	8.8
2975	72	59.1	6.2	-	-	-	-	-	58.9	6.3	-	-	-	-	-
	67	48.9	6.4	10.8	9.4	8.0	6.6	-	46.0	6.7	7.9	6.8	5.7	4.6	-
	62	44.0	6.1	28.7	27.3	25.9	24.5	23.1	40.2	6.4	26.6	25.5	24.4	23.3	22.2
	57	34.1	6.0	27.7	27.3	25.9	24.5	23.1	28.4	6.4	22.4	22.2	21.1	20.0	19.0
3400	72	67.2	6.2	-	-	-	-	-	69.6	6.3	-	-	-	-	-
	67	55.6	6.3	15.4	13.3	11.3	9.2	-	54.7	6.7	12.5	10.7	9.0	7.3	-
	62	50.1	6.0	40.9	38.8	36.8	34.7	32.6	48.0	6.4	40.2	38.5	36.7	35.0	33.3
	57	38.8	6.0	38.8	38.8	36.8	34.7	32.6	34.3	6.3	34.3	34.3	32.6	30.8	29.1
3825	72	68.6	6.1	-	-	-	-	-	69.7	6.2	-	-	-	-	-
	67	56.7	6.3	19.7	17.0	14.4	11.7	-	54.6	6.6	17.2	14.9	12.5	10.2	-
	62	51.1	6.0	46.5	45.5	42.8	40.1	37.5	47.9	6.3	45.3	45.4	43.1	40.7	38.3
	57	39.6	5.9	39.6	39.6	36.9	34.3	31.6	34.0	6.3	34.0	34.0	31.6	29.3	26.9
4250	72	69.9	6.1	-	-	-	-	-	69.8	6.2	-	-	-	-	-
	67	57.8	6.3	24.0	20.8	17.5	14.2	-	54.5	6.6	22.0	19.0	16.0	13.1	-
	62	52.1	5.9	52.1	52.1	48.8	45.6	42.3	47.7	6.3	47.7	47.7	47.7	46.4	43.4
	57	40.4	5.9	40.4	40.4	37.1	33.9	30.6	33.7	6.2	33.7	33.7	30.7	27.8	24.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR120 (10 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
2500	77	137.8	7.3	67.5	55.5	43.9	-	-	-	132.5	8.2	62.6	51.3	40.0	-	-	-
	72	131.8	7.1	85.5	73.9	62.3	50.6	-	-	125.8	8.1	80.7	69.5	58.2	46.9	-	-
	67	125.8	7.0	103.5	92.3	80.6	69.0	57.4	-	119.1	8.0	98.9	87.6	76.4	65.1	53.9	-
	62	113.9	6.9	113.9	112.8	97.5	85.8	74.2	62.6	108.5	7.9	108.5	107.0	91.1	79.8	68.6	57.3
3000	77	143.9	7.4	73.5	60.4	47.3	-	-	-	138.1	8.3	69.4	56.5	43.6	-	-	-
	72	137.6	7.2	93.3	80.2	67.1	54.0	-	-	131.1	8.2	89.1	76.3	63.4	50.5	-	-
	67	131.3	7.0	113.1	100.0	86.9	73.8	60.7	-	124.1	8.0	108.9	96.0	83.1	70.2	57.4	-
	62	118.9	6.9	118.9	118.2	105.1	92.0	78.9	65.8	113.1	8.0	113.1	112.1	99.2	86.3	73.4	60.5
	57	114.8	6.9	114.8	114.8	108.3	95.2	82.2	69.1	110.6	7.9	110.6	110.6	102.2	89.3	76.4	63.5
3500	77	150.0	7.4	79.5	65.3	50.8	-	-	-	143.7	8.3	76.2	61.7	47.1	-	-	-
	72	143.4	7.2	101.1	86.5	72.0	57.4	-	-	136.4	8.2	97.6	83.0	68.5	54.0	-	-
	67	136.9	7.1	122.7	107.7	93.2	78.6	64.0	-	129.1	8.1	119.0	104.4	89.9	75.4	60.9	-
	62	123.9	7.0	123.9	123.6	112.7	98.1	83.5	69.0	117.7	8.0	117.7	117.1	107.2	92.7	78.2	63.7
	57	119.6	7.0	119.6	119.6	116.2	101.6	87.0	72.5	115.1	8.0	115.1	115.1	110.5	96.0	81.5	67.0
4000	77	156.1	7.4	85.5	70.2	54.2	-	-	-	149.3	8.4	83.0	66.8	50.7	-	-	-
	72	149.3	7.3	108.9	92.8	76.8	60.8	-	-	141.7	8.2	106.0	89.8	73.7	57.5	-	-
	67	142.5	7.1	132.2	115.4	99.4	83.4	67.4	-	134.1	8.1	129.0	112.8	96.7	80.5	64.4	-
	62	129.0	7.0	129.0	129.0	120.2	104.2	88.2	72.2	122.2	8.0	122.2	122.2	115.3	99.2	83.0	66.8
	57	124.5	7.0	124.5	124.5	124.0	108.0	91.9	75.9	119.6	8.0	119.6	119.6	118.9	102.7	86.5	70.4
4500	72	151.7	7.3	116.7	99.1	81.6	64.0	-	-	143.8	8.2	113.4	95.8	78.1	60.5	-	-
	67	144.8	7.1	139.7	123.1	105.6	88.0	70.5	-	136.2	8.1	133.6	120.2	102.5	84.9	67.2	-
	62	131.1	7.0	131.1	131.1	126.7	109.2	91.6	74.1	124.1	8.0	124.1	124.1	120.6	103.0	85.3	67.6
	57	126.6	7.0	126.6	126.6	126.3	108.8	91.2	73.7	121.4	8.0	121.4	121.4	121.0	103.4	85.7	68.1
5000	72	154.2	7.3	124.5	105.4	86.4	67.3	-	-	146.0	8.3	120.9	101.7	82.6	63.4	-	-
	67	147.2	7.2	147.2	130.9	111.8	92.7	73.6	-	138.2	8.1	138.2	127.5	108.3	89.2	70.0	-
	62	133.3	7.1	133.3	133.3	133.3	114.2	95.1	76.0	125.9	8.1	125.9	125.9	125.9	106.8	87.6	68.5
	57	128.6	7.1	128.6	128.6	128.6	109.6	90.5	71.4	123.2	8.0	123.2	123.2	123.2	104.1	84.9	65.7
		95°F								105°F							
2500	77	127.3	9.2	57.6	47.1	36.2	-	-	-	117.5	10.5	52.8	44.2	33.5	-	-	-
	72	119.8	9.1	75.9	65.0	54.1	43.3	-	-	110.8	10.4	72.3	61.6	50.9	40.3	-	-
	67	112.4	9.0	94.3	83.0	72.1	61.2	50.3	-	104.0	10.3	91.8	79.1	68.4	57.7	47.0	-
	62	103.2	9.0	103.2	101.2	84.7	73.8	62.9	52.0	96.1	10.2	96.1	95.1	80.3	69.6	58.9	48.2
3000	77	132.4	9.2	65.2	52.5	39.8	-	-	-	122.4	10.5	61.8	49.3	36.9	-	-	-
	72	124.6	9.1	85.0	72.3	59.6	46.9	-	-	115.4	10.4	81.0	68.5	56.1	43.7	-	-
	67	116.9	9.0	104.8	92.1	79.4	66.7	54.0	-	108.3	10.3	100.2	87.8	75.3	62.9	50.5	-
	62	107.3	9.0	107.3	106.0	93.3	80.6	67.9	55.2	100.1	10.2	100.1	99.4	88.5	76.0	63.6	51.2
	57	106.5	8.9	106.5	106.5	96.1	83.4	70.7	58.0	99.2	10.2	99.2	99.2	89.5	77.0	64.6	52.2
3500	77	137.4	9.2	72.9	58.0	43.5	-	-	-	127.3	10.5	70.7	54.5	40.3	-	-	-
	72	129.4	9.2	94.1	79.6	65.1	50.6	-	-	120.0	10.4	89.6	75.5	61.3	47.2	-	-
	67	121.3	9.1	115.3	101.2	86.7	72.2	57.7	-	112.6	10.3	108.6	96.5	82.3	68.1	54.0	-
	62	111.4	9.0	111.4	110.7	101.8	87.3	72.8	58.3	104.0	10.2	104.0	103.7	96.6	82.5	68.3	54.2
	57	110.6	9.0	110.6	110.6	104.9	90.4	75.9	61.4	103.2	10.2	103.2	103.2	97.7	83.6	69.4	55.3
4000	77	142.5	9.3	80.5	63.5	47.2	-	-	-	132.1	10.5	79.6	59.6	43.7	-	-	-
	72	134.1	9.2	103.1	86.8	70.5	54.3	-	-	124.6	10.4	98.3	82.4	66.5	50.6	-	-
	67	125.8	9.1	125.8	110.2	93.9	77.6	61.3	-	117.0	10.3	117.0	105.2	89.3	73.4	57.5	-
	62	115.5	9.0	115.5	115.5	110.4	94.1	77.8	61.5	108.0	10.2	108.0	108.0	104.8	88.9	73.0	57.1
	57	114.7	9.0	114.7	114.7	113.7	97.4	81.1	64.8	107.1	10.2	107.1	107.1	106.0	90.1	74.2	58.3
4500	72	136.0	9.2	110.2	92.4	74.7	56.9	-	-	126.1	10.4	105.2	87.8	70.5	53.1	-	-
	67	127.5	9.1	127.5	117.2	99.4	81.7	63.9	-	118.4	10.3	118.4	111.2	94.6	77.2	59.9	-
	62	117.1	9.0	117.1	117.1	114.5	96.7	79.0	61.2	109.4	10.2	109.4	109.4	107.8	90.4	73.1	55.7
	57	116.2	9.0	116.2	116.2	115.8	98.0	80.2	62.5	108.4	10.2	108.4	108.4	107.9	90.5	73.2	55.8
5000	72	137.8	9.2	117.3	98.0	78.8	59.5	-	-	127.6	10.4	112.0	93.2	74.4	55.6	-	-
	67	129.2	9.1	129.2	124.2	104.9	85.7	66.4	-	119.8	10.3	119.8	117.3	99.9	81.1	62.2	-
	62	118.6	9.0	118.6	118.6	118.6	99.4	80.2	60.9	110.7	10.2	110.7	110.7	110.7	91.9	73.1	54.3
	57	117.8	9.0	117.8	117.8	117.8	98.6	79.3	60.1	109.8	10.2	109.8	109.8	109.8	91.0	72.1	53.3

ZR120 (10 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
2500	77	107.7	11.9	48.1	41.3	30.8	-	-	-	98.0	13.2	43.3	38.4	28.1	-	-	-
	72	101.7	11.7	68.7	58.2	47.7	37.3	-	-	92.6	13.0	65.1	54.8	44.5	34.3	-	-
	67	95.6	11.6	89.3	75.1	64.6	54.2	43.7	-	87.3	12.8	86.8	71.2	60.9	50.6	40.4	-
	62	89.0	11.4	89.0	89.0	75.9	65.4	54.9	44.4	81.8	12.6	81.8	81.8	71.4	61.2	50.9	40.6
3000	77	112.4	11.8	58.3	46.1	34.0	-	-	-	102.5	13.1	54.8	42.9	31.1	-	-	-
	72	106.1	11.7	76.9	64.8	52.6	40.5	-	-	96.9	13.0	72.9	61.0	49.2	37.3	-	-
	67	99.8	11.5	95.6	83.4	71.3	59.1	47.0	-	91.3	12.8	91.0	79.1	67.2	55.4	43.5	-
	62	92.8	11.3	92.8	92.8	83.7	71.5	59.4	47.2	85.6	12.5	85.6	85.6	78.9	67.0	55.1	43.2
	57	91.9	11.4	91.9	91.9	82.8	70.7	58.5	46.4	84.6	12.7	84.6	84.6	76.2	64.3	52.4	40.5
3500	77	117.1	11.8	68.5	51.0	37.2	-	-	-	107.0	13.1	66.3	47.5	34.0	-	-	-
	72	110.6	11.7	85.2	71.4	57.5	43.7	-	-	101.2	12.9	80.8	67.3	53.8	40.3	-	-
	67	104.0	11.5	101.9	91.8	77.9	64.1	50.3	-	95.3	12.7	95.2	87.1	73.6	60.1	46.6	-
	62	96.7	11.3	96.7	96.7	91.5	77.6	63.8	50.0	89.4	12.5	89.4	89.4	86.3	72.8	59.3	45.8
	57	95.7	11.4	95.7	95.7	90.5	76.7	62.9	49.1	88.3	12.6	88.3	88.3	83.4	69.9	56.4	42.9
4000	77	121.8	11.8	78.7	55.8	40.3	-	-	-	111.5	13.0	77.8	52.0	36.9	-	-	-
	72	115.0	11.6	93.4	77.9	62.5	47.0	-	-	105.4	12.8	88.6	73.5	58.4	43.3	-	-
	67	108.2	11.5	108.2	100.1	84.6	69.1	53.6	-	99.3	12.7	99.3	95.0	79.9	64.8	49.7	-
	62	100.6	11.3	100.6	100.6	99.3	83.8	68.3	52.8	93.1	12.4	93.1	93.1	93.1	78.6	63.5	48.4
	57	99.6	11.4	99.6	99.6	98.3	82.8	67.3	51.8	92.0	12.6	92.0	92.0	90.5	75.4	60.3	45.3
4500	72	116.2	11.6	100.1	83.2	66.2	49.3	-	-	106.4	12.9	95.1	78.5	62.0	45.5	-	-
	67	109.3	11.5	109.3	105.3	89.7	72.8	55.8	-	100.2	12.7	100.2	99.3	84.8	68.3	51.8	-
	62	101.7	11.3	101.7	101.7	101.0	84.1	67.1	50.2	94.0	12.4	94.0	94.0	94.0	77.7	61.2	44.7
	57	100.6	11.4	100.6	100.6	100.0	83.1	66.1	49.2	92.9	12.6	92.9	92.9	92.1	75.6	59.1	42.5
5000	72	117.5	11.7	106.8	88.4	70.0	51.6	-	-	107.3	12.9	101.5	83.6	65.6	47.7	-	-
	67	110.5	11.5	110.5	110.5	94.8	76.4	58.1	-	101.1	12.7	101.1	101.1	89.8	71.8	53.9	-
	62	102.7	11.3	102.7	102.7	102.7	84.4	66.0	47.6	94.8	12.5	94.8	94.8	94.8	76.8	58.9	40.9
	57	101.7	11.4	101.7	101.7	101.7	83.3	65.0	46.6	93.7	12.7	93.7	93.7	93.7	75.7	57.8	39.8

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR120 (10 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		35°F								45°F							
2500	77	81.3	6.2	-	-	-	-	-	-	66.7	6.8	-	-	-	-	-	-
	72	75.9	6.1	12.0	9.6	7.1	4.7	-	-	65.6	6.5	6.6	4.6	2.7	-	-	-
	67	70.6	6.0	26.3	23.9	21.5	19.1	16.6	-	64.5	6.2	21.3	19.3	17.3	15.4	13.4	-
	62	72.8	5.8	42.2	39.7	37.3	34.9	32.5	30.0	62.5	6.0	35.2	33.2	31.3	29.3	27.4	25.4
3000	77	82.4	6.2	-	-	-	-	-	-	69.4	6.8	-	-	-	-	-	-
	72	76.7	6.0	15.1	12.1	9.2	6.2	-	-	68.3	6.5	8.5	6.0	3.4	-	-	-
	67	71.0	5.9	31.5	28.6	25.6	22.7	19.7	-	67.1	6.2	27.0	24.4	21.8	19.3	16.7	-
	62	73.6	5.7	50.1	47.2	44.2	41.3	38.3	35.4	65.0	6.0	44.6	42.0	39.4	36.8	34.2	31.6
	57	65.6	5.7	56.8	53.9	50.9	48.0	45.0	42.1	60.6	5.9	51.5	48.9	46.3	43.7	41.1	38.6
3500	77	83.5	6.1	-	-	-	-	-	-	72.1	6.7	-	-	-	-	-	-
	72	77.5	6.0	18.1	14.7	11.2	7.8	-	-	70.9	6.5	10.5	7.3	4.1	-	-	-
	67	71.5	5.9	36.6	33.2	29.7	26.3	22.8	-	69.7	6.2	32.8	29.6	26.3	23.1	19.9	-
	62	74.3	5.7	58.0	54.6	51.1	47.7	44.2	40.8	67.6	6.0	53.9	50.7	47.5	44.3	41.1	37.8
	57	66.1	5.6	61.7	60.2	58.7	55.3	51.8	48.4	63.0	5.9	58.4	57.1	55.9	52.6	49.4	46.2
4000	77	84.7	6.1	-	-	-	-	-	-	74.9	6.7	-	-	-	-	-	-
	72	78.3	6.0	21.2	17.2	13.3	9.3	-	-	73.6	6.4	12.5	8.6	4.8	-	-	-
	67	71.9	5.9	41.8	37.8	33.9	29.9	25.9	-	72.4	6.2	38.5	34.7	30.8	27.0	23.1	-
	62	75.1	5.7	66.0	62.0	58.0	54.1	50.1	46.1	70.1	5.9	63.3	59.4	55.6	51.7	47.9	44.1
	57	66.6	5.6	66.6	66.6	66.6	62.6	58.6	54.7	65.4	5.9	65.4	65.4	65.4	61.5	57.7	53.8
4500	72	79.5	6.0	22.5	18.3	14.1	9.9	-	-	73.1	6.5	13.3	9.2	5.1	-	-	-
	67	73.3	5.9	44.3	40.1	35.9	31.7	27.5	-	71.9	6.2	41.1	36.9	32.8	28.7	24.6	-
	62	76.3	5.7	71.7	67.7	61.5	57.3	53.1	49.0	69.7	6.0	66.2	63.3	59.2	55.1	50.9	46.8
	57	67.8	5.6	67.8	67.8	67.8	63.6	59.4	55.2	64.9	5.9	64.9	64.9	64.9	60.8	56.7	52.6
5000	72	80.8	6.0	23.8	19.4	15.0	10.6	-	-	72.6	6.5	14.1	9.8	5.4	-	-	-
	67	74.7	5.9	46.7	42.3	38.0	33.6	29.2	-	71.4	6.2	43.6	39.2	34.8	30.4	26.0	-
	62	77.5	5.7	77.5	73.5	65.0	60.6	56.2	51.8	69.2	6.0	69.2	67.2	62.8	58.4	54.0	49.6
	57	69.0	5.6	69.0	69.0	69.0	64.6	60.2	55.8	64.5	5.9	64.5	64.5	64.5	60.1	55.7	51.3
		55°F								65°F							
2500	77	52.1	7.4	-	-	-	-	-	-	46.4	7.7	-	-	-	-	-	-
	72	55.3	6.9	1.2	-	-	-	-	-	49.0	7.3	-	-	-	-	-	-
	67	58.4	6.5	16.2	14.7	13.2	11.7	10.2	-	51.6	6.9	13.0	11.8	10.6	9.4	8.2	-
	62	52.2	6.2	28.2	26.7	25.2	23.7	22.3	20.8	46.1	6.5	23.7	22.5	21.3	20.0	18.8	17.6
3000	77	56.5	7.4	-	-	-	-	-	-	51.3	7.7	-	-	-	-	-	-
	72	59.8	6.9	2.0	-	-	-	-	-	54.1	7.3	-	-	-	-	-	-
	67	63.2	6.5	22.5	20.3	18.1	15.8	13.6	-	57.0	6.8	19.4	17.4	15.4	13.5	11.5	-
	62	56.5	6.2	39.0	36.8	34.5	32.3	30.1	27.8	50.8	6.5	34.9	33.0	31.0	29.0	27.1	25.1
	57	55.7	6.1	46.2	44.0	41.7	39.5	37.3	35.0	50.2	6.5	40.6	38.6	36.6	34.7	32.7	30.7
3500	77	60.8	7.3	-	-	-	-	-	-	56.1	7.7	-	-	-	-	-	-
	72	64.4	6.9	2.9	-	-	-	-	-	59.2	7.3	-	-	-	-	-	-
	67	68.0	6.5	28.9	25.9	22.9	20.0	17.0	-	62.3	6.8	25.7	23.0	20.2	17.5	14.8	-
	62	60.8	6.2	49.8	46.8	43.9	40.9	37.9	34.9	55.6	6.5	46.2	43.5	40.7	38.0	35.3	32.5
	57	60.0	6.1	55.2	54.1	53.0	50.0	47.0	44.0	54.9	6.5	50.1	49.1	48.1	45.4	42.6	39.9
4000	77	65.1	7.3	-	-	-	-	-	-	60.9	7.7	-	-	-	-	-	-
	72	69.0	6.9	3.7	-	-	-	-	-	64.3	7.2	-	-	-	-	-	-
	67	72.8	6.5	35.3	31.5	27.8	24.1	20.4	-	67.6	6.8	32.0	28.5	25.1	21.6	18.1	-
	62	65.2	6.2	60.6	56.9	53.2	49.4	45.7	42.0	60.4	6.5	57.5	54.0	50.5	47.0	43.5	40.0
	57	64.2	6.1	64.2	64.2	64.2	60.5	56.8	53.0	59.6	6.5	59.6	59.6	59.6	56.1	52.6	49.1
4500	72	66.7	7.0	4.1	-	-	-	-	-	63.3	7.3	-	-	-	-	-	-
	67	70.4	6.6	37.8	33.8	29.7	25.7	21.6	-	66.7	6.9	36.0	32.0	28.0	24.0	20.0	-
	62	63.0	6.3	60.7	58.9	56.8	52.8	48.7	44.7	59.5	6.6	58.0	56.3	54.5	50.5	46.5	42.5
	57	62.1	6.2	62.1	62.1	62.1	58.0	54.0	49.9	58.8	6.5	58.8	58.8	58.7	54.7	50.7	46.7
5000	72	64.4	7.0	4.5	-	-	-	-	-	62.4	7.3	-	-	-	-	-	-
	67	68.0	6.6	40.4	36.0	31.7	27.3	22.9	-	65.7	6.9	40.0	35.5	31.0	26.5	22.0	-
	62	60.9	6.3	60.9	60.9	60.5	56.2	51.8	47.4	58.6	6.6	58.6	58.6	58.5	53.9	49.4	44.9
	57	60.0	6.2	60.0	60.0	60.0	55.6	51.2	46.8	57.9	6.5	57.9	57.9	57.9	53.4	48.9	44.4

ZR120 (10 Ton) Reheat (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
2500	77	40.8	8.0	-	-	-	-	-	-	35.1	8.4	-	-	-	-	-	-
	72	42.8	7.6	-	-	-	-	-	-	36.6	8.0	-	-	-	-	-	-
	67	44.9	7.2	9.9	9.0	8.1	7.1	6.2	-	38.1	7.5	6.8	6.1	5.5	4.8	4.2	-
	62	39.9	6.9	19.1	18.2	17.3	16.3	15.4	14.5	33.8	7.2	14.6	13.9	13.3	12.6	12.0	11.3
3000	77	46.1	8.0	-	-	-	-	-	-	40.9	8.4	-	-	-	-	-	-
	72	48.4	7.6	-	-	-	-	-	-	42.7	7.9	-	-	-	-	-	-
	67	50.7	7.2	16.2	14.5	12.8	11.1	9.4	-	44.5	7.5	13.0	11.6	10.2	8.7	7.3	-
	62	45.2	6.8	30.9	29.2	27.5	25.7	24.0	22.3	39.5	7.2	26.8	25.3	23.9	22.5	21.0	19.6
	57	44.8	6.8	34.9	33.2	31.5	29.8	28.1	26.4	39.3	7.1	29.3	27.9	26.4	25.0	23.6	22.1
3500	77	51.4	8.0	-	-	-	-	-	-	46.7	8.3	-	-	-	-	-	-
	72	54.0	7.6	-	-	-	-	-	-	48.8	7.9	-	-	-	-	-	-
	67	56.6	7.1	22.5	20.0	17.5	15.1	12.6	-	50.9	7.5	19.3	17.1	14.8	12.6	10.4	-
	62	50.4	6.8	42.6	40.1	37.6	35.1	32.7	30.2	45.1	7.1	39.0	36.8	34.5	32.3	30.0	27.8
	57	49.9	6.8	45.0	44.2	43.2	40.7	38.3	35.8	44.9	7.1	39.9	39.2	38.4	36.1	33.9	31.6
4000	77	56.7	8.0	-	-	-	-	-	-	52.5	8.3	-	-	-	-	-	-
	72	59.6	7.6	-	-	-	-	-	-	54.9	7.9	-	-	-	-	-	-
	67	62.4	7.1	28.8	25.6	22.3	19.0	15.8	-	57.3	7.4	25.6	22.6	19.5	16.5	13.4	-
	62	55.6	6.8	54.3	51.1	47.8	44.6	41.3	38.0	50.8	7.1	50.8	48.2	45.1	42.1	39.1	36.0
	57	55.1	6.8	55.1	55.1	54.9	51.7	48.4	45.1	50.5	7.1	50.5	50.5	50.3	47.2	44.2	41.2
4500	72	60.0	7.6	-	-	-	-	-	-	56.7	7.9	-	-	-	-	-	-
	67	62.9	7.2	34.2	30.3	26.3	22.4	18.4	-	59.2	7.5	32.4	28.5	24.6	20.7	16.8	-
	62	56.0	6.9	55.4	53.7	52.1	48.1	44.2	40.2	52.5	7.2	52.5	51.2	49.7	45.8	41.9	38.0
	57	55.5	6.8	55.5	55.5	55.4	51.4	47.5	43.5	52.2	7.1	52.2	52.2	52.1	48.2	44.2	40.3
5000	72	60.5	7.7	-	-	-	-	-	-	58.5	8.0	-	-	-	-	-	-
	67	63.4	7.2	39.7	35.0	30.4	25.7	21.0	-	61.0	7.5	39.3	34.5	29.7	24.9	20.1	-
	62	56.4	6.9	56.4	56.4	56.4	51.7	47.1	42.4	54.2	7.2	54.2	54.2	54.2	49.5	44.7	39.9
	57	55.9	6.9	55.9	55.9	55.9	51.2	46.6	41.9	53.9	7.2	53.9	53.9	53.9	49.1	44.3	39.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR150 (12.5 Ton) Cooling

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								**85°F**							
3125	77	190.5	9.0	87.6	73.4	59.1	-	-	-	185.2	10.5	81.6	67.3	53.0	-	-	-
	72	180.7	9.2	111.5	97.2	83.0	68.8	-	-	172.9	10.5	105.4	91.1	76.8	62.5	-	-
	67	171.0	9.3	135.4	121.1	106.9	92.7	78.4	-	160.6	10.5	129.2	114.9	100.6	86.3	72.0	-
	62	158.6	9.1	158.6	158.6	158.6	150.5	136.2	122.0	148.0	10.3	148.0	148.0	139.6	125.3	111.1	96.8
3750	77	199.8	9.2	94.7	78.6	62.4	-	-	-	194.0	10.6	89.0	72.9	56.8	-	-	-
	72	189.6	9.3	119.8	103.7	87.5	71.3	-	-	181.1	10.6	114.4	98.3	82.2	66.1	-	-
	67	179.4	9.4	145.0	128.8	112.6	96.4	80.3	-	168.3	10.6	139.9	123.8	107.7	91.6	75.5	-
	62	166.3	9.2	166.3	166.3	166.3	157.9	141.8	125.6	155.1	10.4	155.1	155.1	149.5	133.4	117.3	101.2
	57	154.4	9.2	154.4	154.4	148.9	132.7	116.6	100.4	146.9	10.4	146.9	146.9	137.3	121.2	105.2	89.1
4375	77	209.1	9.3	101.9	83.8	65.7	-	-	-	202.8	10.7	96.3	78.4	60.5	-	-	-
	72	198.4	9.4	128.2	110.1	92.0	73.9	-	-	189.3	10.7	123.4	105.5	87.6	69.7	-	-
	67	187.7	9.6	154.5	136.4	118.3	100.2	82.1	-	175.9	10.7	150.6	132.7	114.8	96.9	79.0	-
	62	174.1	9.4	174.1	174.1	174.1	165.4	147.3	129.2	162.1	10.5	162.1	162.1	159.3	141.4	123.5	105.6
	57	161.6	9.3	161.6	161.6	156.6	138.5	120.4	102.3	153.5	10.5	153.5	153.5	146.4	128.5	110.6	92.7
5000	77	218.4	9.4	109.0	89.0	68.9	-	-	-	211.6	10.8	103.6	83.9	64.2	-	-	-
	72	207.3	9.6	136.6	116.5	96.5	76.5	-	-	197.5	10.8	132.4	112.7	93.0	73.3	-	-
	67	196.1	9.7	164.1	144.1	124.1	104.0	84.0	-	183.5	10.8	161.2	141.5	121.8	102.1	82.4	-
	62	181.8	9.5	181.8	181.8	181.8	172.9	152.9	132.8	169.1	10.6	169.1	169.1	169.1	149.4	129.7	110.0
	57	168.8	9.5	168.8	168.8	164.4	144.3	124.3	104.2	160.2	10.6	160.2	160.2	155.4	135.7	116.0	96.3
5625	72	211.2	9.6	148.0	126.6	105.3	83.9	-	-	202.2	10.8	143.3	122.0	100.8	79.5	-	-
	67	199.9	9.7	179.4	156.7	135.4	114.0	92.7	-	187.8	10.8	174.5	153.2	131.9	110.7	89.4	-
	62	185.3	9.5	185.3	185.3	185.3	169.5	148.2	126.8	173.1	10.6	173.1	173.1	173.1	151.9	130.6	109.3
	57	172.0	9.5	172.0	172.0	169.8	148.5	127.1	105.8	164.0	10.6	164.0	164.0	161.6	140.3	119.1	97.8
6250	72	215.2	9.5	159.4	136.7	114.0	91.4	-	-	206.9	10.8	154.1	131.3	108.5	85.6	-	-
	67	203.6	9.7	194.6	169.4	146.7	124.0	101.4	-	192.2	10.8	187.7	164.9	142.0	119.2	96.4	-
	62	188.8	9.5	188.8	188.8	188.8	166.2	143.5	120.9	177.1	10.6	177.1	177.1	177.1	154.3	131.5	108.6
	57	175.3	9.4	175.3	175.3	175.3	152.6	130.0	107.3	167.8	10.6	167.8	167.8	167.8	145.0	122.1	99.3
		95°F								**105°F**							
3125	77	180.0	11.9	75.6	61.3	46.9	-	-	-	168.2	13.3	71.8	58.0	43.9	-	-	-
	72	165.1	11.8	99.3	85.0	70.6	56.3	-	-	153.8	13.2	95.1	81.0	66.9	52.8	-	-
	67	150.2	11.7	123.0	108.6	94.3	80.0	65.6	-	139.5	13.0	118.4	103.9	89.8	75.7	61.6	-
	62	137.5	11.5	137.5	133.0	114.6	100.2	85.9	71.5	127.9	12.9	127.9	125.7	110.1	96.0	81.9	67.8
3750	77	188.2	12.0	83.2	67.2	51.2	-	-	-	175.5	13.3	79.5	63.7	47.8	-	-	-
	72	172.7	11.9	109.0	93.0	77.0	60.9	-	-	160.6	13.2	104.5	88.6	72.8	56.9	-	-
	67	157.1	11.7	134.8	118.8	102.8	86.7	70.7	-	145.6	13.1	129.4	113.6	97.7	81.9	66.0	-
	62	143.8	11.6	143.8	140.8	124.8	108.8	92.8	76.8	133.5	12.9	133.5	132.1	119.8	104.0	88.1	72.2
	57	139.4	11.6	139.4	139.4	125.8	109.8	93.8	77.7	130.3	13.0	130.3	130.3	117.1	101.2	85.4	69.5
4375	77	196.5	12.0	90.7	73.0	55.4	-	-	-	182.9	13.4	87.3	69.3	51.7	-	-	-
	72	180.3	11.9	118.6	101.0	83.3	65.6	-	-	167.3	13.3	113.9	96.3	78.7	61.0	-	-
	67	164.0	11.8	146.6	128.9	111.2	93.5	75.8	-	151.8	13.1	140.5	123.3	105.6	88.0	70.4	-
	62	150.1	11.6	150.1	148.6	135.1	117.4	99.7	82.0	139.2	13.0	139.2	138.4	129.5	111.9	94.3	76.6
	57	145.5	11.7	145.5	145.5	136.1	118.4	100.7	83.1	135.7	13.0	135.7	135.7	126.6	109.0	91.3	73.7
5000	77	204.8	12.1	98.3	78.9	59.6	-	-	-	190.3	13.4	95.1	75.0	55.6	-	-	-
	72	187.8	12.0	128.3	109.0	89.6	70.2	-	-	174.1	13.3	123.3	104.0	84.6	65.2	-	-
	67	170.9	11.9	158.4	139.0	119.6	100.3	80.9	-	157.9	13.2	151.6	132.9	113.6	94.2	74.8	-
	62	156.4	11.7	156.4	156.4	145.3	126.0	106.6	87.2	144.8	13.0	144.8	144.8	139.2	119.8	100.4	81.1
	57	151.6	11.7	151.6	151.6	146.4	127.1	107.7	88.4	141.2	13.1	141.2	141.2	136.1	116.7	97.3	77.9
5625	72	193.2	12.0	138.6	117.4	96.2	75.1	-	-	178.5	13.3	133.3	112.3	91.2	70.2	-	-
	67	175.8	11.9	169.6	149.7	128.5	107.3	86.1	-	161.8	13.2	158.7	143.5	122.5	101.5	80.4	-
	62	160.9	11.7	160.9	160.9	155.4	134.2	113.0	91.8	148.4	13.0	148.4	148.4	145.6	124.6	103.5	82.5
	57	156.0	11.7	156.0	156.0	153.4	132.2	111.0	89.8	144.7	13.1	144.7	144.7	142.2	121.1	100.1	79.1
6250	72	198.6	12.0	148.9	125.9	102.9	79.9	-	-	182.8	13.3	143.3	120.6	97.9	75.2	-	-
	67	180.7	11.9	180.7	160.4	137.4	114.4	91.4	-	165.8	13.2	165.8	154.1	131.4	108.7	86.1	-
	62	165.4	11.7	165.4	165.4	165.4	142.4	119.4	96.4	152.0	13.0	152.0	152.0	152.0	129.3	106.6	84.0
	57	160.3	11.8	160.3	160.3	160.3	137.3	114.3	91.3	148.3	13.1	148.3	148.3	148.3	125.6	102.9	80.2

ZR150 (12.5 Ton) Cooling (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								**125°F**							
3125	77	156.3	14.6	67.9	54.8	40.9	-	-	-	144.5	16.0	60.9	51.5	37.9	-	-	-
	72	142.6	14.5	90.8	77.0	63.1	49.3	-	-	131.3	15.9	86.6	73.0	59.4	45.8	-	-
	67	128.8	14.4	113.7	99.1	85.3	71.5	57.6	-	118.1	15.7	110.3	94.4	80.8	67.2	53.6	-
	62	118.4	14.2	118.4	118.4	105.7	91.8	78.0	64.1	108.8	15.6	108.8	108.8	102.4	87.6	74.0	60.4
3750	77	162.8	14.7	75.9	60.2	44.5	-	-	-	150.2	16.0	72.3	56.7	41.2	-	-	-
	72	148.5	14.6	100.0	84.3	68.6	52.9	-	-	136.4	15.9	95.5	80.0	64.4	48.9	-	-
	67	134.1	14.4	124.1	108.4	92.7	77.0	61.3	-	122.7	15.8	118.8	103.2	87.7	72.1	56.6	-
	62	123.3	14.3	123.3	123.3	114.8	99.1	83.4	67.7	113.0	15.6	113.0	113.0	109.8	94.3	78.7	63.2
	57	121.1	14.3	121.1	121.1	108.4	92.7	77.0	61.3	112.0	15.7	112.0	112.0	99.7	84.2	68.6	53.1
4375	77	169.3	14.7	83.9	65.6	48.0	-	-	-	155.8	16.1	83.6	61.9	44.4	-	-	-
	72	154.4	14.6	109.2	91.6	74.1	56.5	-	-	141.5	16.0	104.5	87.0	69.5	52.0	-	-
	67	139.5	14.5	134.5	117.6	100.1	82.5	65.0	-	127.2	15.8	127.2	112.0	94.5	77.0	59.5	-
	62	128.2	14.3	128.2	128.2	124.0	106.4	88.8	71.3	117.3	15.7	117.3	117.3	117.3	100.9	83.4	65.9
	57	126.0	14.4	126.0	126.0	117.1	99.5	81.9	64.4	116.2	15.7	116.2	116.2	107.5	90.0	72.6	55.1
5000	77	175.8	14.8	91.9	71.0	51.6	-	-	-	161.4	16.2	95.0	67.0	47.6	-	-	-
	72	160.3	14.7	118.4	98.9	79.5	60.1	-	-	146.6	16.0	113.4	93.9	74.5	55.1	-	-
	67	144.9	14.5	144.9	126.9	107.5	88.1	68.6	-	131.8	15.9	131.8	120.8	101.4	82.0	62.5	-
	62	133.1	14.4	133.1	133.1	133.1	113.7	94.3	74.9	121.5	15.7	121.5	121.5	121.5	107.6	88.1	68.7
	57	130.8	14.4	130.8	130.8	125.7	106.3	86.9	67.5	120.4	15.8	120.4	120.4	115.4	95.9	76.5	57.0
5625	72	163.7	14.7	128.0	107.1	86.2	65.3	-	-	148.9	16.0	122.7	102.0	81.2	60.4	-	-
	67	147.9	14.5	147.9	137.4	116.5	95.6	74.7	-	133.9	15.9	133.9	131.3	110.5	89.7	69.0	-
	62	135.9	14.4	135.9	135.9	135.9	115.0	94.1	73.2	123.4	15.7	123.4	123.4	123.4	105.4	84.6	63.9
	57	133.5	14.4	133.5	133.5	131.0	110.1	89.2	68.3	122.3	15.8	122.3	122.3	119.8	99.0	78.3	57.5
6250	72	167.0	14.7	137.7	115.3	92.9	70.5	-	-	151.2	16.0	132.0	110.0	87.9	65.8	-	-
	67	150.9	14.5	150.9	147.9	125.5	103.1	80.7	-	135.9	15.8	135.9	135.9	119.6	97.5	75.4	-
	62	138.6	14.4	138.6	138.6	138.6	116.3	93.9	71.5	125.3	15.7	125.3	125.3	125.3	103.2	81.1	59.0
	57	136.2	14.4	136.2	136.2	136.2	113.9	91.5	69.1	124.2	15.7	124.2	124.2	124.2	102.1	80.0	58.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR150 (12.5 Ton) Reheat

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)				
				85	80	75	70	65			85	80	75	70	65
		35°F							**45°F**						
3125	72	87.0	7.7	6.6	4.8	3.1	-	-	85.9	8.3	5.6	3.9	2.2	-	-
	67	84.6	7.3	14.4	12.7	11.0	9.2	-	83.3	8.0	11.8	10.1	8.4	6.7	-
	62	82.9	7.3	20.3	18.6	16.9	15.2	13.5	80.8	7.7	17.7	16.0	14.3	12.6	10.9
3750	72	89.0	7.4	11.5	9.2	6.9	-	-	88.9	8.0	10.7	8.3	5.9	-	-
	67	86.5	7.1	26.3	24.0	21.7	19.5	-	86.2	7.7	24.1	21.7	19.3	17.0	-
	62	84.8	7.1	36.7	34.4	32.1	29.8	27.5	83.6	7.4	36.6	34.2	31.9	29.5	27.1
	57	82.2	7.7	43.1	40.9	38.6	36.3	34.0	79.1	8.2	40.8	38.4	36.0	33.7	31.3
4375	72	90.9	7.2	16.4	13.5	10.7	-	-	91.8	7.7	15.8	12.7	9.7	-	-
	67	88.4	6.9	38.3	35.4	32.5	29.7	-	89.1	7.4	36.3	33.3	30.2	27.2	-
	62	86.6	6.8	53.1	50.2	47.4	44.5	41.6	86.4	7.2	55.5	52.5	49.4	46.4	43.3
	57	84.0	7.4	63.2	60.0	57.1	54.2	51.4	81.8	7.9	61.9	58.9	55.8	52.8	49.7
5000	72	92.8	6.9	21.3	17.9	14.4	-	-	94.8	7.4	20.9	17.2	13.4	-	-
	67	90.3	6.6	50.2	46.8	43.3	39.9	-	91.9	7.1	48.6	44.9	41.1	37.4	-
	62	88.5	6.6	69.5	66.0	62.6	59.1	55.7	89.2	6.9	74.5	70.7	67.0	63.3	59.5
	57	85.9	7.1	83.2	79.1	75.6	72.2	68.7	84.4	7.6	83.1	79.4	75.6	71.9	68.2
5625	72	94.1	7.5	15.2	12.5	9.9	-	-	96.7	7.8	16.3	13.1	9.9	-	-
	67	91.5	7.1	35.5	32.8	30.2	27.5	-	93.8	7.6	37.4	34.2	31.0	27.8	-
	62	89.7	7.1	48.0	45.4	42.7	40.1	37.4	91.0	7.3	57.1	53.9	50.7	47.5	44.3
	57	87.1	7.7	58.0	55.0	52.4	49.7	47.1	86.1	8.0	63.7	60.5	57.3	54.1	50.8
6250	72	95.4	8.0	9.1	7.2	5.4	-	-	98.6	8.3	11.7	9.0	6.3	-	-
	67	92.8	7.7	20.7	18.9	17.0	15.2	-	95.6	8.0	26.2	23.5	20.8	18.1	-
	62	91.0	7.6	26.6	24.7	22.9	21.0	19.2	92.8	7.8	39.8	37.1	34.4	31.7	29.0
	57	88.3	8.3	32.9	31.0	29.2	27.3	25.5	87.8	8.5	44.3	41.6	38.9	36.2	33.5
		55°F							**65°F**						
3125	72	84.8	8.9	4.6	2.9	1.2	-	-	84.2	9.3	-	-	-	-	-
	67	81.9	8.7	9.3	7.6	5.9	4.2	-	79.1	8.9	10.4	8.9	7.3	5.8	-
	62	78.7	8.2	15.1	13.4	11.7	10.0	8.3	74.6	8.4	24.9	23.4	21.8	20.3	18.7
3750	72	88.8	8.6	9.9	7.4	5.0	-	-	87.3	9.2	-	-	-	-	-
	67	85.8	8.3	21.9	19.4	16.9	14.5	-	82.0	8.8	18.2	16.0	13.9	11.8	-
	62	82.5	7.8	36.5	34.1	31.6	29.1	26.7	77.4	8.3	40.0	37.9	35.8	33.7	31.5
	57	76.1	8.7	38.4	36.0	33.5	31.0	28.6	72.6	9.0	44.1	42.0	39.9	37.8	35.6
4375	72	92.8	8.2	15.2	11.9	8.7	-	-	90.4	9.1	-	-	-	-	-
	67	89.7	8.0	34.4	31.2	27.9	24.7	-	85.0	8.7	25.9	23.2	20.5	17.8	-
	62	86.2	7.5	58.0	54.7	51.5	48.3	45.0	80.2	8.2	55.1	52.4	49.8	47.1	44.4
	57	79.5	8.3	60.7	57.8	54.6	51.3	48.1	75.2	8.9	60.3	57.7	55.1	52.4	49.7
5000	72	96.8	7.8	20.5	16.5	12.4	-	-	93.5	9.0	1.1	-	-	-	-
	67	93.6	7.6	47.0	42.9	38.9	34.9	-	87.9	8.6	33.6	30.4	27.1	23.8	-
	62	89.9	7.1	79.4	75.4	71.4	67.4	63.4	83.0	8.1	70.3	67.0	63.7	60.4	57.2
	57	83.0	8.0	83.0	79.6	75.6	71.6	67.6	77.8	8.8	76.4	73.5	70.2	66.9	63.7
5625	72	99.3	8.2	17.4	13.6	9.8	-	-	97.7	9.2	-	-	-	-	-
	67	96.0	8.0	39.3	35.5	31.8	28.0	-	91.8	8.8	31.7	28.3	25.0	21.6	-
	62	92.2	7.5	66.2	62.4	58.7	54.9	51.1	86.6	8.3	69.4	66.0	62.6	59.3	55.9
	57	85.1	8.4	69.3	65.9	62.1	58.4	54.6	81.2	9.0	72.7	70.3	66.9	63.6	60.2
6250	72	101.8	8.6	14.3	10.8	7.3	-	-	101.9	9.5	-	-	-	-	-
	67	98.4	8.4	31.7	28.1	24.6	21.1	-	95.7	9.1	29.8	26.3	22.8	19.4	-
	62	94.6	7.9	53.0	49.4	45.9	42.4	38.8	90.3	8.6	68.5	65.0	61.6	58.1	54.6
	57	87.2	8.8	55.7	52.2	48.7	45.1	41.6	84.7	9.3	68.9	67.1	63.7	60.2	56.8

ZR150 (12.5 Ton) Reheat (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)				
CFM	WB (°F)			85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
3125	72	83.6	9.7	-	-	-	-	-	83.0	10.2	-	-	-	-	-
	67	76.2	9.2	11.5	10.1	8.7	7.3	-	73.4	9.4	12.6	11.4	10.1	8.8	-
	62	70.5	8.7	34.8	33.4	32.0	30.6	29.2	66.4	8.9	44.7	43.4	42.1	40.9	39.6
3750	72	85.8	9.9	-	-	-	-	-	84.3	10.5	-	-	-	-	-
	67	78.2	9.3	14.5	12.7	10.9	9.1	-	74.4	9.7	10.8	9.3	7.9	6.4	-
	62	72.3	8.8	43.6	41.8	40.0	38.2	36.4	67.3	9.3	47.1	45.6	44.2	42.7	41.3
	57	69.0	9.3	49.8	48.1	46.3	44.5	42.7	65.5	9.7	55.5	54.1	52.7	51.2	49.8
4375	72	88.0	10.0	-	-	-	-	-	85.5	10.9	-	-	-	-	-
	67	80.2	9.4	17.4	15.2	13.1	10.9	-	75.5	10.1	8.9	7.2	5.6	4.0	-
	62	74.2	8.9	52.3	50.2	48.0	45.8	43.7	68.2	9.6	49.5	47.9	46.2	44.6	43.0
	57	70.8	9.5	59.9	57.7	55.5	53.4	51.2	66.4	10.0	59.4	57.6	56.0	54.4	52.8
5000	72	90.1	10.1	-	-	-	-	-	86.8	11.3	-	-	-	-	-
	67	82.2	9.5	20.3	17.8	15.2	12.7	-	76.5	10.5	7.0	5.2	3.4	1.6	-
	62	76.0	9.0	61.1	58.5	56.0	53.5	50.9	69.1	10.0	51.9	50.1	48.3	46.5	44.7
	57	72.6	9.6	69.9	67.3	64.8	62.3	59.7	67.4	10.4	63.3	61.2	59.4	57.6	55.8
5625	72	96.1	10.3	-	-	-	-	-	94.4	11.3	-	-	-	-	-
	67	87.6	9.6	24.1	21.1	18.1	15.2	-	83.4	10.5	16.4	13.9	11.3	8.8	-
	62	81.0	9.1	72.5	69.6	66.6	63.7	60.7	75.4	9.9	75.4	73.1	70.6	68.0	65.5
	57	77.3	9.7	76.0	74.7	71.8	68.8	65.8	73.4	10.4	73.4	73.4	73.4	73.4	71.5
6250	72	102.0	10.4	-	-	-	-	-	102.0	11.3	-	-	-	-	-
	67	93.0	9.8	27.8	24.5	21.1	17.7	-	90.3	10.4	25.9	22.6	19.3	16.0	-
	62	86.0	9.2	84.0	80.6	77.2	73.8	70.5	81.7	9.9	81.7	81.7	81.7	81.7	81.7
	57	82.1	9.8	82.1	82.1	78.7	75.3	71.9	79.5	10.3	79.5	79.5	79.5	79.5	79.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

Drive Selection

1. Determine side or bottom supply duct Application.
2. Determine desired airflow.
3. Calculate or measure the amount of external static pressure.
   - Add or deduct any additional static resistance from “Additional Static Resistance Table”.
4. Using the operating point determined from steps 1, 2 & 3, locate this point on the appropriate supply air blower performance table. (Linear interpolation may be necessary.)
5. Noting the RPM and BHP from step 4, locate the appropriate motor and, or drive on the RPM selection table.
6. Review the BHP compared to the motor options available. Select the appropriate motor and, or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine turns open to obtain the desired operation point.

Example

1. 2600 CFM
2. 1.6 iwg
3. Using the supply air blower performance table below, the following data point was located: 1268 RPM & 1.95 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 1.95 BHP exceeds the maximum continuous BHP rating of the 1.5 HP motor. The 2 HP motor is required.
6. 1268 RPM is within the range of the 2 HP drives.
7. Using the 2 HP motor and drive, .5 turns open will achieve 1268 RPM.

Airflow Performance

Example Supply Air Blower Performance

Air Flow (CFM)	Available External Static Pressure - IWG																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive								Standard 1.5 HP & Drive						Alternate 2 HP & Drive					
2200	804	0.50	866	0.71	925	0.90	982	1.06	1038	1.21	1092	1.35	1147	1.48	1203	1.61	1259	1.73	1317	1.87
2400	835	0.66	897	0.87	956	1.06	1013	1.22	1069	1.37	1124	1.51	1178	1.64	1234	1.77	1290	1.90	1348	2.03
2600	869	0.84	931	1.05	990	1.24	1047	1.40	1103	1.55	1158	1.69	1212	1.82	1268	1.95	1324	2.07	1382	2.21
2800	906	1.03	968	1.25	1027	1.43	1084	1.60	1139	1.75	1194	1.89	1249	2.02	1304	2.14	1361	2.27	-	-

Example RPM Selection

Size (Tons)	Model	Airflow Option	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
X	Y	Std.	1.5	1.73	1VM50	AK74	N/A	897	945	991	1035	1079	1126
		H. Static	2	2.30	1VM50	AK64	N/A	1039	1094	1150	1207	1256	1308

Example Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only	Economizer	4” Pleated Filter	Electric Heat kW					
						3	6	9	15	20	24
X	Y	900	0.05	-0.05	0.01	0.00	0.00	0.00	0.01	0.01	0.01
		1000	0.05	-0.03	0.02	0.00	0.00	0.00	0.02	0.02	0.02
		1100	0.04	-0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02
		1200	0.04	0.00	0.04	0.01	0.01	0.01	0.02	0.02	0.02
		1300	0.03	0.01	0.05	0.01	0.01	0.01	0.03	0.03	0.03

Altitude and Temperature Correction for CFM, Static Pressure and Power.

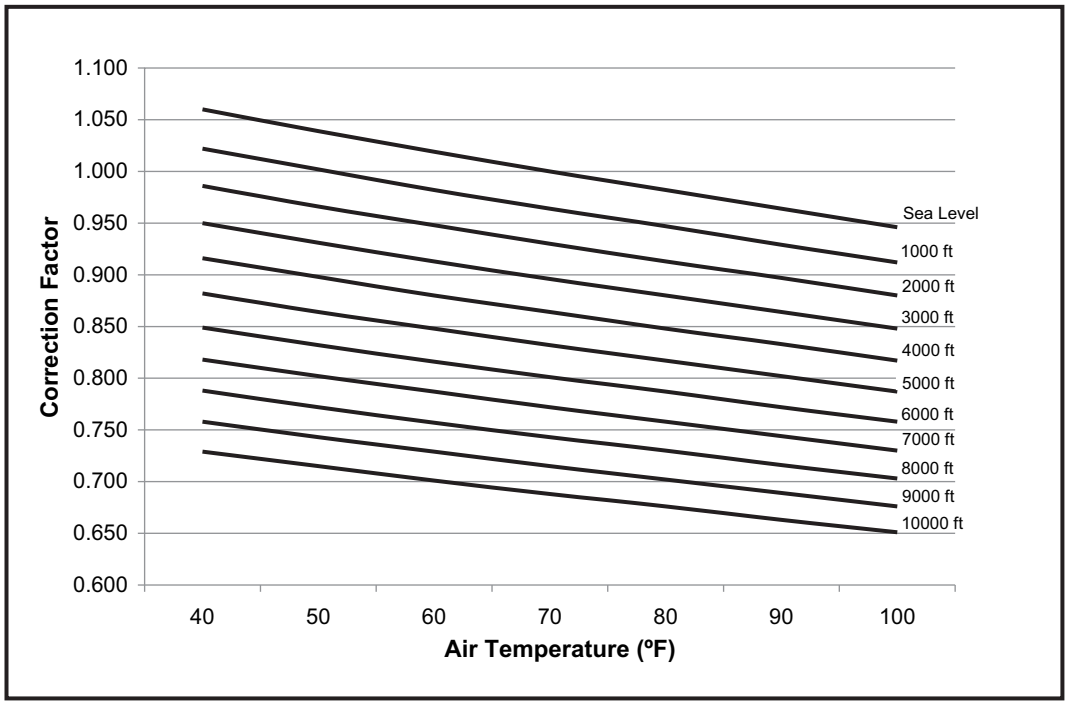
The information below should be used to assist in application of product when being applied at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a "constant volume" device. This means that, if the rpm remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure will be generated and less power will be required than a similar application at sea level. Air density correction factors are shown in Table **Altitude/ Temperature Correction Factors** and following Figure.

Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651



The examples below will assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the rpm is unchanged. However, **Airflow Performance Table** must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. **Altitude/Temperature Correction Factors Table** shows the correction factor to be 0.832.

Corrected static pressure = 1.5 x 0.832 = 1.248 IWC
Corrected BHP = 4.0 x 0.832 = 3.328

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5". Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5" static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 1.5 / .832 = 1.80"

Enter the blower table at 6000 CFM and static pressure of 1.8". The rpm listed will be the same rpm needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

BHP at 5,000 ft. = 3.2 x .832 = 2.66

Indoor Blower Specifications

Size (Tons)	Model	Airflow Option	Motor					Motor Sheave			Blower Sheave			Belt
			HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
037 (3)	ZH	Std.	1-1/2	1725	0.8	1.15	56	2.0 - 3.0	7/8	1VM34	6.5	1	AK69	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	6.5	1	AK69	A47
049 (4)	ZH	Std.	1-1/2	1725	0.8	1.15	56	2.0 - 3.0	7/8	1VM34	5.2	1	AK56	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	5.2	1	AK56	A47
061 (5)	ZH	Std.	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	5.7	1	AK61	A47
		H. Static	2	1725	0.8	1.15	56	4.2 - 5.2	7/8	1VP56	7.0	1	AK74	A51
078 (6.5)	ZH	Std.	1-1/2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A49
		H. Static	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	6.0	1	AK64	A49
090 (7.5)	ZH	Std.	1-1/2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A49
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	5.7	1	AK61	A49
102 (8.5)	ZH	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	9.0	1	AK94	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
120 (10)	ZH	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	ZH	Std.	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		H. Static	5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX55
037 (3)	ZJ	Std.	1-1/2	1725	0.8	1.15	56	2.0 - 3.0	7/8	1VM34	6.5	1	AK69	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	6.5	1	AK69	A47
049 (4)	ZJ	Std.	1-1/2	1725	0.8	1.15	56	2.0 - 3.0	7/8	1VM34	5.2	1	AK56	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	5.2	1	AK56	A47
061 (5)	ZJ	Std.	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	5.7	1	AK61	A47
		H. Static	2	1725	0.8	1.15	56	4.2 - 5.2	7/8	1VP56	7.0	1	AK74	A51
078 (6.5)	ZJ	Std.	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	7.0	1	AK74	A53
		H. Static	2	1725	0.8	1.15	56	3.6 - 4.6	7/8	1VM50	7.0	1	AK74	A54
090 (7.5)	ZJ	Std.	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	6.5	1	AK69	A52
		H. Static	3	1725	0.8	1.15	56	3.6 - 4.6	7/8	1VM50	6.5	1	AK69	A54
102 (8.5)	ZJ	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.5	1	AK89	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
120 (10)	ZJ	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	ZJ	Std.	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		H. Static	5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX55
037 (3)	ZR	Std.	1-1/2	1725	0.8	1.15	56	1.2 - 2.9	7/8	1VP34	5.7	1	AK61	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	5.5	1	AK59	A47
049 (4)	ZR	Std.	1-1/2	1725	0.8	1.15	56	1.2 - 2.9	7/8	1VP34	5.7	1	AK61	A47
		H. Static	1-1/2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	5.5	1	AK59	A47
061 (5)	ZR	Std.	1-1/2	1725	0.8	1.15	56	1.2 - 2.9	7/8	1VP34	5.7	1	AK61	A47
		H. Static	2	1725	0.8	1.15	56	3.0 - 4.0	7/8	1VL44	5.5	1	AK59	A47
078 (6.5)	ZR	Std.	1-1/2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A49
		H. Static	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	6.0	1	AK64	A49
090 (7.5)	ZR	Std.	1-1/2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A49
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	5.7	1	AK61	A49
102 (8.5)	ZR	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.5	1	AK89	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
120 (10)	ZR	Std.	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		H. Static	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	ZR	Std.	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		H. Static	5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX55

Power Exhaust Specifications

Model	Voltage	Motor			Motor			Fuse Size	CFM @ 0.1 ESP
		HP	RPM[1]	QTY	LRA	FLA	MCA		
2PE04703225	208/230-1-60	3/4	1075	1	7.8	5	6.3	10	3800
2PE04703246	460-1-60	3/4	1075	1	3.4	2.2	2.8	5	3800
2PE04703258	575-1-60	3/4	1050	1	2.9	1.5	1.9	4	3800

1. Motors are multi-tapped and factory wired for high speed.

RPM Selection

Size (Tons)	Model	Airflow Option	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
037 (3)	ZH	Std.	1.5	1.5	1VM34	AK69	N/A	531	584	637	690	743	796
		H. Static	1.5	1.5	1VL44	AK69	N/A	796	849	902	955	1008	1062
049 (4)	ZH	Std.	1.5	1.5	1VM34	AK56	N/A	663	730	796	863	929	995
		H. Static	1.5	1.5	1VL44	AK56	N/A	995	1062	1128	1194	1261	1327
061 (5)	ZH	Std.	1.5	1.5	1VL40	AK61	N/A	787	847	908	968	1029	1089
		H. Static	2	2	1VP56	AK74	N/A	1035	1084	1134	1183	1232	1281
078 (6.5)	ZH	Std.	1.5	1.73	1VM50	AK74	N/A	887	936	986	1035	1084	1134
		H. Static	2	2.30	1VM50	AK64	N/A	1039	1094	1150	1207	1256	1308
090 (7.5)	ZH	Std.	1.5	1.73	1VM50	AK74	N/A	887	936	986	1035	1084	1134
		H. Static	3	3.45	1VM50	AK61	N/A	1088	1147	1205	1265	1312	1365
102 (8.5)	ZH	Std.	2	2.30	1VM50	AK94	N/A	690	728	767	805	843	882
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
120 (10)	ZH	Std.	2	2.30	1VM50	AK84	N/A	776	819	863	906	949	992
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
150 (12.5)	ZH	Std.	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
		H. Static	5	5.75	1VP56	BK77	1052	1095	1136	1175	1216	1272	N/A
037 (3)	ZJ	Std.	1.5	1.5	1VM34	AK69	N/A	531	584	637	690	743	796
		H. Static	1.5	1.5	1VL44	AK69	N/A	796	849	902	955	1008	1062
049 (4)	ZJ	Std.	1.5	1.5	1VM34	AK56	N/A	663	730	796	863	929	995
		H. Static	1.5	1.5	1VL44	AK56	N/A	995	1062	1128	1194	1261	1327
061 (5)	ZJ	Std.	1.5	1.5	1VL40	AK61	N/A	787	847	908	968	1029	1089
		H. Static	2	2	1VP56	AK74	N/A	1035	1084	1134	1183	1232	1281
078 (6.5)	ZJ	Std.	1.5	1.73	1VL40	AK74	N/A	641	690	739	789	838	887
		H. Static	2	2.30	1VM50	AK74	N/A	887	936	986	1035	1084	1134
090 (7.5)	ZJ	Std.	1.5	1.73	1VL40	AK69	N/A	690	743	796	849	902	955
		H. Static	3	3.45	1VM50	AK69	N/A	955	1008	1062	1115	1168	1221
102 (8.5)	ZJ	Std.	2	2.30	1VM50	AK89	N/A	731	771	812	852	893	934
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
120 (10)	ZJ	Std.	2	2.30	1VM50	AK84	N/A	776	819	863	906	949	992
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
150 (12.5)	ZJ	Std.	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
		H. Static	5	5.75	1VP56	BK77	1052	1095	1136	1175	1216	1272	N/A
037 (3.0)	ZR	Std.	1.5	1.5	1VP34	AK61	N/A	575	636	696	757	817	878
		H. Static	1.5	1.5	1VL44	AK59	N/A	878	941	1004	1066	1129	1192
049 (4.0)	ZR	Std.	1.5	1.5	1VP34	AK61	N/A	575	636	696	757	817	878
		H. Static	1.5	1.5	1VL44	AK59	N/A	878	941	1004	1066	1129	1192
061 (5.0)	ZR	Std.	1.5	1.5	1VP34	AK61	N/A	575	636	696	757	817	878
		H. Static	2	2	1VL44	AK59	N/A	878	941	1004	1066	1129	1192
078 (6.5)	ZR	Std.	1.5	1.73	1VM50	AK74	N/A	897	945	991	1035	1079	1126
		H. Static	2	2.30	1VM50	AK64	N/A	1039	1094	1150	1207	1256	1308
090 (7.5)	ZR	Std.	1.5	1.73	1VM50	AK74	N/A	897	945	991	1035	1079	1126
		H. Static	3	3.45	1VM50	AK61	N/A	1088	1147	1205	1265	1312	1365
102 (8.5)	ZR	Std.	2	2.30	1VM50	AK89	N/A	735	775	815	851	889	930
		H. Static	3	3.45	1VM50	AK74	N/A	880	928	972	1016	1067	1110
120 (10)	ZR	Std.	2	2.30	1VM50	AK84	N/A	785	821	858	901	940	980
		H. Static	3	3.45	1VM50	AK74	N/A	880	928	972	1016	1067	1110
150 (12.5)	ZR	Std.	3	3.45	1VM50	AK74	N/A	880	928	972	1016	1067	1110
		H. Static	5	5.75	1VP56	BK77	1052	1095	1136	1175	1216	1272	N/A

Additional Static Resistance - ZH037 thru 061

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	4" Pleated Filter[2]	Electric Heat kW[2]					
						3	6	9	15	20	24
037 (3) 049 (4)	ZH	900	0.05	-0.05	0.01	0.00	0.00	0.00	0.01	0.01	0.01
		1000	0.05	-0.03	0.02	0.00	0.00	0.00	0.02	0.02	0.02
		1100	0.04	-0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02
		1200	0.04	0.00	0.04	0.01	0.01	0.01	0.02	0.02	0.02
		1300	0.03	0.01	0.05	0.01	0.01	0.01	0.03	0.03	0.03
		1400	0.03	0.03	0.07	0.02	0.02	0.02	0.03	0.03	0.03
		1500	0.03	0.04	0.08	0.02	0.02	0.02	0.04	0.04	0.04
		1600	0.02	0.06	0.09	0.02	0.02	0.02	0.04	0.04	0.04
		1700	0.02	0.07	0.10	0.03	0.03	0.03	0.05	0.05	0.05
		1800	0.01	0.08	0.11	0.03	0.03	0.03	0.05	0.05	0.05
		1900	0.01	0.10	0.13	0.04	0.04	0.04	0.06	0.06	0.06
		2000	0.00	0.11	0.14	0.04	0.04	0.04	0.07	0.07	0.07
061 (5)	ZH	1500	-0.01	0.13	0.07	0.02	0.02	0.02	0.04	0.04	0.04
		1600	-0.01	0.14	0.08	0.02	0.02	0.02	0.04	0.04	0.04
		1700	-0.01	0.15	0.08	0.03	0.03	0.03	0.05	0.05	0.05
		1800	-0.02	0.16	0.09	0.03	0.03	0.03	0.05	0.05	0.05
		1900	-0.02	0.17	0.10	0.04	0.04	0.04	0.06	0.06	0.06
		2000	-0.02	0.18	0.10	0.04	0.04	0.04	0.07	0.07	0.07
		2100	-0.03	0.19	0.11	0.05	0.05	0.05	0.07	0.07	0.07
		2200	-0.03	0.20	0.12	0.06	0.06	0.06	0.08	0.08	0.08
		2300	-0.04	0.21	0.12	0.06	0.06	0.06	0.09	0.09	0.09
		2400	-0.04	0.22	0.13	0.07	0.07	0.07	0.10	0.10	0.10
		2500	-0.05	0.23	0.14	0.08	0.08	0.08	0.11	0.11	0.11

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Additional Static Resistance - ZJ/ZR037 thru 061

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	4" Pleated Filter[2]	Electric Heat kW[2]					
						3	6	9	15	20	24
037 (3)	ZJ/ZR	900	0.05	-0.05	0.01	0.00	0.00	0.00	0.01	0.01	0.01
		1000	0.05	-0.03	0.02	0.00	0.00	0.00	0.02	0.02	0.02
		1100	0.04	-0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02
		1200	0.04	0.00	0.04	0.01	0.01	0.01	0.02	0.02	0.02
		1300	0.03	0.01	0.05	0.01	0.01	0.01	0.03	0.03	0.03
		1400	0.03	0.03	0.07	0.02	0.02	0.02	0.03	0.03	0.03
		1500	0.03	0.04	0.08	0.02	0.02	0.02	0.04	0.04	0.04
049 (4) 061 (5)	ZJ/ZR	1200	-0.01	0.10	0.05	0.01	0.01	0.01	0.02	0.02	0.02
		1300	-0.01	0.11	0.06	0.01	0.01	0.01	0.03	0.03	0.03
		1400	-0.01	0.12	0.06	0.02	0.02	0.02	0.03	0.03	0.03
		1500	-0.01	0.13	0.07	0.02	0.02	0.02	0.04	0.04	0.04
		1600	-0.01	0.14	0.08	0.02	0.02	0.02	0.04	0.04	0.04
		1700	-0.01	0.15	0.08	0.03	0.03	0.03	0.05	0.05	0.05
		1800	-0.02	0.16	0.09	0.03	0.03	0.03	0.05	0.05	0.05
		1900	-0.02	0.17	0.10	0.04	0.04	0.04	0.06	0.06	0.06
		2000	-0.02	0.18	0.10	0.04	0.04	0.04	0.07	0.07	0.07
		2100	-0.03	0.19	0.11	0.05	0.05	0.05	0.07	0.07	0.07
		2200	-0.03	0.20	0.12	0.06	0.06	0.06	0.08	0.08	0.08
		2300	-0.04	0.21	0.12	0.06	0.06	0.06	0.09	0.09	0.09
		2400	-0.04	0.22	0.13	0.07	0.07	0.07	0.10	0.10	0.10
		2500	-0.05	0.23	0.14	0.08	0.08	0.08	0.11	0.11	0.11

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Additional Static Resistance - ZH/ZR078 thru 150

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	4" Filter[2]	Electric Heat kW[2]				
						09	18	24	36	54
078 (6.5) 090 (7.5)	ZHZR	1900	0.00	0.07	0.10	0.05	0.06	0.07	0.08	0.10
		2100	-0.01	0.09	0.11	0.06	0.07	0.08	0.09	0.11
		2300	-0.01	0.11	0.12	0.07	0.08	0.09	0.10	0.13
		2500	-0.02	0.13	0.14	0.08	0.09	0.10	0.11	0.14
		2700	-0.03	0.16	0.15	0.09	0.10	0.12	0.13	0.16
		2900	-0.04	0.18	0.16	0.10	0.11	0.13	0.14	0.18
		3100	-0.05	0.20	0.18	0.12	0.13	0.15	0.16	0.20
		3300	-0.06	0.22	0.19	0.13	0.14	0.17	0.18	0.22
		3500	-0.07	0.24	0.20	0.15	0.16	0.19	0.20	0.24
		3700	-0.08	0.27	0.21	0.17	0.18	0.21	0.22	0.26
		3900	-0.09	0.29	0.23	0.19	0.20	0.23	0.24	0.28
		4100	-0.09	0.31	0.24	0.21	0.22	0.25	0.26	0.31
		4300	-0.10	0.30	0.25	0.23	0.24	0.28	0.29	0.34
		4500	-0.11	0.35	0.26	0.25	0.26	0.30	0.31	0.37
102 (8.5) 120 (10) 150 (12.5)	ZH/ZR	1900	0.06	0.02	0.12	0.05	0.06	0.07	0.08	0.10
		2100	0.07	0.02	0.13	0.06	0.07	0.08	0.09	0.11
		2300	0.08	0.04	0.14	0.07	0.08	0.09	0.10	0.13
		2500	0.09	0.11	0.16	0.08	0.09	0.10	0.11	0.14
		2700	0.11	0.18	0.17	0.09	0.10	0.12	0.13	0.16
		2900	0.12	0.25	0.19	0.10	0.11	0.13	0.14	0.18
		3100	0.14	0.31	0.20	0.12	0.13	0.15	0.16	0.20
		3300	0.16	0.37	0.22	0.13	0.14	0.17	0.18	0.22
		3500	0.18	0.43	0.25	0.15	0.16	0.19	0.20	0.24
		3700	0.20	0.49	0.27	0.17	0.18	0.21	0.22	0.26
		3900	0.23	0.54	0.29	0.19	0.20	0.23	0.24	0.28
		4100	0.25	0.58	0.32	0.21	0.22	0.25	0.26	0.31
		4300	0.28	0.65	0.35	0.23	0.24	0.28	0.29	0.34
		4500	0.30	0.69	0.38	0.25	0.26	0.30	0.31	0.37
		4700	0.33	0.74	0.41	0.28	0.29	0.33	0.34	0.40
		4900	0.36	0.78	0.44	0.30	0.31	0.35	0.37	0.43
		5100	0.39	0.82	0.47	0.33	0.34	0.38	0.40	0.46
		5300	0.42	0.86	0.51	0.35	0.37	0.41	0.43	0.49
		5500	0.45	0.89	0.56	0.38	0.40	0.44	0.46	0.53
		5700	0.48	0.93	0.58	0.41	0.43	0.47	0.49	0.56
		5900	0.52	0.96	0.62	0.44	0.46	0.50	0.53	0.59
		6100	0.56	0.98	0.67	0.47	0.49	0.53	0.56	0.62
		6300	0.60	1.01	0.71	0.50	0.53	0.56	0.59	0.65

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Additional Static Resistance - ZJ078-150

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2,3]	4" Filter[2]	Electric Heat kW[2]				
						9	18	24	36	54
078 (6.5) 090 (7.5) 102 (8.5) 120 (10) 150 (12.5)	ZJ	1900	0.06	0.02	0.12	0.05	0.06	0.07	0.08	0.10
		2100	0.07	0.02	0.13	0.06	0.07	0.08	0.09	0.11
		2300	0.08	0.04	0.14	0.07	0.08	0.09	0.10	0.13
		2500	0.09	0.11	0.16	0.08	0.09	0.10	0.11	0.14
		2700	0.11	0.18	0.17	0.09	0.10	0.12	0.13	0.16
		2900	0.12	0.25	0.19	0.10	0.11	0.13	0.14	0.18
		3100	0.14	0.31	0.20	0.12	0.13	0.15	0.16	0.20
		3300	0.16	0.37	0.22	0.13	0.14	0.17	0.18	0.22
		3500	0.18	0.43	0.26	0.15	0.16	0.19	0.20	0.24
		3700	0.20	0.49	0.27	0.17	0.18	0.21	0.22	0.26
		3900	0.23	0.54	0.29	0.19	0.20	0.23	0.24	0.28
		4100	0.25	0.58	0.32	0.21	0.22	0.25	0.26	0.31
		4300	0.28	0.65	0.35	0.23	0.24	0.28	0.29	0.34
		4500	0.30	0.69	0.38	0.25	0.26	0.30	0.31	0.37
		4700	0.33	0.74	0.41	0.28	0.29	0.33	0.34	0.40
		4900	0.36	0.78	0.44	0.30	0.31	0.35	0.37	0.43
		5100	0.39	0.82	0.47	0.33	0.34	0.38	0.40	0.46
		5300	0.42	0.86	0.51	0.35	0.37	0.41	0.43	0.49
		5500	0.45	0.89	0.55	0.38	0.40	0.44	0.46	0.53
		5700	0.48	0.93	0.58	0.41	0.43	0.47	0.49	0.56
		5900	0.52	0.96	0.62	0.44	0.46	0.50	0.53	0.59
		6100	0.56	0.98	0.67	0.47	0.49	0.53	0.56	0.62
		6300	0.60	1.01	0.71	0.50	0.53	0.56	0.59	0.65

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Gas Heat Minimum Supply Air

Size (Tons)	Model	Heat Size	Supply Air (CFM) Heating	
			Min	Max
037 (3)	ZH/ZJ/ZR	H06 / N06	890	2220
		H08 / N08	915	2370
		H12 / N12	1130	1800
049 (4)	ZH/ZJ/ZR	H06 / N06	890	2220
		H08 / N08	915	2370
		H12 / N12	1290	2250
061 (5)	ZH/ZJ/ZR	H08 / N08	915	2370
		H12 / N12	1380	2570
		H16 / N16	1580	2630
078 (6.5)	ZH/ZJ/ZR	N12	1950	3250
		N18	1950	3250
090 (7.5)	ZH/ZJ/ZR	N12	2250	3750
		N18	2250	3750
102 (8.5)	ZH/ZJ/ZR	N12	2550	4250
		N18	2550	4250
120 (10)	ZH/ZJ/ZR	N18	3000	5000
		N24	3000	5000
150 (12.5)	ZH/ZJ/ZR	N18	3750	6250
		N24	3750	6250

Electric Heat Minimum Supply Air

3 thru 5 Tons

Size (Tons)	Model	Voltage	Minimum Supply Air (CFM) Heater kW					
			3	6	9	15	20	24
037 (3)	ZH/ZJ/ZR	208/230-3-60	960	960	1020	1020	-	-
		460-3-60	980	960	960	960	-	-
		600-3-60	-	-	960	960	-	-
049 (4)	ZH/ZJ/ZR	208/230-3-60	-	1280	1420	1420	1420	-
		460-3-60	-	1400	1400	1400	1400	-
		600-3-60	-	-	1400	1400	1400	-
061 (5)	ZH/ZJ/ZR	208/230-3-60	-	1600	1600	1600	1600	1600
		460-3-60	-	1600	1600	1600	1600	1600
		600-3-60	-	-	1600	1600	1600	1600

6-1/2 thru 12-1/5 Tons

Size (Tons)	Model	Voltage	Minimum Supply Air (CFM) Heater kW				
			9	18	24	36	54
078 (6.5)	ZH/ZJ/ZR	208/230-3-60	1950	1950	1950	1950	-
		460-3-60	1950	1950	1950	1950	-
		600-3-60	1950	1950	1950	1950	-
090 (7.5)	ZH/ZJ/ZR	208/230-3-60	2250	2250	2250	2250	-
		460-3-60	2250	2250	2250	2250	-
		600-3-60	2250	2250	2250	2250	-
102 (8.5)	ZH/ZJ/ZR	208/230-3-60	2550	2550	2550	2550	-
		460-3-60	2550	2550	2550	2550	-
		600-3-60	2550	2550	2550	2550	-
120 (10)	ZH/ZJ/ZR	208/230-3-60	-	3000	3000	3000	3500
		460-3-60	-	3000	3000	3000	3000
		600-3-60	-	3000	3000	3000	3500
150 (12.5)	ZH/ZJ/ZR	208/230-3-60	-	3750	3750	3750	4000
		460-3-60	-	3750	3750	3750	3750
		600-3-60	-	3750	3750	3750	3750

Airflow Performance

ZH037-150 Side Duct Application

ZH037 (3.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive								Hi Static 1.5 HP & Drive											
900	560	0.29	628	0.35	695	0.42	760	0.51	823	0.61	886	0.72	949	0.82	1011	0.92	1073	1.01	1136	1.09
1000	582	0.29	650	0.34	716	0.42	781	0.51	845	0.61	908	0.71	970	0.82	1032	0.92	1095	1.01	1158	1.08
1100	601	0.30	670	0.35	736	0.43	801	0.52	864	0.62	927	0.72	990	0.83	1052	0.93	1114	1.02	1177	1.09
1200	620	0.32	688	0.37	754	0.45	819	0.54	883	0.64	946	0.74	1008	0.85	1070	0.95	1133	1.04	1196	1.11
1300	638	0.35	706	0.40	772	0.48	837	0.57	901	0.67	964	0.77	1026	0.88	1088	0.98	1151	1.06	1214	1.14
1400	655	0.39	724	0.44	790	0.51	855	0.60	918	0.70	981	0.81	1044	0.91	1106	1.01	1168	1.10	1231	1.18
1500	673	0.43	741	0.48	807	0.56	872	0.65	936	0.75	999	0.85	1061	0.96	1124	1.06	1186	1.15	1249	1.22
															1.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH049 (4.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive										Hi Static 1.5 HP & Drive							
1200	620	0.32	688	0.37	754	0.45	819	0.54	883	0.64	946	0.74	1008	0.85	1070	0.95	1133	1.04	1196	1.11
1300	638	0.35	706	0.40	772	0.48	837	0.57	901	0.67	964	0.77	1026	0.88	1088	0.98	1151	1.06	1214	1.14
1400	655	0.39	724	0.44	790	0.51	855	0.60	918	0.70	981	0.81	1044	0.91	1106	1.01	1168	1.10	1231	1.18
1500	673	0.43	741	0.48	807	0.56	872	0.65	936	0.75	999	0.85	1061	0.96	1124	1.06	1186	1.15	1249	1.22
1600	691	0.48	759	0.54	825	0.61	890	0.70	954	0.80	1017	0.90	1079	1.01	1141	1.11	1204	1.20	1267	1.27
1700	709	0.54	777	0.59	843	0.67	908	0.76	972	0.86	1035	0.96	1097	1.07	1160	1.17	1222	1.26	1285	1.33
1800	728	0.60	796	0.66	862	0.73	927	0.82	991	0.92	1053	1.03	1116	1.13	1178	1.23	1241	1.32	1303	1.39
1900	747	0.67	815	0.73	881	0.80	946	0.89	1010	0.99	1073	1.09	1135	1.20	1197	1.30	1260	1.39	1323	1.46
2000	766	0.75	834	0.80	901	0.87	966	0.96	1029	1.06	1092	1.17	1155	1.27	1217	1.37	1279	1.46	-	-

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZH061 (5.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive						Standard 1.5 HP & Drive										Hi Static 2 HP & Drive			
1500	659	0.35	719	0.46	780	0.57	843	0.67	905	0.77	964	0.87	1020	0.97	1071	1.07	1116	1.17	1154	1.28
1600	675	0.38	735	0.50	796	0.60	859	0.71	920	0.81	980	0.91	1036	1.01	1087	1.11	1132	1.21	1170	1.32
1700	691	0.42	751	0.54	812	0.64	875	0.75	936	0.85	996	0.95	1052	1.05	1103	1.15	1148	1.25	1186	1.36
1800	707	0.47	767	0.58	829	0.69	891	0.79	953	0.90	1012	0.99	1069	1.09	1120	1.20	1165	1.30	1202	1.41
1900	724	0.53	784	0.64	846	0.75	908	0.85	970	0.95	1029	1.05	1085	1.15	1137	1.25	1182	1.35	1219	1.46
2000	741	0.59	801	0.70	863	0.81	925	0.91	987	1.01	1047	1.11	1103	1.21	1154	1.31	1199	1.41	1236	1.52
2100	759	0.65	819	0.77	881	0.87	943	0.98	1005	1.08	1065	1.18	1121	1.28	1172	1.38	1217	1.48	1254	1.59
2200	778	0.73	838	0.84	900	0.95	962	1.05	1024	1.15	1083	1.25	1139	1.35	1191	1.45	1236	1.56	1273	1.66
2300	797	0.81	857	0.92	919	1.03	981	1.13	1043	1.23	1103	1.33	1159	1.43	1210	1.53	1255	1.64	1292	1.74
2400	817	0.90	877	1.01	939	1.12	1002	1.22	1063	1.32	1123	1.42	1179	1.52	1230	1.62	1275	1.73	1312	1.83
2500	838	1.00	898	1.11	960	1.22	1022	1.32	1084	1.42	1144	1.52	1200	1.62	1251	1.72	1296	1.82	1333	1.93
																			FS[4]	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZH078 (6.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive						Standard 1.5 HP & Drive								Hi Static 2 HP & Drive					
1800	751	0.22	813	0.43	872	0.62	929	0.78	985	0.93	1040	1.07	1095	1.20	1150	1.33	1206	1.46	1265	1.59
2000	776	0.35	838	0.56	897	0.75	954	0.92	1010	1.07	1064	1.20	1119	1.33	1175	1.46	1231	1.59	1289	1.72
2200	804	0.50	866	0.71	925	0.90	982	1.06	1038	1.21	1092	1.35	1147	1.48	1203	1.61	1259	1.73	1317	1.87
2400	835	0.66	897	0.87	956	1.06	1013	1.22	1069	1.37	1124	1.51	1178	1.64	1234	1.77	1290	1.90	1348	2.03
2600	869	0.84	931	1.05	990	1.24	1047	1.40	1103	1.55	1158	1.69	1212	1.82	1268	1.95	1324	2.07	1382	2.21
2800	906	1.03	968	1.25	1027	1.43	1084	1.60	1139	1.75	1194	1.89	1249	2.02	1304	2.14	1361	2.27	-	-
3000	945	1.25	1007	1.46	1066	1.65	1123	1.81	1179	1.96	1234	2.10	1288	2.23	-	-	-	-	-	-
3200	987	1.48	1048	1.69	1107	1.88	1165	2.04	1220	2.19	-	-	-	-	-	-	-	-	-	-
3400	1030	1.73	1092	1.94	1151	2.12	1208	2.29	-	-	-	-	-	-	-	-	-	-	-	-
															2 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH090 (7.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 1.5 HP & Drive										Hi Static 3 HP & Drive					
2000	776	0.35	838	0.56	897	0.75	954	0.92	1010	1.07	1064	1.20	1119	1.33	1175	1.46	1231	1.59	1289	1.72
2200	804	0.50	866	0.71	925	0.90	982	1.06	1038	1.21	1092	1.35	1147	1.48	1203	1.61	1259	1.73	1317	1.87
2400	835	0.66	897	0.87	956	1.06	1013	1.22	1069	1.37	1124	1.51	1178	1.64	1234	1.77	1290	1.90	1348	2.03
2600	869	0.84	931	1.05	990	1.24	1047	1.40	1103	1.55	1158	1.69	1212	1.82	1268	1.95	1324	2.07	1382	2.21
2800	906	1.03	968	1.25	1027	1.43	1084	1.60	1139	1.75	1194	1.89	1249	2.02	1304	2.14	1361	2.27	1419	2.40
3000	945	1.25	1007	1.46	1066	1.65	1123	1.81	1179	1.96	1234	2.10	1288	2.23	1344	2.36	1400	2.48	1458	2.62
3200	987	1.48	1048	1.69	1107	1.88	1165	2.04	1220	2.19	1275	2.33	1330	2.46	1385	2.59	1442	2.71	1500	2.85
3400	1030	1.73	1092	1.94	1151	2.12	1208	2.29	1264	2.44	1319	2.58	1374	2.71	1429	2.84	1485	2.96	1544	3.10
3600	1076	1.99	1138	2.20	1197	2.39	1254	2.56	1310	2.71	1364	2.84	1419	2.97	1475	3.10	1531	3.23	1589	3.36
3800	1124	2.27	1185	2.48	1245	2.67	1302	2.84	1357	2.99	1412	3.12	1467	3.25	1522	3.38	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH102 (8.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive						Hi Static 3 HP & Drive									
2600	628	0.56	678	0.76	730	0.93	781	1.09	833	1.25	883	1.41	933	1.59	980	1.80	1025	2.05	1068	2.35
2800	648	0.67	698	0.87	750	1.04	801	1.20	853	1.36	903	1.52	953	1.70	1000	1.91	1046	2.16	1088	2.46
3000	666	0.80	717	1.00	768	1.17	820	1.33	871	1.49	922	1.65	971	1.83	1019	2.04	1064	2.29	1106	2.59
3200	684	0.95	735	1.15	786	1.32	838	1.48	889	1.63	940	1.80	989	1.98	1037	2.19	1082	2.44	1124	2.74
3400	702	1.11	753	1.31	804	1.48	856	1.64	907	1.79	958	1.96	1007	2.14	1055	2.35	1100	2.60	1142	2.90
3600	721	1.28	772	1.48	824	1.65	875	1.81	927	1.97	977	2.13	1027	2.31	1074	2.52	1119	2.77	-	-
3800	742	1.47	793	1.67	844	1.84	896	2.00	947	2.15	998	2.32	1047	2.50	1095	2.71	1140	2.96	-	-
4000	765	1.67	815	1.86	867	2.04	918	2.19	970	2.35	1020	2.51	1070	2.70	1117	2.91	-	-	-	-
4200	789	1.87	840	2.07	891	2.24	943	2.40	995	2.56	1045	2.72	1094	2.90	-	-	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH120 (10 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive										Hi Static 3 HP & Drive					
2600	675	0.53	726	0.74	776	0.94	824	1.12	870	1.30	914	1.48	957	1.65	1000	1.82	1041	1.99	1082	2.17
2800	686	0.63	738	0.84	787	1.04	835	1.23	881	1.41	925	1.58	969	1.76	1011	1.93	1052	2.10	1093	2.27
3000	699	0.75	750	0.96	800	1.16	847	1.34	893	1.52	938	1.70	981	1.87	1024	2.04	1065	2.21	1106	2.39
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	-	-	-	-
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	-	-	-	-	-	-
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	-	-	-	-	-	-	-	-	-	-
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	-	-	-	-	-	-	-	-	-	-	-	-
									3 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH150 (12.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive								Standard 3 HP & Drive											
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	1194	3.46	1235	3.64
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	1177	3.54	1219	3.72	1259	3.89
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	1118	3.47	1161	3.65	1203	3.82	1245	3.99	1285	4.16
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	1101	3.59	1146	3.76	1189	3.94	1231	4.11	1273	4.28	1313	4.45
5200	936	3.12	987	3.33	1037	3.53	1084	3.72	1130	3.90	1175	4.07	1218	4.24	1260	4.42	1302	4.59	1343	4.76
5400	966	3.45	1018	3.66	1067	3.86	1115	4.05	1161	4.23	1206	4.40	1249	4.57	1291	4.74	1333	4.91	1373	5.09
5600	999	3.80	1050	4.01	1100	4.20	1147	4.39	1193	4.57	1238	4.75	1281	4.92	1323	5.09	1365	5.26	1405	5.44
5800	1032	4.16	1084	4.37	1133	4.57	1181	4.75	1227	4.93	1271	5.11	1315	5.28	1357	5.45	1398	5.62	-	-
6000	1067	4.54	1119	4.75	1168	4.95	1216	5.13	1262	5.31	1306	5.49	1350	5.66	-	-	-	-	-	-
6200	1103	4.94	1155	5.15	1204	5.34	1252	5.53	1298	5.71	-	-	-	-	-	-	-	-	-	-
	Hi Static 5 HP & Drive								5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH037-150 Bottom Duct Application

ZH037 (3.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive						Hi Static 1.5 HP & Drive													
900	605	0.23	671	0.33	738	0.42	804	0.52	869	0.62	933	0.71	995	0.80	1054	0.89	1111	0.98	1164	1.07
1000	621	0.25	688	0.34	754	0.44	820	0.53	885	0.63	949	0.72	1011	0.82	1071	0.91	1127	1.00	1180	1.09
1100	637	0.27	703	0.36	769	0.46	835	0.56	900	0.65	964	0.74	1026	0.84	1086	0.93	1142	1.02	1195	1.11
1200	651	0.30	717	0.39	784	0.49	850	0.58	915	0.68	979	0.77	1041	0.87	1100	0.96	1157	1.05	1210	1.13
1300	666	0.33	732	0.43	799	0.52	865	0.62	930	0.71	994	0.81	1056	0.90	1115	0.99	1172	1.08	1225	1.17
1400	681	0.37	747	0.47	814	0.56	880	0.66	945	0.75	1009	0.85	1071	0.94	1130	1.03	1187	1.12	1240	1.21
1500	697	0.42	763	0.51	830	0.61	896	0.71	961	0.80	1025	0.90	1087	0.99	1146	1.08	1203	1.17	1256	1.26
															1.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH049 (4.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive										Hi Static 1.5 HP & Drive							
1200	651	0.30	717	0.39	784	0.49	850	0.58	915	0.68	979	0.77	1041	0.87	1100	0.96	1157	1.05	1210	1.13
1300	666	0.33	732	0.43	799	0.52	865	0.62	930	0.71	994	0.81	1056	0.90	1115	0.99	1172	1.08	1225	1.17
1400	681	0.37	747	0.47	814	0.56	880	0.66	945	0.75	1009	0.85	1071	0.94	1130	1.03	1187	1.12	1240	1.21
1500	697	0.42	763	0.51	830	0.61	896	0.71	961	0.80	1025	0.90	1087	0.99	1146	1.08	1203	1.17	1256	1.26
1600	714	0.47	780	0.57	846	0.66	913	0.76	978	0.86	1042	0.95	1103	1.04	1163	1.14	1220	1.22	1273	1.31
1700	732	0.53	798	0.63	864	0.73	930	0.82	996	0.92	1059	1.01	1121	1.10	1181	1.20	1237	1.29	1291	1.37
1800	751	0.60	817	0.70	883	0.79	950	0.89	1015	0.98	1079	1.08	1140	1.17	1200	1.26	1257	1.35	1310	1.44
1900	771	0.68	837	0.77	904	0.87	970	0.96	1035	1.06	1099	1.15	1161	1.25	1220	1.34	1277	1.43	-	-
2000	793	0.75	859	0.85	925	0.95	991	1.04	1056	1.14	1120	1.23	1182	1.32	1242	1.42	1298	1.51	-	-

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZH061 (5.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive				Standard 1.5 HP & Drive										Hi Static 2 HP & Drive					
1500	673	0.47	736	0.54	797	0.63	855	0.72	910	0.82	964	0.92	1016	1.03	1067	1.14	1117	1.25	1166	1.36
1600	693	0.49	756	0.57	817	0.65	874	0.75	930	0.85	984	0.95	1036	1.06	1087	1.17	1137	1.28	1186	1.39
1700	713	0.53	777	0.60	837	0.69	895	0.78	951	0.88	1004	0.98	1057	1.09	1107	1.20	1157	1.31	1207	1.42
1800	734	0.57	797	0.65	858	0.73	916	0.83	971	0.92	1025	1.03	1077	1.14	1128	1.25	1178	1.36	1228	1.47
1900	755	0.62	819	0.70	879	0.79	937	0.88	992	0.98	1046	1.08	1098	1.19	1149	1.30	1199	1.41	1249	1.52
2000	776	0.69	840	0.76	900	0.85	958	0.94	1014	1.04	1067	1.14	1120	1.25	1171	1.36	1221	1.47	1270	1.59
2100	798	0.76	861	0.84	921	0.92	979	1.02	1035	1.11	1089	1.22	1141	1.32	1192	1.44	1242	1.55	1291	1.66
2200	819	0.84	882	0.92	943	1.00	1001	1.10	1056	1.20	1110	1.30	1162	1.41	1213	1.52	1263	1.63	1312	1.74
2300	840	0.93	903	1.01	964	1.10	1022	1.19	1077	1.29	1131	1.39	1183	1.50	1234	1.61	1284	1.72	1334	1.83
2400	861	1.03	925	1.11	985	1.20	1043	1.29	1099	1.39	1152	1.49	1204	1.60	1255	1.71	1305	1.82	1355	1.93
2500	882	1.14	946	1.22	1006	1.30	1064	1.40	1120	1.50	1173	1.60	1226	1.71	1276	1.82	1326	1.93	1376	2.04
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH078 (6.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 1.5 HP & Drive						Hi Static 2 HP & Drive									
1800	775	0.31	850	0.53	924	0.72	998	0.89	1072	1.05	1147	1.20	1224	1.35	1303	1.51	1384	1.69	1469	1.89
2000	803	0.45	878	0.67	952	0.86	1026	1.03	1100	1.19	1175	1.34	1252	1.49	1331	1.65	1412	1.83	1497	2.03
2200	838	0.60	913	0.82	986	1.01	1060	1.19	1134	1.34	1210	1.49	1286	1.65	1365	1.81	1447	1.98	1532	2.18
2400	878	0.78	953	1.00	1027	1.19	1100	1.36	1174	1.52	1250	1.67	1327	1.82	1405	1.98	1487	2.16	-	-
2600	923	0.98	997	1.20	1071	1.39	1145	1.56	1219	1.72	1294	1.87	1371	2.02	1450	2.18	-	-	-	-
2800	971	1.20	1046	1.42	1119	1.61	1193	1.78	1267	1.94	1343	2.09	1419	2.24	-	-	-	-	-	-
3000	1023	1.44	1097	1.66	1171	1.85	1245	2.03	1319	2.18	-	-	-	-	-	-	-	-	-	-
3200	1077	1.71	1151	1.93	1225	2.12	1299	2.29	-	-	-	-	-	-	-	-	-	-	-	-
3400	1133	1.99	1208	2.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
									2 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH090 (7.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 1.5 HP & Drive						Hi Static 3 HP & Drive									
2000	803	0.45	878	0.67	952	0.86	1026	1.03	1100	1.19	1175	1.34	1252	1.49	1331	1.65	1412	1.83	1497	2.03
2200	838	0.60	913	0.82	986	1.01	1060	1.19	1134	1.34	1210	1.49	1286	1.65	1365	1.81	1447	1.98	1532	2.18
2400	878	0.78	953	1.00	1027	1.19	1100	1.36	1174	1.52	1250	1.67	1327	1.82	1405	1.98	1487	2.16	1572	2.36
2600	923	0.98	997	1.20	1071	1.39	1145	1.56	1219	1.72	1294	1.87	1371	2.02	1450	2.18	1532	2.36	1617	2.56
2800	971	1.20	1046	1.42	1119	1.61	1193	1.78	1267	1.94	1343	2.09	1419	2.24	1498	2.40	1580	2.58	1665	2.78
3000	1023	1.44	1097	1.66	1171	1.85	1245	2.03	1319	2.18	1394	2.33	1471	2.49	1550	2.65	1632	2.82	1717	3.02
3200	1077	1.71	1151	1.93	1225	2.12	1299	2.29	1373	2.45	1448	2.60	1525	2.75	1604	2.91	1686	3.09	1771	3.29
3400	1133	1.99	1208	2.21	1282	2.41	1356	2.58	1430	2.73	1505	2.88	1582	3.04	1661	3.20	1742	3.37	-	-
3600	1192	2.30	1267	2.52	1341	2.71	1414	2.88	1489	3.04	1564	3.19	1641	3.34	-	-	-	-	-	-
3800	1253	2.63	1327	2.85	1401	3.04	1475	3.21	1549	3.37	-	-	-	-	-	-	-	-	-	-
									3 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH102 (8.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 2 HP & Drive						Hi Static 3 HP & Drive											
2600	674	0.71	731	0.88	786	1.05	838	1.24	887	1.42	933	1.59	974	1.74	1010	1.87	1040	1.97	1064	2.03
2800	689	0.86	746	1.02	801	1.20	854	1.38	903	1.56	948	1.73	989	1.88	1025	2.01	1056	2.11	1080	2.17
3000	707	1.01	764	1.17	819	1.35	872	1.53	921	1.71	966	1.88	1007	2.03	1043	2.16	1074	2.26	1098	2.32
3200	728	1.17	785	1.33	840	1.51	892	1.69	941	1.87	987	2.04	1028	2.20	1064	2.33	1094	2.42	1118	2.48
3400	751	1.34	808	1.51	863	1.68	915	1.87	964	2.05	1010	2.22	1051	2.37	1087	2.50	1117	2.60	1141	2.66
3600	776	1.53	833	1.70	888	1.87	941	2.06	990	2.24	1035	2.41	1076	2.56	1112	2.69	1142	2.79	1167	2.85
3800	804	1.74	861	1.90	916	2.08	969	2.26	1018	2.44	1063	2.61	1104	2.77	1140	2.90	1170	2.99	-	-
4000	835	1.97	892	2.13	947	2.31	999	2.49	1048	2.67	1094	2.84	1135	2.99	-	-	-	-	-	-
4200	867	2.21	924	2.37	979	2.55	1032	2.73	1081	2.91	1127	3.08	-	-	-	-	-	-	-	-
													3 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZH120 (10 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive		Standard 2 HP & Drive										Hi Static 3 HP & Drive							
2600	722	0.83	776	0.97	828	1.11	878	1.25	926	1.37	973	1.50	1018	1.62	1063	1.74	1106	1.86	1149	1.99
2800	744	0.97	798	1.12	850	1.26	900	1.39	949	1.52	995	1.64	1041	1.76	1085	1.88	1128	2.00	1171	2.13
3000	769	1.13	823	1.28	875	1.42	925	1.55	974	1.68	1020	1.80	1066	1.92	1110	2.05	1153	2.17	1196	2.29
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	-	-	-	-	-	-
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	-	-	-	-	-	-	-	-	-	-
4600	1065	3.22	1119	3.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			3 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZH150 (12.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 3 HP & Drive										Hi Static 5 HP & Drive					
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	1316	3.48	1360	3.60	1402	3.73
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	1270	3.55	1315	3.67	1360	3.80	1403	3.92	1446	4.04
4600	1065	3.22	1119	3.36	1171	3.50	1221	3.64	1269	3.76	1316	3.89	1361	4.01	1405	4.13	1449	4.25	1491	4.38
4800	1113	3.57	1167	3.72	1219	3.86	1269	3.99	1317	4.12	1364	4.24	1409	4.36	1453	4.48	1497	4.61	1540	4.73
5000	1163	3.94	1217	4.09	1269	4.23	1319	4.36	1367	4.49	1414	4.62	1459	4.74	1504	4.86	1547	4.98	1590	5.10
5200	1216	4.34	1270	4.48	1321	4.62	1371	4.76	1420	4.88	1466	5.01	1512	5.13	1556	5.25	1600	5.37	1642	5.50
5400	1270	4.75	1324	4.89	1376	5.03	1426	5.17	1474	5.29	1521	5.42	1566	5.54	1611	5.66	-	-	-	-
5600	1327	5.17	1381	5.32	1433	5.46	1483	5.59	1531	5.72	-	-	-	-	-	-	-	-	-	-
5800	1385	5.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5 HP & Field Supplied Drive																			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ037-150 Side Duct Application

ZJ037 (3.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive								Hi Static 1.5 HP & Drive											
900	560	0.29	628	0.35	695	0.42	760	0.51	823	0.61	886	0.72	949	0.82	1011	0.92	1073	1.01	1136	1.09
1000	582	0.29	650	0.34	716	0.42	781	0.51	845	0.61	908	0.71	970	0.82	1032	0.92	1095	1.01	1158	1.08
1100	601	0.30	670	0.35	736	0.43	801	0.52	864	0.62	927	0.72	990	0.83	1052	0.93	1114	1.02	1177	1.09
1200	620	0.32	688	0.37	754	0.45	819	0.54	883	0.64	946	0.74	1008	0.85	1070	0.95	1133	1.04	1196	1.11
1300	638	0.35	706	0.40	772	0.48	837	0.57	901	0.67	964	0.77	1026	0.88	1088	0.98	1151	1.06	1214	1.14
1400	655	0.39	724	0.44	790	0.51	855	0.60	918	0.70	981	0.81	1044	0.91	1106	1.01	1168	1.10	1231	1.18
1500	673	0.43	741	0.48	807	0.56	872	0.65	936	0.75	999	0.85	1061	0.96	1124	1.06	1186	1.15	1249	1.22
															1.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ049 (4.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive												Hi Static 1.5 HP & Drive					
1200	608	0.25	677	0.34	744	0.44	807	0.54	868	0.64	927	0.74	986	0.84	1043	0.93	1101	1.02	1160	1.10
1300	623	0.28	692	0.37	758	0.47	822	0.57	883	0.67	942	0.77	1001	0.86	1058	0.96	1116	1.04	1175	1.13
1400	637	0.31	706	0.40	772	0.50	836	0.60	897	0.70	956	0.80	1015	0.90	1072	0.99	1130	1.08	1189	1.16
1500	650	0.35	720	0.44	786	0.54	849	0.64	911	0.74	970	0.84	1028	0.93	1086	1.03	1144	1.12	1202	1.20
1600	664	0.39	734	0.49	800	0.58	863	0.68	924	0.78	984	0.88	1042	0.98	1100	1.07	1158	1.16	1216	1.24
1700	678	0.44	748	0.54	814	0.63	877	0.73	938	0.83	998	0.93	1056	1.03	1114	1.12	1172	1.21	1230	1.29
1800	693	0.50	763	0.59	829	0.69	892	0.79	953	0.89	1013	0.99	1071	1.08	1129	1.18	1186	1.26	1245	1.35
1900	708	0.56	778	0.65	844	0.75	907	0.85	968	0.95	1028	1.05	1086	1.15	1144	1.24	1202	1.33	1260	1.41
2000	725	0.62	794	0.72	860	0.82	924	0.92	985	1.02	1044	1.12	1102	1.21	1160	1.30	1218	1.39	1277	1.47

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive

ZJ061 (5.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Suplied Drive						Standard 1.5 HP & Drive										Hi Static 2 HP & Drive			
1500	659	0.35	719	0.46	780	0.57	843	0.67	905	0.77	964	0.87	1020	0.97	1071	1.07	1116	1.17	1154	1.28
1600	675	0.38	735	0.50	796	0.60	859	0.71	920	0.81	980	0.91	1036	1.01	1087	1.11	1132	1.21	1170	1.32
1700	691	0.42	751	0.54	812	0.64	875	0.75	936	0.85	996	0.95	1052	1.05	1103	1.15	1148	1.25	1186	1.36
1800	707	0.47	767	0.58	829	0.69	891	0.79	953	0.90	1012	0.99	1069	1.09	1120	1.20	1165	1.30	1202	1.41
1900	724	0.53	784	0.64	846	0.75	908	0.85	970	0.95	1029	1.05	1085	1.15	1137	1.25	1182	1.35	1219	1.46
2000	741	0.59	801	0.70	863	0.81	925	0.91	987	1.01	1047	1.11	1103	1.21	1154	1.31	1199	1.41	1236	1.52
2100	759	0.65	819	0.77	881	0.87	943	0.98	1005	1.08	1065	1.18	1121	1.28	1172	1.38	1217	1.48	1254	1.59
2200	778	0.73	838	0.84	900	0.95	962	1.05	1024	1.15	1083	1.25	1139	1.35	1191	1.45	1236	1.56	1273	1.66
2300	797	0.81	857	0.92	919	1.03	981	1.13	1043	1.23	1103	1.33	1159	1.43	1210	1.53	1255	1.64	1292	1.74
2400	817	0.90	877	1.01	939	1.12	1002	1.22	1063	1.32	1123	1.42	1179	1.52	1230	1.62	1275	1.73	1312	1.83
2500	838	1.00	898	1.11	960	1.22	1022	1.32	1084	1.42	1144	1.52	1200	1.62	1251	1.72	1296	1.82	1333	1.93
																	FS[4]			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ078 (6.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]				Standard 1.5 HP & Drive										Hi Static 2 HP & Drive					
1800	514	0.15	586	0.33	657	0.52	727	0.71	794	0.89	857	1.07	917	1.23	972	1.38	1021	1.50	1064	1.59
2000	529	0.23	601	0.41	672	0.60	741	0.79	808	0.97	872	1.15	931	1.31	986	1.46	1036	1.58	1079	1.67
2200	544	0.33	616	0.51	687	0.69	756	0.88	823	1.07	886	1.24	946	1.41	1001	1.55	1051	1.67	1094	1.77
2400	559	0.43	631	0.61	702	0.80	771	0.98	838	1.17	902	1.35	961	1.51	1016	1.65	1066	1.78	1109	1.87
2600	574	0.54	646	0.72	717	0.91	787	1.10	853	1.28	917	1.46	977	1.62	1032	1.77	1081	1.89	1124	1.98
2800	590	0.67	662	0.85	733	1.03	802	1.22	869	1.41	933	1.59	993	1.75	1047	1.89	1097	2.02	1140	2.11
3000	607	0.80	679	0.98	750	1.17	819	1.36	886	1.54	949	1.72	1009	1.88	1064	2.03	1113	2.15	1157	2.24
3200	624	0.95	695	1.13	766	1.31	836	1.50	903	1.69	966	1.86	1026	2.03	1081	2.17	1130	2.29	-	-
3400	641	1.10	713	1.28	784	1.47	853	1.66	920	1.84	984	2.02	1043	2.18	1098	2.33	-	-	-	-
																	FS[4]			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ090 (7.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]				Standard 1.5 HP & Drive										Hi Static 3 HP & Drive					
2000	-	-	656	0.24	711	0.48	768	0.73	826	0.96	886	1.19	945	1.41	1003	1.61	1058	1.79	1110	1.95
2200	619	0.07	670	0.32	724	0.57	781	0.81	840	1.04	899	1.27	959	1.49	1016	1.69	1072	1.87	1124	2.04
2400	631	0.16	682	0.41	736	0.66	793	0.90	852	1.14	911	1.36	970	1.58	1028	1.78	1084	1.97	1136	2.13
2600	642	0.27	692	0.52	747	0.76	804	1.01	862	1.24	922	1.47	981	1.69	1039	1.89	1094	2.07	1146	2.24
2800	652	0.39	703	0.64	757	0.88	814	1.13	873	1.36	932	1.59	992	1.81	1049	2.01	1105	2.19	1157	2.36
3000	663	0.53	714	0.77	768	1.02	825	1.26	884	1.50	943	1.73	1003	1.94	1060	2.14	1116	2.33	1168	2.49
3200	675	0.68	726	0.92	780	1.17	837	1.41	896	1.65	955	1.88	1014	2.09	1072	2.29	1128	2.48	1180	2.64
3400	688	0.84	739	1.09	793	1.34	850	1.58	909	1.82	968	2.04	1027	2.26	1085	2.46	1141	2.65	1193	2.81
3600	703	1.03	753	1.28	807	1.52	864	1.76	923	2.00	983	2.23	1042	2.44	1100	2.64	1155	2.83	-	-
3800	718	1.23	769	1.47	823	1.72	880	1.96	939	2.20	998	2.43	1058	2.64	1115	2.84	1171	3.03	-	-

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ102 (8.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive								Hi Static 3 HP & Drive							
2200	654	0.32	706	0.53	755	0.73	803	0.92	849	1.10	893	1.27	937	1.44	979	1.62	1020	1.79	1061	1.96
2400	664	0.43	716	0.64	765	0.83	813	1.02	859	1.20	904	1.38	947	1.55	989	1.72	1030	1.89	1071	2.07
2600	675	0.53	726	0.74	776	0.94	824	1.12	870	1.30	914	1.48	957	1.65	1000	1.82	1041	1.99	1082	2.17
2800	686	0.63	738	0.84	787	1.04	835	1.23	881	1.41	925	1.58	969	1.76	1011	1.93	1052	2.10	1093	2.27
3000	699	0.75	750	0.96	800	1.16	847	1.34	893	1.52	938	1.70	981	1.87	1024	2.04	1065	2.21	1106	2.39
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
																	3 HP & Field Supplied Drive			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ120 (10 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive										Hi Static 3 HP & Drive					
2600	675	0.53	726	0.74	776	0.94	824	1.12	870	1.30	914	1.48	957	1.65	1000	1.82	1041	1.99	1082	2.17
2800	686	0.63	738	0.84	787	1.04	835	1.23	881	1.41	925	1.58	969	1.76	1011	1.93	1052	2.10	1093	2.27
3000	699	0.75	750	0.96	800	1.16	847	1.34	893	1.52	938	1.70	981	1.87	1024	2.04	1065	2.21	1106	2.39
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	-	-	-	-
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	-	-	-	-	-	-
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	-	-	-	-	-	-	-	-	-	-
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	-	-	-	-	-	-	-	-	-	-	-	-
											3 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ150 (12.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive								Standard 3 HP & Drive											
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	1194	3.46	1235	3.64
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	1177	3.54	1219	3.72	1259	3.89
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	1118	3.47	1161	3.65	1203	3.82	1245	3.99	1285	4.16
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	1101	3.59	1146	3.76	1189	3.94	1231	4.11	1273	4.28	1313	4.45
5200	936	3.12	987	3.33	1037	3.53	1084	3.72	1130	3.90	1175	4.07	1218	4.24	1260	4.42	1302	4.59	1343	4.76
5400	966	3.45	1018	3.66	1067	3.86	1115	4.05	1161	4.23	1206	4.40	1249	4.57	1291	4.74	1333	4.91	1373	5.09
5600	999	3.80	1050	4.01	1100	4.20	1147	4.39	1193	4.57	1238	4.75	1281	4.92	1323	5.09	1365	5.26	1405	5.44
5800	1032	4.16	1084	4.37	1133	4.57	1181	4.75	1227	4.93	1271	5.11	1315	5.28	1357	5.45	1398	5.62	-	-
6000	1067	4.54	1119	4.75	1168	4.95	1216	5.13	1262	5.31	1306	5.49	1350	5.66	-	-	-	-	-	-
6200	1103	4.94	1155	5.15	1204	5.34	1252	5.53	1298	5.71	-	-	-	-	-	-	-	-	-	-
	Hi Static 5 HP & Drive								5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ037-150 Bottom Duct Application

ZJ037 (3.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive						Hi Static 1.5 HP & Drive													
900	605	0.23	671	0.33	738	0.42	804	0.52	869	0.62	933	0.71	995	0.80	1054	0.89	1111	0.98	1164	1.07
1000	621	0.25	688	0.34	754	0.44	820	0.53	885	0.63	949	0.72	1011	0.82	1071	0.91	1127	1.00	1180	1.09
1100	637	0.27	703	0.36	769	0.46	835	0.56	900	0.65	964	0.74	1026	0.84	1086	0.93	1142	1.02	1195	1.11
1200	651	0.30	717	0.39	784	0.49	850	0.58	915	0.68	979	0.77	1041	0.87	1100	0.96	1157	1.05	1210	1.13
1300	666	0.33	732	0.43	799	0.52	865	0.62	930	0.71	994	0.81	1056	0.90	1115	0.99	1172	1.08	1225	1.17
1400	681	0.37	747	0.47	814	0.56	880	0.66	945	0.75	1009	0.85	1071	0.94	1130	1.03	1187	1.12	1240	1.21
1500	697	0.42	763	0.51	830	0.61	896	0.71	961	0.80	1025	0.90	1087	0.99	1146	1.08	1203	1.17	1256	1.26
															1.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ049 (4.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive										Hi Static 1.5 HP & Drive							
1200	635	0.25	704	0.34	770	0.44	832	0.54	893	0.65	953	0.75	1013	0.85	1073	0.94	1134	1.02	1197	1.08
1300	648	0.28	717	0.38	782	0.47	845	0.58	906	0.68	966	0.78	1025	0.88	1085	0.97	1147	1.05	1210	1.12
1400	661	0.32	730	0.42	796	0.51	858	0.62	919	0.72	979	0.82	1039	0.92	1099	1.01	1160	1.09	1223	1.16
1500	675	0.37	744	0.46	810	0.56	872	0.66	933	0.77	993	0.87	1053	0.96	1113	1.05	1174	1.14	1237	1.20
1600	690	0.42	759	0.51	825	0.61	887	0.72	948	0.82	1008	0.92	1068	1.02	1128	1.11	1189	1.19	1252	1.26
1700	706	0.48	775	0.57	841	0.67	903	0.77	964	0.88	1024	0.98	1084	1.08	1144	1.17	1205	1.25	1268	1.31
1800	723	0.55	792	0.64	857	0.74	920	0.84	981	0.94	1041	1.04	1101	1.14	1161	1.23	1222	1.31	1285	1.38
1900	741	0.62	810	0.71	875	0.81	938	0.91	999	1.01	1059	1.11	1118	1.21	1178	1.30	1240	1.38	1303	1.45
2000	760	0.69	829	0.79	894	0.88	957	0.99	1018	1.09	1078	1.19	1137	1.29	1197	1.38	1258	1.46	1322	1.53

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ061 (5.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive				Standard 1.5 HP & Drive												Hi Static 2 HP & Drive			
1500	673	0.47	736	0.54	797	0.63	855	0.72	910	0.82	964	0.92	1016	1.03	1067	1.14	1117	1.25	1166	1.36
1600	693	0.49	756	0.57	817	0.65	874	0.75	930	0.85	984	0.95	1036	1.06	1087	1.17	1137	1.28	1186	1.39
1700	713	0.53	777	0.60	837	0.69	895	0.78	951	0.88	1004	0.98	1057	1.09	1107	1.20	1157	1.31	1207	1.42
1800	734	0.57	797	0.65	858	0.73	916	0.83	971	0.92	1025	1.03	1077	1.14	1128	1.25	1178	1.36	1228	1.47
1900	755	0.62	819	0.70	879	0.79	937	0.88	992	0.98	1046	1.08	1098	1.19	1149	1.30	1199	1.41	1249	1.52
2000	776	0.69	840	0.76	900	0.85	958	0.94	1014	1.04	1067	1.14	1120	1.25	1171	1.36	1221	1.47	1270	1.59
2100	798	0.76	861	0.84	921	0.92	979	1.02	1035	1.11	1089	1.22	1141	1.32	1192	1.44	1242	1.55	1291	1.66
2200	819	0.84	882	0.92	943	1.00	1001	1.10	1056	1.20	1110	1.30	1162	1.41	1213	1.52	1263	1.63	1312	1.74
2300	840	0.93	903	1.01	964	1.10	1022	1.19	1077	1.29	1131	1.39	1183	1.50	1234	1.61	1284	1.72	1334	1.83
2400	861	1.03	925	1.11	985	1.20	1043	1.29	1099	1.39	1152	1.49	1204	1.60	1255	1.71	1305	1.82	1355	1.93
2500	882	1.14	946	1.22	1006	1.30	1064	1.40	1120	1.50	1173	1.60	1226	1.71	1276	1.82	1326	1.93	1376	2.04
																	2 HP & Field Supplied Drive			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ078 (6.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive								Hi Static 2 HP & Drive									
1800	603	0.13	656	0.36	718	0.58	784	0.79	851	0.98	914	1.16	968	1.31	1010	1.43	1035	1.53	1039	1.59
2000	627	0.26	680	0.49	742	0.71	808	0.92	875	1.12	937	1.29	992	1.44	1034	1.57	1059	1.66	1063	1.72
2200	650	0.40	703	0.63	765	0.85	831	1.06	898	1.25	961	1.43	1015	1.58	1057	1.71	1082	1.80	1086	1.86
2400	673	0.55	726	0.78	788	1.00	854	1.21	921	1.40	984	1.58	1038	1.73	1080	1.85	1105	1.95	1109	2.01
2600	696	0.71	749	0.94	811	1.16	878	1.37	944	1.56	1007	1.73	1061	1.89	1103	2.01	1128	2.10	1133	2.16
2800	720	0.87	773	1.10	835	1.32	902	1.53	968	1.73	1031	1.90	1085	2.05	1127	2.18	1152	2.27	1157	2.33
3000	745	1.05	798	1.28	860	1.50	926	1.71	993	1.91	1056	2.08	1110	2.23	1152	2.36	1177	2.45	1181	2.51
3200	771	1.24	824	1.47	886	1.69	952	1.90	1019	2.09	1081	2.27	1136	2.42	1178	2.54	1203	2.64	1207	2.70
3400	797	1.44	850	1.67	912	1.89	979	2.10	1045	2.29	1108	2.47	1162	2.62	1204	2.74	1229	2.84	1234	2.90
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ090 (7.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive										Hi Static 3 HP & Drive							
2000	644	0.11	698	0.38	755	0.62	814	0.85	874	1.06	933	1.26	990	1.46	1043	1.66	1090	1.87	1131	2.09
2200	666	0.26	720	0.53	777	0.77	836	1.00	896	1.21	956	1.41	1012	1.61	1065	1.81	1113	2.02	1153	2.24
2400	689	0.42	743	0.69	800	0.93	859	1.16	919	1.37	978	1.57	1035	1.77	1088	1.97	1135	2.18	1176	2.40
2600	712	0.60	766	0.87	823	1.11	882	1.34	942	1.55	1002	1.75	1058	1.95	1111	2.15	1159	2.36	1199	2.58
2800	736	0.80	790	1.06	847	1.31	906	1.53	967	1.74	1026	1.94	1082	2.14	1135	2.34	1183	2.55	1223	2.78
3000	761	1.00	815	1.27	872	1.52	931	1.74	991	1.95	1051	2.15	1107	2.35	1160	2.55	1208	2.76	1248	2.98
3200	787	1.22	840	1.49	898	1.74	957	1.96	1017	2.17	1076	2.37	1133	2.57	1186	2.77	1233	2.98	1274	3.20
3400	813	1.46	867	1.73	924	1.97	984	2.19	1044	2.40	1103	2.61	1160	2.80	1212	3.01	1260	3.21	-	-
3600	841	1.70	894	1.97	952	2.21	1011	2.44	1071	2.65	1130	2.85	1187	3.05	-	-	-	-	-	-
3800	869	1.96	923	2.22	980	2.47	1039	2.69	1099	2.90	1158	3.10	1215	3.30	-	-	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ102 (8.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 2 HP & Drive								Hi Static 3 HP & Drive									
2200	685	0.59	739	0.74	791	0.88	841	1.01	889	1.14	936	1.27	981	1.39	1025	1.51	1069	1.63	1111	1.75
2400	702	0.70	756	0.85	808	0.99	858	1.12	906	1.25	953	1.37	999	1.49	1043	1.62	1086	1.74	1129	1.86
2600	722	0.83	776	0.97	828	1.11	878	1.25	926	1.37	973	1.50	1018	1.62	1063	1.74	1106	1.86	1149	1.99
2800	744	0.97	798	1.12	850	1.26	900	1.39	949	1.52	995	1.64	1041	1.76	1085	1.88	1128	2.00	1171	2.13
3000	769	1.13	823	1.28	875	1.42	925	1.55	974	1.68	1020	1.80	1066	1.92	1110	2.05	1153	2.17	1196	2.29
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	-	-	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZJ120 (10 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive		Standard 2 HP & Drive										Hi Static 3 HP & Drive							
2600	722	0.83	776	0.97	828	1.11	878	1.25	926	1.37	973	1.50	1018	1.62	1063	1.74	1106	1.86	1149	1.99
2800	744	0.97	798	1.12	850	1.26	900	1.39	949	1.52	995	1.64	1041	1.76	1085	1.88	1128	2.00	1171	2.13
3000	769	1.13	823	1.28	875	1.42	925	1.55	974	1.68	1020	1.80	1066	1.92	1110	2.05	1153	2.17	1196	2.29
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	-	-	-	-	-	-
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	-	-	-	-	-	-	-	-	-	-
4600	1065	3.22	1119	3.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			3 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZJ150 (12.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 3 HP & Drive										Hi Static 5 HP & Drive					
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	1316	3.48	1360	3.60	1402	3.73
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	1270	3.55	1315	3.67	1360	3.80	1403	3.92	1446	4.04
4600	1065	3.22	1119	3.36	1171	3.50	1221	3.64	1269	3.76	1316	3.89	1361	4.01	1405	4.13	1449	4.25	1491	4.38
4800	1113	3.57	1167	3.72	1219	3.86	1269	3.99	1317	4.12	1364	4.24	1409	4.36	1453	4.48	1497	4.61	1540	4.73
5000	1163	3.94	1217	4.09	1269	4.23	1319	4.36	1367	4.49	1414	4.62	1459	4.74	1504	4.86	1547	4.98	1590	5.10
5200	1216	4.34	1270	4.48	1321	4.62	1371	4.76	1420	4.88	1466	5.01	1512	5.13	1556	5.25	1600	5.37	1642	5.50
5400	1270	4.75	1324	4.89	1376	5.03	1426	5.17	1474	5.29	1521	5.42	1566	5.54	1611	5.66	-	-	-	-
5600	1327	5.17	1381	5.32	1433	5.46	1483	5.59	1531	5.72	-	-	-	-	-	-	-	-	-	-
5800	1385	5.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
									5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR037-150 Side Duct Application

ZR037 (3.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive								Hi Static 1.5 HP & Drive									
900	480	0.4	582	0.4	673	0.5	756	0.5	830	0.6	898	0.7	960	0.8	1018	0.9	1072	1.0	1124	1.1
1000	489	0.4	591	0.4	682	0.5	764	0.6	839	0.6	907	0.7	969	0.8	1026	0.9	1080	1.0	1132	1.1
1100	500	0.4	602	0.4	693	0.5	776	0.6	850	0.6	918	0.7	980	0.8	1038	0.9	1092	1.0	1144	1.1
1200	513	0.4	614	0.5	706	0.5	788	0.6	863	0.7	931	0.8	993	0.8	1050	0.9	1104	1.0	1156	1.1
1300	525	0.4	627	0.5	719	0.6	801	0.6	876	0.7	943	0.8	1005	0.9	1063	1.0	1117	1.1	1169	1.2
1400	537	0.5	639	0.5	731	0.6	813	0.7	888	0.7	955	0.8	1017	0.9	1075	1.0	1129	1.1	1181	1.2
1500	549	0.5	650	0.6	742	0.6	824	0.7	899	0.8	966	0.9	1028	0.9	1086	1.0	1140	1.1	1192	1.2

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZR049 (4.0 Ton) Side Duct

Air Flow (CFM	Available External Static Pressure - IWG[1]																	
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive		Standard 1.5 HP & Drive								Hi Static 1.5 HP & Drive									
1200	513	0.4	614	0.5	706	0.5	788	0.6	863	0.7	931	0.8	993	0.8	1050	0.9	1104	1.0	1156	1.1
1300	525	0.4	627	0.5	719	0.6	801	0.6	876	0.7	943	0.8	1005	0.9	1063	1.0	1117	1.1	1169	1.2
1400	537	0.5	639	0.5	731	0.6	813	0.7	888	0.7	955	0.8	1017	0.9	1075	1.0	1129	1.1	1181	1.2
1500	549	0.5	650	0.6	742	0.6	824	0.7	899	0.8	966	0.9	1028	0.9	1086	1.0	1140	1.1	1192	1.2
1600	558	0.6	660	0.6	752	0.7	834	0.8	909	0.8	976	0.9	1038	1.0	1096	1.1	1150	1.2	1202	1.3
1700	566	0.6	668	0.7	760	0.7	842	0.8	917	0.9	984	1.0	1046	1.1	1104	1.1	1158	1.2	1210	1.4
1800	573	0.7	675	0.7	766	0.8	849	0.9	923	1.0	991	1.0	1053	1.1	1110	1.2	1164	1.3	1216	1.4
1900	577	0.8	679	0.8	771	0.9	853	1.0	928	1.0	995	1.1	1057	1.2	1115	1.3	1169	1.4	1221	1.5
2000	580	0.8	682	0.9	773	1.0	856	1.0	930	1.1	998	1.2	1060	1.3	1117	1.4	1172	1.5	1224	1.6
																			FS[4]	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZR061 (5.0 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive								Hi Static 2 HP & Drive											
1500	616	0.5	685	0.6	766	0.7	833	0.8	905	0.9	975	1.0	1035	1.0	1101	1.1	1163	1.2	1229	1.3
1600	638	0.6	707	0.7	781	0.7	848	0.8	920	0.9	990	1.0	1050	1.1	1104	1.1	1166	1.2	1232	1.3
1700	655	0.6	724	0.7	796	0.8	863	0.9	935	1.0	1005	1.1	1064	1.1	1109	1.2	1172	1.3	1238	1.4
1800	670	0.7	739	0.8	810	0.8	877	0.9	949	1.0	1018	1.1	1078	1.2	1117	1.2	1179	1.3	1245	1.5
1900	686	0.7	755	0.8	823	0.9	890	1.0	962	1.1	1032	1.2	1091	1.2	1125	1.3	1187	1.4	1253	1.5
2000	702	0.8	772	0.9	836	1.0	903	1.1	975	1.2	1045	1.3	1078	1.3	1135	1.4	1197	1.5	1263	1.6
2100	722	0.9	791	1.0	849	1.0	916	1.1	988	1.2	1058	1.3	1089	1.4	1147	1.5	1209	1.6	1275	1.7
2200	745	0.9	814	1.0	861	1.1	928	1.2	1000	1.3	1050	1.4	1102	1.5	1159	1.6	1221	1.7	1287	1.8
2300	772	1.0	841	1.1	874	1.2	941	1.3	1013	1.4	1064	1.5	1115	1.6	1173	1.7	1235	1.8	-	-
2400	804	1.1	832	1.2	886	1.3	953	1.4	1033	1.4	1078	1.6	1130	1.7	1188	1.8	-	-	-	-
2500	841	1.2	844	1.3	898	1.4	965	1.5	1049	1.5	1094	1.7	-	-	-	-	2 HP & Field Supplied Drive			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR078-150 Side Duct Application

ZR078 (6.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive						Standard 1.5 HP & Drive								Hi Static 2 HP & Drive					
1800	778	0.37	838	0.56	895	0.73	951	0.88	1005	1.01	1059	1.13	1112	1.25	1166	1.36	1221	1.47	1278	1.59
2000	803	0.50	864	0.69	921	0.85	977	1.00	1031	1.14	1085	1.26	1138	1.37	1192	1.49	1247	1.60	1304	1.72
2200	833	0.64	893	0.83	951	1.00	1006	1.14	1061	1.28	1114	1.40	1168	1.51	1221	1.63	1276	1.74	1333	1.86
2400	866	0.80	926	0.99	984	1.15	1039	1.30	1094	1.43	1147	1.56	1201	1.67	1254	1.78	1309	1.90	1366	2.02
2600	902	0.97	962	1.16	1020	1.33	1076	1.47	1130	1.61	1183	1.73	1237	1.85	1291	1.96	1346	2.07	1402	2.19
2800	941	1.16	1002	1.35	1059	1.52	1115	1.67	1169	1.80	1222	1.92	1276	2.04	1330	2.15	1385	2.26	-	-
3000	983	1.37	1043	1.56	1101	1.73	1157	1.88	1211	2.01	1264	2.13	1318	2.25	-	-	-	-	-	-
3200	1028	1.60	1088	1.79	1145	1.95	1201	2.10	1255	2.24	-	-	-	-	-	-	-	-	-	-
3400	1074	1.84	1134	2.03	1192	2.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
											2 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR090 (7.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive						Standard 1.5 HP & Drive						Hi Static 3 HP & Drive							
2000	803	0.50	864	0.69	921	0.85	977	1.00	1031	1.14	1085	1.26	1138	1.37	1192	1.49	1247	1.60	1304	1.72
2200	833	0.64	893	0.83	951	1.00	1006	1.14	1061	1.28	1114	1.40	1168	1.51	1221	1.63	1276	1.74	1333	1.86
2400	866	0.80	926	0.99	984	1.15	1039	1.30	1094	1.43	1147	1.56	1201	1.67	1254	1.78	1309	1.90	1366	2.02
2600	902	0.97	962	1.16	1020	1.33	1076	1.47	1130	1.61	1183	1.73	1237	1.85	1291	1.96	1346	2.07	1402	2.19
2800	941	1.16	1002	1.35	1059	1.52	1115	1.67	1169	1.80	1222	1.92	1276	2.04	1330	2.15	1385	2.26	1442	2.38
3000	983	1.37	1043	1.56	1101	1.73	1157	1.88	1211	2.01	1264	2.13	1318	2.25	1372	2.36	1427	2.47	1483	2.59
3200	1028	1.60	1088	1.79	1145	1.95	1201	2.10	1255	2.24	1309	2.36	1362	2.47	1416	2.59	1471	2.70	1528	2.82
3400	1074	1.84	1134	2.03	1192	2.20	1248	2.35	1302	2.48	1355	2.60	1409	2.72	1463	2.83	1518	2.94	1574	3.06
3600	1123	2.10	1183	2.29	1241	2.46	1297	2.61	1351	2.74	1404	2.86	1458	2.98	1512	3.09	1567	3.21	1623	3.32
3800	1174	2.38	1234	2.57	1292	2.74	1348	2.88	1402	3.02	1455	3.14	1509	3.26	1562	3.37	-	-	-	-
									3 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR102 (8.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP & Field Supplied Drive		Standard 2 HP & Drive										Hi Static 3 HP & Drive							
2200	684	0.48	735	0.67	783	0.84	829	1.01	874	1.17	918	1.32	960	1.48	1001	1.63	1041	1.78	1081	1.94
2400	695	0.58	745	0.76	793	0.94	840	1.11	885	1.27	928	1.42	970	1.57	1011	1.73	1052	1.88	1091	2.04
2600	706	0.67	756	0.86	805	1.04	851	1.20	896	1.36	939	1.52	981	1.67	1023	1.82	1063	1.98	1103	2.13
2800	719	0.78	769	0.96	817	1.14	863	1.31	908	1.47	952	1.62	994	1.78	1035	1.93	1075	2.08	1115	2.24
3000	732	0.89	782	1.08	831	1.25	877	1.42	922	1.58	965	1.74	1007	1.89	1049	2.04	1089	2.19	1128	2.35
3200	747	1.02	797	1.21	846	1.38	892	1.55	937	1.71	980	1.86	1023	2.02	1064	2.17	1104	2.32	1144	2.48
3400	764	1.16	814	1.35	862	1.53	909	1.69	954	1.85	997	2.01	1039	2.16	1080	2.31	1121	2.47	1160	2.62
3600	783	1.33	833	1.51	881	1.69	927	1.86	972	2.02	1016	2.17	1058	2.32	1099	2.48	1139	2.63	1179	2.79
3800	803	1.51	853	1.69	901	1.87	948	2.04	992	2.20	1036	2.35	1078	2.50	1119	2.66	1159	2.81	1199	2.97
4000	825	1.71	875	1.89	923	2.07	970	2.23	1014	2.39	1058	2.55	1100	2.70	1141	2.86	1181	3.01	1221	3.16
4200	849	1.92	899	2.11	947	2.29	993	2.45	1038	2.61	1082	2.77	1124	2.92	1165	3.07	1205	3.23	1245	3.38
													3 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR120 (10 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP & Field Supplied Drive				Standard 2 HP & Drive								Hi Static 3 HP & Drive							
2600	706	0.67	756	0.86	805	1.04	851	1.20	896	1.36	939	1.52	981	1.67	1023	1.82	1063	1.98	1103	2.13
2800	719	0.78	769	0.96	817	1.14	863	1.31	908	1.47	952	1.62	994	1.78	1035	1.93	1075	2.08	1115	2.24
3000	732	0.89	782	1.08	831	1.25	877	1.42	922	1.58	965	1.74	1007	1.89	1049	2.04	1089	2.19	1128	2.35
3200	747	1.02	797	1.21	846	1.38	892	1.55	937	1.71	980	1.86	1023	2.02	1064	2.17	1104	2.32	1144	2.48
3400	764	1.16	814	1.35	862	1.53	909	1.69	954	1.85	997	2.01	1039	2.16	1080	2.31	1121	2.47	1160	2.62
3600	783	1.33	833	1.51	881	1.69	927	1.86	972	2.02	1016	2.17	1058	2.32	1099	2.48	1139	2.63	1179	2.79
3800	803	1.51	853	1.69	901	1.87	948	2.04	992	2.20	1036	2.35	1078	2.50	1119	2.66	1159	2.81	1199	2.97
4000	825	1.71	875	1.89	923	2.07	970	2.23	1014	2.39	1058	2.55	1100	2.70	1141	2.86	1181	3.01	1221	3.16
4200	849	1.92	899	2.11	947	2.29	993	2.45	1038	2.61	1082	2.77	1124	2.92	1165	3.07	1205	3.23	1245	3.38
4400	874	2.16	924	2.35	972	2.52	1019	2.69	1064	2.85	1107	3.01	1149	3.16	1190	3.31	-	-	-	-
4600	901	2.42	952	2.61	1000	2.78	1046	2.95	1091	3.11	1134	3.26	1177	3.42	-	-	-	-	-	-
4800	930	2.70	981	2.88	1029	3.06	1075	3.23	1120	3.39	-	-	-	-	-	-	-	-	-	-
5000	961	2.99	1011	3.18	1059	3.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
									3 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR150 (12.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	3 HP & Field Supplied Drive						Standard 3 HP & Drive													
3200	747	1.02	797	1.21	846	1.38	892	1.55	937	1.71	980	1.86	1023	2.02	1064	2.17	1104	2.32	1144	2.48
3400	764	1.16	814	1.35	862	1.53	909	1.69	954	1.85	997	2.01	1039	2.16	1080	2.31	1121	2.47	1160	2.62
3600	783	1.33	833	1.51	881	1.69	927	1.86	972	2.02	1016	2.17	1058	2.32	1099	2.48	1139	2.63	1179	2.79
3800	803	1.51	853	1.69	901	1.87	948	2.04	992	2.20	1036	2.35	1078	2.50	1119	2.66	1159	2.81	1199	2.97
4000	825	1.71	875	1.89	923	2.07	970	2.23	1014	2.39	1058	2.55	1100	2.70	1141	2.86	1181	3.01	1221	3.16
4200	849	1.92	899	2.11	947	2.29	993	2.45	1038	2.61	1082	2.77	1124	2.92	1165	3.07	1205	3.23	1245	3.38
4400	874	2.16	924	2.35	972	2.52	1019	2.69	1064	2.85	1107	3.01	1149	3.16	1190	3.31	1231	3.47	1270	3.62
4600	901	2.42	952	2.61	1000	2.78	1046	2.95	1091	3.11	1134	3.26	1177	3.42	1218	3.57	1258	3.72	1298	3.88
4800	930	2.70	981	2.88	1029	3.06	1075	3.23	1120	3.39	1163	3.54	1206	3.69	1247	3.85	1287	4.00	1327	4.16
5000	961	2.99	1011	3.18	1059	3.35	1106	3.52	1151	3.68	1194	3.84	1236	3.99	1277	4.14	1318	4.29	1357	4.45
5200	993	3.31	1043	3.49	1092	3.67	1138	3.84	1183	4.00	1226	4.15	1269	4.30	1310	4.46	1350	4.61	1390	4.77
5400	1027	3.64	1077	3.83	1126	4.00	1172	4.17	1217	4.33	1260	4.48	1302	4.64	1344	4.79	1384	4.94	1424	5.10
5600	1063	3.99	1113	4.18	1161	4.35	1207	4.52	1252	4.68	1296	4.84	1338	4.99	1379	5.14	1419	5.29	1459	5.45
5800	1100	4.36	1150	4.55	1198	4.72	1244	4.89	1289	5.05	1333	5.20	1375	5.36	1416	5.51	1456	5.66	-	-
6000	1138	4.75	1188	4.93	1237	5.11	1283	5.28	1328	5.44	1371	5.59	1413	5.74	-	-	-	-	-	-
6200	1178	5.15	1228	5.34	1277	5.51	1323	5.68	-	-	-	-	-	-	-	-	-	-	-	-
	Hi Static 5 HP & Drive				5 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR037-150 Bottom Duct Application

ZR037 (3.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive								Hi Static 1.5 HP & Drive									
900	544	0.4	632	0.5	708	0.5	774	0.6	834	0.7	889	0.8	941	0.9	993	1.0	1047	1.1	1104	1.2
1000	549	0.4	637	0.5	713	0.5	779	0.6	839	0.7	894	0.8	946	0.9	998	1.0	1052	1.1	1109	1.2
1100	562	0.4	649	0.5	725	0.6	792	0.6	852	0.7	906	0.8	959	0.9	1010	1.0	1064	1.1	1121	1.2
1200	579	0.5	666	0.5	742	0.6	809	0.6	868	0.7	923	0.8	975	0.9	1027	1.0	1081	1.1	1138	1.2
1300	598	0.5	685	0.5	761	0.6	828	0.7	887	0.8	942	0.8	994	0.9	1046	1.0	1100	1.2	1157	1.3
1400	617	0.5	705	0.6	781	0.6	847	0.7	907	0.8	962	0.9	1014	1.0	1066	1.1	1119	1.2	1177	1.3
1500	637	0.6	724	0.6	800	0.7	867	0.8	927	0.8	981	0.9	1034	1.0	1085	1.1	1139	1.2	1196	1.4
																			FS[4]	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZR049 (4.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive										Hi Static 1.5 HP & Drive									
1200	579	0.5	666	0.5	742	0.6	809	0.6	868	0.7	923	0.8	975	0.9	1027	1.0	1081	1.1	1138	1.2
1300	598	0.5	685	0.5	761	0.6	828	0.7	887	0.8	942	0.8	994	0.9	1046	1.0	1100	1.2	1157	1.3
1400	617	0.5	705	0.6	781	0.6	847	0.7	907	0.8	962	0.9	1014	1.0	1066	1.1	1119	1.2	1177	1.3
1500	637	0.6	724	0.6	800	0.7	867	0.8	927	0.8	981	0.9	1034	1.0	1085	1.1	1139	1.2	1196	1.4
1600	655	0.6	743	0.7	819	0.7	885	0.8	945	0.9	1000	1.0	1052	1.1	1104	1.2	1158	1.3	1215	1.4
1700	672	0.7	760	0.7	836	0.8	902	0.9	962	1.0	1017	1.0	1069	1.1	1121	1.2	1175	1.3	1232	1.5
1800	687	0.7	775	0.8	851	0.9	918	0.9	977	1.0	1032	1.1	1084	1.2	1136	1.3	1190	1.4	1247	1.5
1900	700	0.8	788	0.9	864	0.9	930	1.0	990	1.1	1045	1.2	1097	1.3	1149	1.4	1202	1.5	1260	1.6
2000	711	0.9	798	0.9	874	1.0	941	1.1	1000	1.2	1055	1.2	1107	1.3	1159	1.4	1213	1.6	1270	1.7
																	FS[4]			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

ZR061 (5.0 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 1.5 HP & Drive								Hi Static 2 HP & Drive											
1500	613	0.5	684	0.6	759	0.7	831	0.7	928	0.8	984	0.9	1042	1.0	1093	1.1	1149	1.2	1201	1.3
1600	629	0.6	700	0.6	775	0.7	847	0.8	929	0.8	985	0.9	1043	1.0	1098	1.1	1154	1.2	1206	1.3
1700	646	0.6	717	0.7	793	0.8	864	0.8	934	0.9	990	1.0	1048	1.1	1106	1.2	1161	1.3	1214	1.4
1800	666	0.7	737	0.7	812	0.8	884	0.9	943	1.0	999	1.1	1057	1.2	1116	1.3	1172	1.4	1224	1.5
1900	687	0.7	758	0.8	833	0.9	905	0.9	954	1.0	1010	1.1	1068	1.2	1128	1.3	1184	1.4	1236	1.5
2000	710	0.8	781	0.9	856	0.9	927	1.0	968	1.1	1024	1.2	1082	1.3	1142	1.4	1198	1.5	1250	1.6
2100	733	0.8	804	0.9	879	1.0	951	1.1	983	1.2	1039	1.3	1097	1.4	1157	1.5	1213	1.6	1265	1.7
2200	758	0.9	828	1.0	904	1.1	947	1.2	1000	1.3	1056	1.4	1116	1.5	1174	1.6	1229	1.7	1281	1.8
2300	783	1.0	854	1.1	929	1.1	964	1.3	1018	1.4	1075	1.5	1133	1.6	1191	1.7	1246	1.8	-	-
2400	809	1.1	879	1.2	932	1.3	983	1.4	1037	1.5	1094	1.6	1152	1.7	1209	1.8	-	-	-	-
2500	835	1.1	906	1.2	951	1.4	1001	1.5	1055	1.6	1112	1.7	1170	1.8	2 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR078-150 Bottom Duct Application

ZR078 (6.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive				Standard 1.5 HP & Drive						Hi Static 2 HP & Drive									
1800	801	0.45	874	0.65	946	0.82	1018	0.97	1090	1.11	1163	1.25	1238	1.38	1315	1.52	1395	1.68	1477	1.86
2000	831	0.59	903	0.78	975	0.95	1047	1.10	1119	1.24	1193	1.38	1267	1.51	1344	1.66	1424	1.81	1507	1.99
2200	867	0.74	940	0.93	1012	1.10	1084	1.25	1156	1.39	1229	1.53	1304	1.66	1381	1.81	1461	1.96	1543	2.14
2400	910	0.91	983	1.10	1055	1.27	1126	1.43	1199	1.57	1272	1.70	1347	1.84	1424	1.98	1503	2.14	-	-
2600	957	1.10	1030	1.30	1102	1.47	1174	1.62	1246	1.76	1320	1.89	1394	2.03	1471	2.17	-	-	-	-
2800	1009	1.32	1082	1.51	1154	1.69	1225	1.84	1298	1.98	1371	2.11	1446	2.25	-	-	-	-	-	-
3000	1064	1.56	1137	1.75	1208	1.92	1280	2.08	1353	2.22	-	-	-	-	-	-	-	-	-	-
3200	1122	1.82	1194	2.02	1266	2.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3400	1182	2.10	1254	2.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
					2 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR090 (7.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive		Standard 1.5 HP & Drive								Hi Static 3 HP & Drive									
2000	831	0.59	903	0.78	975	0.95	1047	1.10	1119	1.24	1193	1.38	1267	1.51	1344	1.66	1424	1.81	1507	1.99
2200	867	0.74	940	0.93	1012	1.10	1084	1.25	1156	1.39	1229	1.53	1304	1.66	1381	1.81	1461	1.96	1543	2.14
2400	910	0.91	983	1.10	1055	1.27	1126	1.43	1199	1.57	1272	1.70	1347	1.84	1424	1.98	1503	2.14	1586	2.31
2600	957	1.10	1030	1.30	1102	1.47	1174	1.62	1246	1.76	1320	1.89	1394	2.03	1471	2.17	1551	2.33	1634	2.51
2800	1009	1.32	1082	1.51	1154	1.69	1225	1.84	1298	1.98	1371	2.11	1446	2.25	1523	2.39	1602	2.55	1685	2.73
3000	1064	1.56	1137	1.75	1208	1.92	1280	2.08	1353	2.22	1426	2.35	1501	2.49	1578	2.63	1657	2.79	1740	2.96
3200	1122	1.82	1194	2.02	1266	2.19	1338	2.34	1410	2.48	1484	2.61	1559	2.75	1636	2.89	1715	3.05	1798	3.23
3400	1182	2.10	1254	2.30	1326	2.47	1398	2.62	1471	2.76	1544	2.90	1619	3.03	1696	3.17	1775	3.33	-	-
3600	1244	2.41	1317	2.60	1389	2.77	1461	2.93	1533	3.07	1606	3.20	1681	3.33	-	-	-	-	-	-
3800	1308	2.73	1381	2.93	1453	3.10	1525	3.25	1597	3.39	-	-	-	-	-	-	-	-	-	-
					3 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR102 (8.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP & Field Supplied Drive		Standard 2 HP & Drive								Hi Static 3 HP & Drive									
2200	715	0.72	768	0.85	818	0.98	867	1.09	914	1.21	960	1.32	1004	1.43	1047	1.53	1089	1.64	1131	1.75
2400	734	0.83	786	0.96	837	1.08	886	1.20	933	1.31	978	1.42	1022	1.53	1066	1.64	1108	1.75	1150	1.86
2600	755	0.95	808	1.08	858	1.20	907	1.32	954	1.44	1000	1.55	1044	1.65	1087	1.76	1129	1.87	1171	1.98
2800	779	1.09	832	1.22	882	1.35	931	1.46	978	1.58	1024	1.69	1068	1.80	1111	1.90	1153	2.01	1195	2.12
3000	806	1.25	859	1.38	910	1.51	958	1.63	1005	1.74	1051	1.85	1095	1.96	1138	2.07	1181	2.17	1222	2.28
3200	837	1.44	889	1.57	940	1.69	989	1.81	1036	1.93	1081	2.04	1125	2.14	1168	2.25	1211	2.36	1252	2.47
3400	870	1.65	922	1.78	973	1.90	1022	2.02	1069	2.13	1114	2.24	1158	2.35	1202	2.46	1244	2.57	1286	2.68
3600	906	1.88	959	2.01	1009	2.13	1058	2.25	1105	2.36	1150	2.47	1195	2.58	1238	2.69	1280	2.80	1322	2.91
3800	945	2.13	998	2.26	1048	2.38	1097	2.50	1144	2.61	1190	2.72	1234	2.83	1277	2.94	1319	3.05	1361	3.16
4000	987	2.40	1040	2.53	1090	2.66	1139	2.78	1186	2.89	1231	3.00	1276	3.11	1319	3.21	1361	3.32	1403	3.43
4200	1032	2.70	1084	2.83	1135	2.95	1184	3.07	1231	3.18	1276	3.29	1320	3.40	-	-	-	-	-	-
					3 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR120 (10 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP & Field Supplied Drive		Standard 2 HP & Drive								Hi Static 3 HP & Drive									
2600	755	0.95	808	1.08	858	1.20	907	1.32	954	1.44	1000	1.55	1044	1.65	1087	1.76	1129	1.87	1171	1.98
2800	779	1.09	832	1.22	882	1.35	931	1.46	978	1.58	1024	1.69	1068	1.80	1111	1.90	1153	2.01	1195	2.12
3000	806	1.25	859	1.38	910	1.51	958	1.63	1005	1.74	1051	1.85	1095	1.96	1138	2.07	1181	2.17	1222	2.28
3200	837	1.44	889	1.57	940	1.69	989	1.81	1036	1.93	1081	2.04	1125	2.14	1168	2.25	1211	2.36	1252	2.47
3400	870	1.65	922	1.78	973	1.90	1022	2.02	1069	2.13	1114	2.24	1158	2.35	1202	2.46	1244	2.57	1286	2.68
3600	906	1.88	959	2.01	1009	2.13	1058	2.25	1105	2.36	1150	2.47	1195	2.58	1238	2.69	1280	2.80	1322	2.91
3800	945	2.13	998	2.26	1048	2.38	1097	2.50	1144	2.61	1190	2.72	1234	2.83	1277	2.94	1319	3.05	1361	3.16
4000	987	2.40	1040	2.53	1090	2.66	1139	2.78	1186	2.89	1231	3.00	1276	3.11	1319	3.21	1361	3.32	1403	3.43
4200	1032	2.70	1084	2.83	1135	2.95	1184	3.07	1231	3.18	1276	3.29	1320	3.40	-	-	-	-	-	-
4400	1079	3.01	1132	3.15	1182	3.27	1231	3.39	-	-	-	-	-	-	-	-	-	-	-	-
4600	1129	3.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3 HP & Field Supplied Drive																			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

ZR150 (12.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	3 HP & Field Supplied Drive		Standard 3 HP & Drive										Hi Static 5 HP & Drive							
3200	837	1.44	889	1.57	940	1.69	989	1.81	1036	1.93	1081	2.04	1125	2.14	1168	2.25	1211	2.36	1252	2.47
3400	870	1.65	922	1.78	973	1.90	1022	2.02	1069	2.13	1114	2.24	1158	2.35	1202	2.46	1244	2.57	1286	2.68
3600	906	1.88	959	2.01	1009	2.13	1058	2.25	1105	2.36	1150	2.47	1195	2.58	1238	2.69	1280	2.80	1322	2.91
3800	945	2.13	998	2.26	1048	2.38	1097	2.50	1144	2.61	1190	2.72	1234	2.83	1277	2.94	1319	3.05	1361	3.16
4000	987	2.40	1040	2.53	1090	2.66	1139	2.78	1186	2.89	1231	3.00	1276	3.11	1319	3.21	1361	3.32	1403	3.43
4200	1032	2.70	1084	2.83	1135	2.95	1184	3.07	1231	3.18	1276	3.29	1320	3.40	1364	3.51	1406	3.62	1447	3.73
4400	1079	3.01	1132	3.15	1182	3.27	1231	3.39	1278	3.50	1324	3.61	1368	3.72	1411	3.83	1453	3.93	1495	4.05
4600	1129	3.35	1182	3.48	1232	3.61	1281	3.72	1328	3.84	1374	3.95	1418	4.06	1461	4.16	1503	4.27	1545	4.38
4800	1182	3.71	1235	3.84	1285	3.96	1334	4.08	1381	4.20	1426	4.31	1471	4.41	1514	4.52	1556	4.63	1598	4.74
5000	1237	4.08	1290	4.22	1340	4.34	1389	4.46	1436	4.57	1481	4.68	1526	4.79	1569	4.90	1611	5.01	1653	5.12
5200	1294	4.48	1347	4.61	1398	4.74	1446	4.85	1493	4.97	1539	5.08	1583	5.19	1626	5.29	1669	5.40	1710	5.51
5400	1354	4.89	1407	5.03	1457	5.15	1506	5.27	1553	5.38	1599	5.49	1643	5.60	1686	5.71	-	-	-	-
5600	1416	5.33	1469	5.46	1519	5.58	1568	5.70	-	-	-	-	-	-	-	-	-	-	-	-
5800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5 HP & Field Supplied Drive																			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

Sound Performance

Indoor Sound Power Levels (3 thru 5 Ton)

Indoor Sound Power Levels (Horizontal Ducted Inlet, Standard Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet			
Indoor Blower Speed (RPM)	612 - 3 Turns Open Equivalent		709 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.5		0.4	
Airflow (CFM)	850		1300	
Blower Motor BHP	0.37		0.40	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	73	77	73	77
125	61	70	66	71
250	56	63	60	64
500	51	56	55	57
1000	44	48	51	52
2000	41	44	48	49
4000	44	47	47	48
8000	42	44	43	44

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet			
Indoor Blower Speed (RPM)	612 - 3 Turns Open Equivalent		709 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.5		0.4	
Airflow (CFM)	850		1300	
Blower Motor BHP	0.37		0.40	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	73	77	73	77
125	61	70	66	71
250	56	63	60	64
500	51	56	55	57
1000	44	48	51	52
2000	41	44	48	49
4000	44	47	47	48
8000	42	44	43	44

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet			
Indoor Blower Speed (RPM)	814 - 3 Turns Open Equivalent		918 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.6		0.8	
Airflow (CFM)	1700		1950	
Blower Motor BHP	0.42		0.88	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	77	81	85	82
125	71	80	68	81
250	63	67	64	68
500	58	60	60	61
1000	56	57	58	59
2000	52	53	55	55
4000	51	51	54	54
8000	47	47	48	48

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Horizontal Ducted Discharge, Standard Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	610 - 3 Turns Open Equivalent		710 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.5		0.6	
Airflow (CFM)	850		950	
Blower Motor BHP	0.37		0.42	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	77	78	79	79
125	74	75	75	76
250	66	68	70	70
500	61	61	65	64
1000	60	62	65	66
2000	52	52	58	58
4000	52	52	59	60
8000	44	44	50	50

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	610 - 3 Turns Open Equivalent		710 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.5		0.6	
Airflow (CFM)	850		950	
Blower Motor BHP	0.37		0.42	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	77	78	79	79
125	74	75	75	76
250	66	68	70	70
500	61	61	65	64
1000	60	62	65	66
2000	52	52	58	58
4000	52	52	59	60
8000	44	44	50	50

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	810 - 3 Turns Open Equivalent		918 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.4		0.8	
Airflow (CFM)	2050		1950	
Blower Motor BHP	0.73		0.88	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	85	83	83	83
125	78	79	76	79
250	69	70	69	70
500	68	68	68	68
1000	64	64	65	65
2000	63	63	64	64
4000	64	64	64	64
8000	59	59	59	60

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Vertical Ducted Inlet, Standard Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet			
Indoor Blower Speed (RPM)	609 - 3 Turns Open Equivalent		708 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.4		0.4	
Airflow (CFM)	850		1150	
Blower Motor BHP	0.32		0.38	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	76	76	74	76
125	63	70	66	70
250	55	62	59	62
500	54	55	58	59
1000	48	48	53	53
2000	44	44	48	48
4000	41	44	45	46
8000	42	43	43	44

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet			
Indoor Blower Speed (RPM)	609 - 3 Turns Open Equivalent		708 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.4		0.4	
Airflow (CFM)	850		1150	
Blower Motor BHP	0.32		0.38	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	76	76	74	76
125	63	70	66	70
250	55	62	59	62
500	54	55	58	59
1000	48	48	53	53
2000	44	44	48	48
4000	41	44	45	46
8000	42	43	43	44

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet			
Indoor Blower Speed (RPM)	812 - 3 Turns Open Equivalent		915- 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.6		0.8	
Airflow (CFM)	1575		1800	
Blower Motor BHP	0.64		0.83	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	75	78	80	80
125	66	80	69	81
250	59	66	62	65
500	60	60	63	63
1000	57	57	60	60
2000	52	53	55	55
4000	49	50	53	53
8000	44	45	47	47

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Vertical Ducted Discharge, Standard Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	609 - 3 Turns Open Equivalent		712 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.4		0.6	
Airflow (CFM)	850		950	
Blower Motor BHP	0.32		0.42	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	76	77	81	81
125	68	68	72	72
250	55	65	57	57
500	56	57	57	57
1000	51	57	52	56
2000	49	49	50	50
4000	48	48	49	51
8000	46	46	47	48

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	609 - 3 Turns Open Equivalent		712 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.4		0.6	
Airflow (CFM)	850		950	
Blower Motor BHP	0.32		0.42	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	76	77	81	81
125	68	68	72	72
250	55	65	57	57
500	56	57	57	57
1000	51	57	52	56
2000	49	49	50	50
4000	48	48	49	51
8000	46	46	47	48

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / Standard Static Belt Drive			
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge			
Indoor Blower Speed (RPM)	809 - 3 Turns Open Equivalent		914 - 1 Turn Open Equivalent	
External Static Pressure (IWG)	0.5		0.8	
Airflow (CFM)	1700		1800	
Blower Motor BHP	0.64		0.83	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	81	81	79	79
125	75	75	75	76
250	65	65	63	63
500	67	67	67	67
1000	63	63	63	63
2000	61	62	61	61
4000	62	62	61	61
8000	57	57	56	56

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Horizontal Ducted Inlet, High Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet					
Indoor Blower Speed (RPM)	876 - 4 Turns Open Equivalent		1,064 - 1/2 Turn Open Equivalent		1,190 - 2.5 Turns Open Equivalent[1]	
External Static Pressure (IWG)	1.0		1.6		2.0 [1]	
Nominal Airflow (CFM)	1,200		1,100		1,000	
Blower Motor BHP	0.64		0.93		1.08	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)
63	75	80	81	81	81	83
125	69	71	71	73	73	75
250	62	68	66	71	68	70
500	54	56	57	59	59	60
1000	52	56	56	58	58	60
2000	47	49	52	52	54	56
4000	43	45	48	49	51	53
8000	43	45	45	46	47	48

1. Requires driven pulley #AK-56, normal high static pulley is an #AK-69.
2. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet					
Indoor Blower Speed (RPM)	965 - 5.5 Turns Open Equivalent		1,088 - 4 Turns Open Equivalent		1,186 - 2.5 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	1,600		1,400		1,200	
Blower Motor BHP	0.86		1.03		1.13	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	74	80	77	80	81	81
125	69	74	72	75	75	76
250	68	68	68	69	70	71
500	62	62	60	61	61	63
1000	60	61	58	58	59	60
2000	57	57	53	54	55	56
4000	56	56	49	50	51	52
8000	54	54	45	47	47	48

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Return) Ducted Inlet					
Indoor Blower Speed (RPM)	1,012- 5.5 Turns Open Equivalent		1,134 - 3 Turns Open Equivalent		1,174 - 2 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	2,000		1,800		1,600	
Blower Motor BHP	1.04		1.25		1.39	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	76	78	78	79	79	81
125	70	73	73	76	74	77
250	68	70	68	69	69	70
500	61	62	61	62	60	62
1000	61	62	61	62	58	60
2000	57	58	57	58	54	56
4000	56	56	55	56	52	53
8000	50	50	50	50	47	48

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Horizontal Ducted Discharge, High Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	896 - 3.5 Turns Open Equivalent		1,072 - Fully Closed Equivalent		1,170 - 2.5 Turns Open Equivalent[1]	
External Static Pressure (IWG)	1.0		1.6		2.0 [1]	
Nominal Airflow (CFM)	1,200		1,100		1,000	
Blower Motor BHP	0.64		0.93		1.08	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)
63	77	81	83	84	83	84
125	74	76	76	77	80	80
250	67	68	70	70	72	73
500	65	66	67	67	67	68
1000	61	62	67	67	66	69
2000	58	60	63	63	63	64
4000	57	59	62	62	62	63
8000	51	53	56	57	56	58

1. Requires driven pulley #AK-56, normal high static pulley is an #AK-69.
2. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	922 - 6 Turns Open Equivalent		1,069 - 4 Turns Open Equivalent		1,165 - 2.5 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	1,600		1,400		1,200	
Blower Motor BHP	0.86		1.03		1.13	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	80	82	82	83	84	84
125	76	77	76	77	78	79
250	71	72	72	72	74	74
500	69	69	69	69	70	70
1000	65	65	69	69	70	70
2000	64	64	64	64	65	65
4000	63	63	63	63	64	64
8000	58	58	58	58	59	59

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / High Static Belt Drive					
TEST CONFIGURATION	Horizontal (Side Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	1,009- 5.5 Turns Open Equivalent		1,131 - 3 Turns Open Equivalent		1,184 - 2 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	2,000		1,800		1,600	
Blower Motor BHP	1.04		1.25		1.39	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	84	85	82	83	82	83
125	78	79	79	79	78	79
250	75	75	74	75	73	73
500	71	71	70	71	69	69
1000	69	69	71	71	71	72
2000	66	67	67	67	66	66
4000	66	66	66	67	66	66
8000	61	62	61	62	60	60

1. Cooling Operation – ID blower, compressor and outdoor fan operating at 230 VAC.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Vertical Ducted Inlet, High Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet					
Indoor Blower Speed (RPM)	927 - 3 Turns Open Equivalent		1,085 - 1/2 Turn Open Equivalent		1,190 - 2.5 Turns Open Equivalent[1]	
External Static Pressure (IWG)	1.0		1.6		2.0[1]	
Nominal Airflow (CFM)	1,200		1,100		1,000	
Blower Motor BHP	0.68		0.93		1.09	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)
63	77	79	82	83	79	81
125	68	69	70	71	72	73
250	60	67	62	69	64	67
500	58	58	63	63	62	63
1000	54	55	60	60	60	60
2000	48	49	56	56	55	55
4000	43	44	48	49	51	51
8000	44	44	45	46	47	47

1. Requires driven pulley #AK-56, normal high static pulley is an #AK-69.
2. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet					
Indoor Blower Speed (RPM)	968 - 5.5 Turns Open Equivalent		1,120 - 3.5 Turns Open Equivalent		1,218 - 2.0 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	1,600		1,400		1,200	
Blower Motor BHP	0.86		1.03		1.13	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	77	79	78	78	81	81
125	69	73	71	73	73	74
250	63	63	63	64	66	66
500	63	64	62	63	64	64
1000	59	59	59	59	61	61
2000	54	54	53	54	56	56
4000	49	49	48	48	50	51
8000	45	46	45	46	47	47

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Return) Ducted Inlet					
Indoor Blower Speed (RPM)	1,039 - 5 Turns Open Equivalent		1,143 - 3 Turns Open Equivalent		1,201 - 2 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	2,000		1,800		1,600	
Blower Motor BHP	1.11		1.25		1.39	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	79	80	77	77	81	81
125	74	75	71	73	73	74
250	63	65	63	64	63	65
500	62	63	64	64	62	62
1000	61	61	61	61	59	59
2000	55	56	55	56	54	55
4000	52	52	50	51	50	50
8000	47	47	46	46	46	46

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (Vertical Ducted Discharge, High Static Belt Drive)

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR037 / 3 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	920 - 3.0 Turns Open Equivalent		1,074 - Fully Closed Equivalent		1,189 - 2.0 Turns Open Equivalent[1]	
External Static Pressure (IWG)	1.0		1.6		2.0[1]	
Nominal Airflow (CFM)	1,200		1,100		1,000	
Blower Motor BHP	0.68		0.93		1.09	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)	ID Blower Only (dB)	Cooling Operation[2] (dB)
63	81	82	81	81	82	82
125	78	78	78	78	81	81
250	69	70	70	71	74	74
500	67	68	68	69	71	71
1000	62	63	67	68	70	71
2000	60	61	62	63	65	66
4000	61	61	63	63	66	66
8000	54	55	57	57	60	61

1. Requires driven pulley #AK-56, normal high static pulley is an #AK-69.
2. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.

- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR049 / 4 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	962 - 5.5 Turns Open Equivalent		1,092 - 3.5 Turns Open Equivalent		1,190 - 2.0 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	1,600		1,400		1,200	
Blower Motor BHP	0.86		1.03		1.13	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	83	84	82	82	83	83
125	80	81	79	80	80	81
250	75	75	74	75	75	75
500	71	72	70	71	71	72
1000	66	67	70	71	72	72
2000	63	64	64	64	65	65
4000	64	64	64	64	65	66
8000	58	59	59	59	60	60

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.
- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

UNIT DESCRIPTION / MODEL	ZH/ZJ/ZR061 / 5 Ton / High Static Belt Drive					
TEST CONFIGURATION	Vertical (Bottom Supply) Ducted Discharge					
Indoor Blower Speed (RPM)	1,033 - 5.5 Turns Open Equivalent		1,135 - 3 turns Open Equivalent		1,175 - 2.5 Turns Open Equivalent	
External Static Pressure (IWG)	1.0		1.6		2.0	
Nominal Airflow (CFM)	2,000		1,135		1,175	
Blower Motor BHP	1.11		1.25		1.39	
Octave Center Freq. Hz	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)	ID Blower Only (dB)	Cooling Operation[1] (dB)
63	83	83	83	83	85	86
125	84	84	82	82	79	81
250	79	80	77	78	66	66
500	73	73	70	71	65	66
1000	69	70	69	70	61	65
2000	67	67	65	66	60	61
4000	67	68	66	67	61	62
8000	62	63	60	61	54	54

1. Differentials for Cooling Operation (IDB, COMP, & ODF) are logarithmically calculated from the horizontal flow sound test.
- Tested in accordance with AHRI Standard 260-2001. Refer to 2001 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
- Testing datum includes effect of standard inlet air filters.
- Test duct dimension: 18 in. wide x 28 in. high x 8 ft. long, no elbows.
- Test duct termination is flush with reverberant room wall.
- Duct end (sound reflection) corrections included: (7.2, 3.4, 1.2, 0.4, 0.1, 0, 0, 0) dB at (63, 125, 250, 500, 1k, 2k, 4k, 8k) Hz respectively.

Indoor Sound Power Levels (6.5 thru 12.5 Ton)

Size (Tons)	Model	CFM	ESP (IWG)	Blower		Sound Power, dB (10^{-12}) Watts								
						Sound Rating[1] dB (A)	Octave Band Centerline Frequency (Hz)							
				RPM	BHP		63	125	250	500	1000	2000	4000	8000
078 (6.5)	ZH/ZJ/ZR	2600	0.6	812	1.14	74	71	73	73	71	69	65	65	60
090 (7.5)	ZH/ZJ/ZR	3000	0.6	854	1.47	77	74	76	76	74	72	68	68	63
102 (8.5)	ZH/ZJ/ZR	3400	0.6	872	1.65	80	77	79	79	77	75	71	71	66
120 (10)	ZH/ZJ/ZR	4000	0.6	959	2.29	83	80	82	82	80	78	74	74	69
150 (12.5)	ZH/ZJ/ZR	5000	0.6	1132	3.74	87	84	86	86	84	82	78	78	73

1. These values have been accessed using a model of sound propagation from a point source into the hemispheric/free field. The dBA values provided are to be used for reference only. Calculation of dBA values cover matters of system design and the fan manufacture has no way of knowing the details of each system. This constitutes an exception to any specification or guarantee requiring a dBA value of sound data in any other form than sound power level ratings.

Outdoor Sound Power Levels
ZH/ZJ/ZR037-150

Size (Tons)	Model	Sound Rating[1] dB (A)	Octave Band Centerline Frequency (Hz)							
			63	125	250	500	1000	2000	4000	8000
037 (3)	ZH	81	82.5	86.5	78.0	75.5	76.5	68.5	63.0	56.5
049 (4)	ZH	78	82.0	86.0	78.5	75.5	73.0	68.0	63.0	56.0
061 (5)	ZH	84	81.0	91.0	82.5	80.5	79.0	73.5	69.5	64.5
078 (6.5)	ZH	87	89.0	88.5	84.5	84.5	82.0	76.5	72.0	66.5
090 (7.5)	ZH	92	93.0	92.0	90.5	88.0	86.5	83.0	77.5	73.5
102 (8.5)	ZH	92	97.0	94.0	93.5	90.5	87.0	81.5	76.0	69.0
120 (10)	ZH	91	99.5	91.5	91.5	89.0	86.0	80.5	76.5	71.0
150 (12.5)	ZH	86	89.5	91.0	85.5	84.0	81.0	76.5	71.0	62.5
037 (3)	ZJ	77	82.0	83.5	80.0	73.0	70.0	65.5	60.5	55.5
049 (4)	ZJ	80	80.0	87.0	77.0	75.5	75.0	70.5	65.5	62.0
061 (5)	ZJ	84	86.5	87.0	86.0	79.0	76.5	71.5	68.0	64.0
078 (6.5)	ZJ	85	87.5	85.0	84.0	82.0	80.0	75.5	71.5	67.0
090 (7.5)	ZJ	90	90.0	93.0	90.5	86.0	83.5	81.5	78.0	75.0
102 (8.5)	ZJ	92	97.0	94.0	93.5	90.5	87.0	81.5	76.0	69.0
120 (10)	ZJ	91	99.5	91.5	91.5	89.0	86.0	80.5	76.5	71.0
150 (12.5)	ZJ	85	89.0	88.0	83.5	83.5	78.5	74.0	69.5	64.5
037 (3)	ZR	77	82.0	83.5	80.0	73.0	70.0	65.5	60.5	55.5
049 (4)	ZR	81	87.5	88.5	83.0	77.5	73.5	70.5	67.0	62.0
61 (5)	ZR	84	86.5	87.0	86.0	79.0	76.5	71.5	68.0	64.0
078 (6.5)	ZR	83	~	88.0	82.5	81.5	78.0	73.0	69.0	62.0
090 (7.5)	ZR	83	~	89.5	83.5	82.0	78.0	72.5	68.0	60.5
102 (8.5)	ZR	83	~	89.0	84.5	81.5	78.0	72.5	68.5	70.5
120 (10)	ZR	83	~	89.5	83.5	81.0	78.0	72.0	68.5	70.5
150 (12.5)	ZR	84	~	90.0	84.5	81.5	77.5	72.0	68.5	61.5

1. Rated in accordance with AHRI 270 standard.

Electrical Data

ZH037-061 Standard Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	9.1	68.0	14.2	2.1	5.2	5.5	0.0	None	-	-	-	18.7	24.2	25	30
									E03	2.3	1	6.4	18.7	24.2	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	9.1	68.0	14.2	2.1	5.2	5.5	0.0	None	-	-	-	18.7	24.2	25	30
									E03	3.0	1	7.2	18.7	24.2	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.5	34.0	7.0	1.3	2.6	2.2	0.0	None	-	-	-	9.5	11.7	15	15
									E03	3.0	1	3.6	9.5	11.7	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.8	28.0	6.0	0.7	2.0	1.8	0.0	None	-	-	-	7.4	9.2	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.6	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.8	27.3	30	35
									E06	4.5	1	12.5	22.1	29.0	30	35
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.6	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.8	27.3	30	35
									E06	6.0	1	14.4	24.5	31.4	30	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.6	44.0	8.0	1.3	2.6	2.2	0.0	None	-	-	-	10.9	13.1	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.5	36.0	7.0	0.7	2.0	1.8	0.0	None	-	-	-	8.3	10.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	4.5	1	12.5	27.0	32.5	35	45
									E09	6.8	1	18.9	30.1	37.0	40	45
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
	230	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	6.0	1	14.4	27.0	32.5	35	45
									E09	9.0	1	21.7	33.6	40.4	40	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
									E24	24.0	2	57.7	78.7	85.5	80	90
	460	7.7	55.0	12.0	1.3	2.6	2.2	0.0	None	-	-	-	14.7	16.9	20	20
									E06	6.0	1	7.2	14.7	16.9	20	20
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
									E24	24.0	2	28.9	39.3	42.1	40	45
	575	5.1	36.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	9.7	11.5	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
									E24	24.0	2	23.1	31.4	33.6	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Standard Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.6	68.0	14.5	2.1	5.2	5.5	0.0	None	-	-	-	31.0	36.5	40	45
									E09	6.8	1	18.9	31.0	37.0	40	45
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	9.6	68.0	14.5	2.1	5.2	5.5	0.0	None	-	-	-	31.0	36.5	40	45
									E09	9.0	1	21.7	33.6	40.4	40	45
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	4.9	34.0	7.7	1.3	2.6	2.2	0.0	None	-	-	-	16.1	18.3	20	20
									E09	9.0	1	10.8	16.8	19.5	20	20
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	3.8	28.0	6.0	0.7	2.0	1.8	0.0	None	-	-	-	11.9	13.7	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
090 (7.5)	208	11.9	88.0	18.5	3.0	5.2	5.5	0.0	None	-	-	-	38.0	43.5	45	50
									E09	6.8	1	18.9	38.0	43.5	45	50
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	11.9	88.0	18.5	3.0	5.2	5.5	0.0	None	-	-	-	38.0	43.5	45	50
									E09	9.0	1	21.7	38.0	43.5	45	50
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	5.2	44.0	8.1	1.6	2.6	2.2	0.0	None	-	-	-	17.5	19.7	20	20
									E09	9.0	1	10.8	17.5	19.7	20	20
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	4.8	36.0	7.5	1.4	2.0	1.8	0.0	None	-	-	-	15.5	17.3	20	20
									E09	9.0	1	8.7	15.5	17.3	20	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
102 (8.5)	208	12.2	88.0	19.0	3.0	6.8	5.5	0.0	None	-	-	-	40.3	45.8	50	50
									E09	6.8	1	18.9	40.3	45.8	50	50
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	12.2	88.0	19.0	3.0	6.8	5.5	0.0	None	-	-	-	40.3	45.8	50	50
									E09	9.0	1	21.7	40.3	45.8	50	50
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	5.8	44.0	9.0	1.6	3.4	2.2	0.0	None	-	-	-	19.7	21.9	25	25
									E09	9.0	1	10.8	19.7	21.9	25	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	4.4	36.0	5.5	1.4	2.4	1.8	0.0	None	-	-	-	15.0	16.8	15	20
									E09	9.0	1	8.7	15.0	16.8	15	20
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50

ZH078-150 Standard Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
									E54	40.6	2	112.7	149.4	156.2	150	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
									E54	54.0	2	129.9	138.4	145.3	150	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	0.0	None	-	-	-	24.2	26.4	30	30
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
									E54	54.0	2	65.0	69.2	72.0	80	80
	575	5.7	38.9	8.9	1.4	2.4	1.8	0.0	None	-	-	-	17.9	19.7	20	25
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
									E54	54.0	2	52.0	55.0	57.2	60	60
150 (12.5)	208	23.1	160.0	36.0	2.1	9.6	5.5	0.0	None	-	-	-	70.0	75.5	90	90
									E18	13.5	2	37.5	70.0	75.5	90	90
									E24	18.0	2	50.0	74.5	81.3	90	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	23.1	160.0	36.0	2.1	9.6	5.5	0.0	None	-	-	-	70.0	75.5	90	90
									E18	18.0	2	43.3	70.0	75.5	90	90
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	12.2	87.0	19.0	1.3	4.7	2.2	0.0	None	-	-	-	37.2	39.4	45	50
									E18	18.0	2	21.7	37.2	39.4	45	50
									E24	24.0	2	28.9	42.0	44.7	45	50
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	8.7	62.0	13.5	0.7	3.6	1.8	0.0	None	-	-	-	25.8	27.6	30	35
									E18	18.0	2	17.3	26.2	28.4	30	35
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH037-061 Hi Static Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	9.1	68.0	14.2	2.1	5.2	5.5	0.0	None	-	-	-	18.7	24.2	25	30
									E03	2.3	1	6.4	18.7	24.2	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	9.1	68.0	14.2	2.1	5.2	5.5	0.0	None	-	-	-	18.7	24.2	25	30
									E03	3.0	1	7.2	18.7	24.2	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.5	34.0	7.0	1.3	2.6	2.2	0.0	None	-	-	-	9.5	11.7	15	15
									E03	3.0	1	3.6	9.5	11.7	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.8	28.0	6.0	0.7	2.0	1.8	0.0	None	-	-	-	7.4	9.2	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.6	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.8	27.3	30	35
									E06	4.5	1	12.5	22.1	29.0	30	35
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.6	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.8	27.3	30	35
									E06	6.0	1	14.4	24.5	31.4	30	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.6	44.0	8.0	1.3	2.6	2.2	0.0	None	-	-	-	10.9	13.1	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.5	36.0	7.0	0.7	2.0	1.8	0.0	None	-	-	-	8.3	10.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	4.5	1	12.5	28.6	34.1	40	45
									E09	6.8	1	18.9	32.1	39.0	40	45
									E15	11.3	2	31.4	47.7	54.6	50	60
									E20	15.0	2	41.6	60.5	67.4	70	70
									E24	18.0	2	50.0	71.0	77.8	80	80
	230	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	6.0	1	14.4	28.6	34.1	40	45
									E09	9.0	1	21.7	35.6	42.4	40	45
									E15	15.0	2	36.1	53.6	60.5	60	70
									E20	20.0	2	48.1	68.6	75.5	70	80
									E24	24.0	2	57.7	80.7	87.5	90	90
	460	7.7	55.0	12.0	1.3	3.4	2.2	0.0	None	-	-	-	15.5	17.7	20	25
									E06	6.0	1	7.2	15.5	17.7	20	25
									E09	9.0	1	10.8	17.8	20.5	20	25
									E15	15.0	2	18.0	26.8	29.6	30	30
									E20	20.0	2	24.1	34.3	37.1	35	40
									E24	24.0	2	28.9	40.3	43.1	45	45
	575	5.1	36.0	7.5	0.7	2.4	1.8	0.0	None	-	-	-	10.1	11.9	15	15
									E09	9.0	1	8.7	13.8	16.1	15	20
									E15	15.0	2	14.4	21.0	23.3	25	25
									E20	20.0	2	19.2	27.1	29.3	30	30
									E24	24.0	2	23.1	31.9	34.1	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Hi Static Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.6	68.0	14.5	2.1	6.8	5.5	0.0	None	-	-	-	32.6	38.1	40	45
									E09	6.8	1	18.9	32.6	39.0	40	45
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	9.6	68.0	14.5	2.1	6.8	5.5	0.0	None	-	-	-	32.6	38.1	40	45
									E09	9.0	1	21.7	35.6	42.4	40	45
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	4.9	34.0	7.7	1.3	3.4	2.2	0.0	None	-	-	-	16.9	19.1	20	20
									E09	9.0	1	10.8	17.8	20.5	20	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	3.8	28.0	6.0	0.7	2.4	1.8	0.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	13.8	16.1	15	20
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
090 (7.5)	208	11.9	88.0	18.5	3.0	9.6	5.5	0.0	None	-	-	-	42.4	47.9	50	50
									E09	6.8	1	18.9	42.4	47.9	50	50
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	11.9	88.0	18.5	3.0	9.6	5.5	0.0	None	-	-	-	42.4	47.9	50	50
									E09	9.0	1	21.7	42.4	47.9	50	50
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	5.2	44.0	8.1	1.6	4.7	2.2	0.0	None	-	-	-	19.6	21.8	20	25
									E09	9.0	1	10.8	19.6	22.2	20	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	4.8	36.0	7.5	1.4	3.6	1.8	0.0	None	-	-	-	17.1	18.9	20	20
									E09	9.0	1	8.7	17.1	18.9	20	20
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
102 (8.5)	208	12.2	88.0	19.0	3.0	9.6	5.5	0.0	None	-	-	-	43.1	48.6	50	60
									E09	6.8	1	18.9	43.1	48.6	50	60
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	12.2	88.0	19.0	3.0	9.6	5.5	0.0	None	-	-	-	43.1	48.6	50	60
									E09	9.0	1	21.7	43.1	48.6	50	60
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	5.8	44.0	9.0	1.6	4.7	2.2	0.0	None	-	-	-	21.0	23.2	25	25
									E09	9.0	1	10.8	21.0	23.2	25	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	4.4	36.0	5.5	1.4	3.6	1.8	0.0	None	-	-	-	16.2	18.0	20	20
									E09	9.0	1	8.7	16.2	18.0	20	20
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50

ZH078-150 Hi Static Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	0.0	None	-	-	-	25.5	27.7	30	35
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	5.7	38.9	8.9	1.4	3.6	1.8	0.0	None	-	-	-	19.1	20.9	20	25
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	14.0	5.5	0.0	None	-	-	-	74.4	79.9	90	100
									E18	13.5	2	37.5	74.4	79.9	90	100
									E24	18.0	2	50.0	80.0	86.8	90	100
									E36	25.5	2	70.8	106.0	112.9	110	125
									E54	40.6	2	112.7	158.4	165.2	175	175
	230	23.1	160.0	36.0	2.1	14.0	5.5	0.0	None	-	-	-	74.4	79.9	90	100
									E18	18.0	2	43.3	74.4	79.9	90	100
									E24	24.0	2	57.7	89.7	96.5	90	100
									E36	34.0	2	81.8	119.7	126.6	125	150
									E54	54.0	2	129.9	147.4	154.3	175	175
	460	12.2	87.0	19.0	1.3	6.6	2.2	0.0	None	-	-	-	39.1	41.3	50	50
									E18	18.0	2	21.7	39.1	41.3	50	50
									E24	24.0	2	28.9	44.3	47.1	50	50
									E36	34.0	2	40.9	59.4	62.1	60	70
									E54	54.0	2	65.0	73.2	76.0	80	90
	575	8.7	62.0	13.5	0.7	5.2	1.8	0.0	None	-	-	-	27.4	29.2	35	35
									E18	18.0	2	17.3	28.2	30.4	35	35
									E24	24.0	2	23.1	35.4	37.6	40	40
									E36	34.0	2	32.7	47.4	49.6	50	50
									E54	54.0	2	52.0	58.5	60.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH037-061 Standard Indoor Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	9.1	68.0	14.2	2.1	5.2	5.5	10.0	None	-	-	-	28.9	34.4	35	40
									E03	2.3	1	6.4	28.9	34.4	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	9.1	68.0	14.2	2.1	5.2	5.5	10.0	None	-	-	-	28.9	34.4	35	40
									E03	3.0	1	7.2	28.9	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.5	34.0	7.0	1.3	2.6	2.2	5.0	None	-	-	-	14.6	16.8	15	20
									E03	3.0	1	3.6	14.6	16.8	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.8	28.0	6.0	0.7	2.0	1.8	4.0	None	-	-	-	11.5	13.3	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.6	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.8	37.3	40	45
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.6	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.8	37.3	40	45
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.6	44.0	8.0	1.3	2.6	2.2	5.0	None	-	-	-	15.9	18.1	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.5	36.0	7.0	0.7	2.0	1.8	4.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	4.5	1	12.5	37.0	42.5	50	50
									E09	6.8	1	18.9	42.6	49.5	50	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
									E24	18.0	2	50.0	81.5	88.3	90	90
	230	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	6.0	1	14.4	37.0	43.9	50	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
									E24	24.0	2	57.7	91.2	98.0	100	100
	460	7.7	55.0	12.0	1.3	2.6	2.2	5.0	None	-	-	-	19.7	21.9	25	25
									E06	6.0	1	7.2	19.7	21.9	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
									E24	24.0	2	28.9	45.6	48.3	50	50
	575	5.1	36.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	13.7	15.5	15	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
									E24	24.0	2	23.1	36.4	38.6	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Standard Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.6	68.0	14.5	2.1	5.2	5.5	10.0	None	-	-	-	41.1	46.6	50	50
									E09	6.8	1	18.9	42.6	49.5	50	50
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	9.6	68.0	14.5	2.1	5.2	5.5	10.0	None	-	-	-	41.1	46.6	50	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	4.9	34.0	7.7	1.3	2.6	2.2	5.0	None	-	-	-	21.2	23.4	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	3.8	28.0	6.0	0.7	2.0	1.8	4.0	None	-	-	-	15.9	17.7	20	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
090 (7.5)	208	11.9	88.0	18.5	3.0	5.2	5.5	10.0	None	-	-	-	48.0	53.5	50	60
									E09	6.8	1	18.9	48.0	53.5	50	60
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	11.9	88.0	18.5	3.0	5.2	5.5	10.0	None	-	-	-	48.0	53.5	50	60
									E09	9.0	1	21.7	48.0	53.5	50	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	5.2	44.0	8.1	1.6	2.6	2.2	5.0	None	-	-	-	22.5	24.7	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	4.8	36.0	7.5	1.4	2.0	1.8	4.0	None	-	-	-	19.5	21.3	20	25
									E09	9.0	1	8.7	19.5	21.3	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
102 (8.5)	208	12.2	88.0	19.0	3.0	6.8	5.5	10.0	None	-	-	-	50.3	55.8	60	60
									E09	6.8	1	18.9	50.3	55.8	60	60
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	12.2	88.0	19.0	3.0	6.8	5.5	10.0	None	-	-	-	50.3	55.8	60	60
									E09	9.0	1	21.7	50.3	55.8	60	60
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	5.8	44.0	9.0	1.6	3.4	2.2	5.0	None	-	-	-	24.7	26.9	30	30
									E09	9.0	1	10.8	24.7	26.9	30	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	4.4	36.0	5.5	1.4	2.4	1.8	4.0	None	-	-	-	19.0	20.8	20	25
									E09	9.0	1	8.7	19.0	21.1	20	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60

ZH078-150 Standard Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
									E54	40.6	2	112.7	161.9	168.7	175	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
									E54	54.0	2	129.9	150.9	157.8	175	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	5.0	None	-	-	-	29.2	31.4	35	35
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
									E54	54.0	2	65.0	75.5	78.2	80	90
	575	5.7	38.9	8.9	1.4	2.4	1.8	4.0	None	-	-	-	21.9	23.7	25	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
									E54	54.0	2	52.0	60.0	62.2	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	9.6	5.5	10.0	None	-	-	-	80.0	85.5	100	100
									E18	13.5	2	37.5	80.0	85.5	100	100
									E24	18.0	2	50.0	87.0	93.8	100	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	23.1	160.0	36.0	2.1	9.6	5.5	10.0	None	-	-	-	80.0	85.5	100	100
									E18	18.0	2	43.3	80.0	85.5	100	100
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	12.2	87.0	19.0	1.3	4.7	2.2	5.0	None	-	-	-	42.2	44.4	50	50
									E18	18.0	2	21.7	42.2	44.4	50	50
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	8.7	62.0	13.5	0.7	3.6	1.8	4.0	None	-	-	-	29.8	31.6	35	40
									E18	18.0	2	17.3	31.2	33.4	35	40
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH037-061 Hi Static Indoor Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	9.1	68.0	14.2	2.1	5.2	5.5	10.0	None	-	-	-	28.9	34.4	35	40
									E03	2.3	1	6.4	28.9	34.4	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	9.1	68.0	14.2	2.1	5.2	5.5	10.0	None	-	-	-	28.9	34.4	35	40
									E03	3.0	1	7.2	28.9	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.5	34.0	7.0	1.3	2.6	2.2	5.0	None	-	-	-	14.6	16.8	15	20
									E03	3.0	1	3.6	14.6	16.8	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.8	28.0	6.0	0.7	2.0	1.8	4.0	None	-	-	-	11.5	13.3	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.6	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.8	37.3	40	45
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.6	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.8	37.3	40	45
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.6	44.0	8.0	1.3	2.6	2.2	5.0	None	-	-	-	15.9	18.1	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.5	36.0	7.0	0.7	2.0	1.8	4.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	4.5	1	12.5	38.6	44.1	50	50
									E09	6.8	1	18.9	44.6	51.5	50	60
									E15	11.3	2	31.4	60.2	67.1	70	70
									E20	15.0	2	41.6	73.0	79.9	80	80
									E24	18.0	2	50.0	83.5	90.3	90	100
	230	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	6.0	1	14.4	39.0	45.9	50	50
									E09	9.0	1	21.7	48.1	54.9	50	60
									E15	15.0	2	36.1	66.1	73.0	70	80
									E20	20.0	2	48.1	81.1	88.0	90	90
									E24	24.0	2	57.7	93.2	100.0	100	100
	460	7.7	55.0	12.0	1.3	3.4	2.2	5.0	None	-	-	-	20.5	22.7	25	30
									E06	6.0	1	7.2	20.5	22.7	25	30
									E09	9.0	1	10.8	24.0	26.8	25	30
									E15	15.0	2	18.0	33.1	35.8	35	40
									E20	20.0	2	24.1	40.6	43.3	45	45
									E24	24.0	2	28.9	46.6	49.3	50	50
	575	5.1	36.0	7.5	0.7	2.4	1.8	4.0	None	-	-	-	14.1	15.9	15	20
									E09	9.0	1	8.7	18.8	21.1	20	25
									E15	15.0	2	14.4	26.0	28.3	30	30
									E20	20.0	2	19.2	32.1	34.3	35	35
									E24	24.0	2	23.1	36.9	39.1	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Hi Static Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.6	68.0	14.5	2.1	6.8	5.5	10.0	None	-	-	-	42.7	48.2	50	50
									E09	6.8	1	18.9	44.6	51.5	50	60
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	9.6	68.0	14.5	2.1	6.8	5.5	10.0	None	-	-	-	42.7	48.2	50	50
									E09	9.0	1	21.7	48.1	54.9	50	60
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	4.9	34.0	7.7	1.3	3.4	2.2	5.0	None	-	-	-	22.0	24.2	25	25
									E09	9.0	1	10.8	24.0	26.8	25	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	3.8	28.0	6.0	0.7	2.4	1.8	4.0	None	-	-	-	16.3	18.1	20	20
									E09	9.0	1	8.7	18.8	21.1	20	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
090 (7.5)	208	11.9	88.0	18.5	3.0	9.6	5.5	10.0	None	-	-	-	52.4	57.9	60	60
									E09	6.8	1	18.9	52.4	57.9	60	60
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	11.9	88.0	18.5	3.0	9.6	5.5	10.0	None	-	-	-	52.4	57.9	60	60
									E09	9.0	1	21.7	52.4	58.4	60	60
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	5.2	44.0	8.1	1.6	4.7	2.2	5.0	None	-	-	-	24.6	26.8	25	30
									E09	9.0	1	10.8	25.7	28.4	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	4.8	36.0	7.5	1.4	3.6	1.8	4.0	None	-	-	-	21.1	22.9	25	25
									E09	9.0	1	8.7	21.1	22.9	25	25
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
102 (8.5)	208	12.2	88.0	19.0	3.0	9.6	5.5	10.0	None	-	-	-	53.1	58.6	60	70
									E09	6.8	1	18.9	53.1	58.6	60	70
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	12.2	88.0	19.0	3.0	9.6	5.5	10.0	None	-	-	-	53.1	58.6	60	70
									E09	9.0	1	21.7	53.1	58.6	60	70
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	5.8	44.0	9.0	1.6	4.7	2.2	5.0	None	-	-	-	26.0	28.2	30	30
									E09	9.0	1	10.8	26.0	28.4	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	4.4	36.0	5.5	1.4	3.6	1.8	4.0	None	-	-	-	20.2	22.0	25	25
									E09	9.0	1	8.7	20.3	22.6	25	25
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60

ZH078-150 Hi Static Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	5.0	None	-	-	-	30.5	32.7	35	40
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	5.7	38.9	8.9	1.4	3.6	1.8	4.0	None	-	-	-	23.1	24.9	25	30
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	14.0	5.5	10.0	None	-	-	-	84.4	89.9	100	110
									E18	13.5	2	37.5	84.4	89.9	100	110
									E24	18.0	2	50.0	92.5	99.3	100	110
									E36	25.5	2	70.8	118.5	125.4	125	150
									E54	40.6	2	112.7	170.9	177.7	175	200
	230	23.1	160.0	36.0	2.1	14.0	5.5	10.0	None	-	-	-	84.4	89.9	100	110
									E18	18.0	2	43.3	84.4	91.0	100	110
									E24	24.0	2	57.7	102.2	109.0	110	110
									E36	34.0	2	81.8	132.2	139.1	150	150
									E54	54.0	2	129.9	159.9	166.8	175	175
	460	12.2	87.0	19.0	1.3	6.6	2.2	5.0	None	-	-	-	44.1	46.3	50	50
									E18	18.0	2	21.7	44.1	46.3	50	50
									E24	24.0	2	28.9	50.6	53.3	60	60
									E36	34.0	2	40.9	65.6	68.4	70	70
									E54	54.0	2	65.0	79.5	82.2	90	90
	575	8.7	62.0	13.5	0.7	5.2	1.8	4.0	None	-	-	-	31.4	33.2	40	40
									E18	18.0	2	17.3	33.2	35.4	40	40
									E24	24.0	2	23.1	40.4	42.6	45	45
									E36	34.0	2	32.7	52.4	54.6	60	60
									E54	54.0	2	52.0	63.5	65.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ037-061 Standard Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	2.3	1	6.4	18.2	23.7	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	3.0	1	7.2	18.2	23.7	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.6	34.0	7.1	1.3	2.6	2.2	0.0	None	-	-	-	9.6	11.8	15	15
									E03	3.0	1	3.6	9.6	11.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.5	28.0	5.5	0.7	2.0	1.8	0.0	None	-	-	-	7.0	8.8	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.2	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.3	26.8	30	35
									E06	4.5	1	12.5	22.1	29.0	30	35
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.2	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.3	26.8	30	35
									E06	6.0	1	14.4	24.5	31.4	30	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.6	44.0	8.0	1.3	2.6	2.2	0.0	None	-	-	-	10.9	13.1	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.5	36.0	7.0	0.7	2.0	1.8	0.0	None	-	-	-	8.3	10.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	4.5	1	12.5	27.0	32.5	35	45
									E09	6.8	1	18.9	30.1	37.0	40	45
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
	230	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	6.0	1	14.4	27.0	32.5	35	45
									E09	9.0	1	21.7	33.6	40.4	40	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
									E24	24.0	2	57.7	78.7	85.5	80	90
	460	7.7	55.0	12.0	1.3	2.6	2.2	0.0	None	-	-	-	14.7	16.9	20	20
									E06	6.0	1	7.2	14.7	16.9	20	20
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
									E24	24.0	2	28.9	39.3	42.1	40	45
	575	5.1	36.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	9.7	11.5	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
									E24	24.0	2	23.1	31.4	33.6	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ078-150 Standard Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.3	68.0	14.5	2.1	5.2	5.5	0.0	None	-	-	-	30.3	35.8	35	45
									E09	6.8	1	18.9	30.3	37.0	35	45
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	9.3	68.0	14.5	2.1	5.2	5.5	0.0	None	-	-	-	30.3	35.8	35	45
									E09	9.0	1	21.7	33.6	40.4	35	45
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	4.9	34.0	7.6	1.3	2.6	2.2	0.0	None	-	-	-	16.1	18.3	20	20
									E09	9.0	1	10.8	16.8	19.5	20	20
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	3.8	28.0	6.0	0.7	2.0	1.8	0.0	None	-	-	-	11.9	13.7	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
090 (7.5)	208	11.9	88.0	18.5	3.0	5.2	5.5	0.0	None	-	-	-	38.0	43.5	45	50
									E09	6.8	1	18.9	38.0	43.5	45	50
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	11.9	88.0	18.5	3.0	5.2	5.5	0.0	None	-	-	-	38.0	43.5	45	50
									E09	9.0	1	21.7	38.0	43.5	45	50
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	5.2	44.0	8.1	1.6	2.6	2.2	0.0	None	-	-	-	17.5	19.7	20	20
									E09	9.0	1	10.8	17.5	19.7	20	20
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	4.8	36.0	7.5	1.4	2.0	1.8	0.0	None	-	-	-	15.5	17.3	20	20
									E09	9.0	1	8.7	15.5	17.3	20	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
102 (8.5)	208	12.2	88.0	19.0	3.0	6.8	5.5	0.0	None	-	-	-	40.3	45.8	50	50
									E09	6.8	1	18.9	40.3	45.8	50	50
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	12.2	88.0	19.0	3.0	6.8	5.5	0.0	None	-	-	-	40.3	45.8	50	50
									E09	9.0	1	21.7	40.3	45.8	50	50
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	5.8	44.0	9.0	1.6	3.4	2.2	0.0	None	-	-	-	19.7	21.9	25	25
									E09	9.0	1	10.8	19.7	21.9	25	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	4.4	36.0	5.5	1.4	2.4	1.8	0.0	None	-	-	-	15.0	16.8	15	20
									E09	9.0	1	8.7	15.0	16.8	15	20
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50

ZJ078-150 Standard Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
									E54	40.6	2	112.7	149.4	156.2	150	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
									E54	54.0	2	129.9	138.4	145.3	150	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	0.0	None	-	-	-	24.2	26.4	30	30
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
									E54	54.0	2	65.0	69.2	72.0	80	80
	575	5.7	38.9	8.9	1.4	2.4	1.8	0.0	None	-	-	-	17.9	19.7	20	25
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
									E54	54.0	2	52.0	55.0	57.2	60	60
150 (12.5)	208	23.1	160.0	36.0	2.1	9.6	5.5	0.0	None	-	-	-	70.0	75.5	90	90
									E18	13.5	2	37.5	70.0	75.5	90	90
									E24	18.0	2	50.0	74.5	81.3	90	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	23.1	160.0	36.0	2.1	9.6	5.5	0.0	None	-	-	-	70.0	75.5	90	90
									E18	18.0	2	43.3	70.0	75.5	90	90
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	12.2	87.0	19.0	1.3	4.7	2.2	0.0	None	-	-	-	37.2	39.4	45	50
									E18	18.0	2	21.7	37.2	39.4	45	50
									E24	24.0	2	28.9	42.0	44.7	45	50
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	8.7	62.0	13.5	0.7	3.6	1.8	0.0	None	-	-	-	25.8	27.6	30	35
									E18	18.0	2	17.3	26.2	28.4	30	35
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ037-061 Hi Static Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	2.3	1	6.4	18.2	23.7	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	3.0	1	7.2	18.2	23.7	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.6	34.0	7.1	1.3	2.6	2.2	0.0	None	-	-	-	9.6	11.8	15	15
									E03	3.0	1	3.6	9.6	11.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.5	28.0	5.5	0.7	2.0	1.8	0.0	None	-	-	-	7.0	8.8	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.2	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.3	26.8	30	35
									E06	4.5	1	12.5	22.1	29.0	30	35
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.2	88.0	17.5	2.1	5.2	5.5	0.0	None	-	-	-	21.3	26.8	30	35
									E06	6.0	1	14.4	24.5	31.4	30	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.6	44.0	8.0	1.3	2.6	2.2	0.0	None	-	-	-	10.9	13.1	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.5	36.0	7.0	0.7	2.0	1.8	0.0	None	-	-	-	8.3	10.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	4.5	1	12.5	28.6	34.1	40	45
									E09	6.8	1	18.9	32.1	39.0	40	45
									E15	11.3	2	31.4	47.7	54.6	50	60
									E20	15.0	2	41.6	60.5	67.4	70	70
									E24	18.0	2	50.0	71.0	77.8	80	80
	230	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	6.0	1	14.4	28.6	34.1	40	45
									E09	9.0	1	21.7	35.6	42.4	40	45
									E15	15.0	2	36.1	53.6	60.5	60	70
									E20	20.0	2	48.1	68.6	75.5	70	80
									E24	24.0	2	57.7	80.7	87.5	90	90
	460	7.7	55.0	12.0	1.3	3.4	2.2	0.0	None	-	-	-	15.5	17.7	20	25
									E06	6.0	1	7.2	15.5	17.7	20	25
									E09	9.0	1	10.8	17.8	20.5	20	25
									E15	15.0	2	18.0	26.8	29.6	30	30
									E20	20.0	2	24.1	34.3	37.1	35	40
									E24	24.0	2	28.9	40.3	43.1	45	45
	575	5.1	36.0	7.5	0.7	2.4	1.8	0.0	None	-	-	-	10.1	11.9	15	15
									E09	9.0	1	8.7	13.8	16.1	15	20
									E15	15.0	2	14.4	21.0	23.3	25	25
									E20	20.0	2	19.2	27.1	29.3	30	30
									E24	24.0	2	23.1	31.9	34.1	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ078-150 Hi Static Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.3	68.0	14.5	2.1	6.8	5.5	0.0	None	-	-	-	31.9	37.4	40	45
									E09	6.8	1	18.9	32.1	39.0	40	45
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	9.3	68.0	14.5	2.1	6.8	5.5	0.0	None	-	-	-	31.9	37.4	40	45
									E09	9.0	1	21.7	35.6	42.4	40	45
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	4.9	34.0	7.6	1.3	3.4	2.2	0.0	None	-	-	-	16.9	19.1	20	20
									E09	9.0	1	10.8	17.8	20.5	20	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	3.8	28.0	6.0	0.7	2.4	1.8	0.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	13.8	16.1	15	20
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
090 (7.5)	208	11.9	88.0	18.5	3.0	9.6	5.5	0.0	None	-	-	-	42.4	47.9	50	50
									E09	6.8	1	18.9	42.4	47.9	50	50
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	11.9	88.0	18.5	3.0	9.6	5.5	0.0	None	-	-	-	42.4	47.9	50	50
									E09	9.0	1	21.7	42.4	47.9	50	50
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	5.2	44.0	8.1	1.6	4.7	2.2	0.0	None	-	-	-	19.6	21.8	20	25
									E09	9.0	1	10.8	19.6	22.2	20	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	4.8	36.0	7.5	1.4	3.6	1.8	0.0	None	-	-	-	17.1	18.9	20	20
									E09	9.0	1	8.7	17.1	18.9	20	20
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
102 (8.5)	208	12.2	88.0	19.0	3.0	9.6	5.5	0.0	None	-	-	-	43.1	48.6	50	60
									E09	6.8	1	18.9	43.1	48.6	50	60
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	12.2	88.0	19.0	3.0	9.6	5.5	0.0	None	-	-	-	43.1	48.6	50	60
									E09	9.0	1	21.7	43.1	48.6	50	60
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	5.8	44.0	9.0	1.6	4.7	2.2	0.0	None	-	-	-	21.0	23.2	25	25
									E09	9.0	1	10.8	21.0	23.2	25	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	4.4	36.0	5.5	1.4	3.6	1.8	0.0	None	-	-	-	16.2	18.0	20	20
									E09	9.0	1	8.7	16.2	18.0	20	20
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50

ZJ078-150 Hi Static Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	0.0	None	-	-	-	25.5	27.7	30	35
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	5.7	38.9	8.9	1.4	3.6	1.8	0.0	None	-	-	-	19.1	20.9	20	25
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	14.0	5.5	0.0	None	-	-	-	74.4	79.9	90	100
									E18	13.5	2	37.5	74.4	79.9	90	100
									E24	18.0	2	50.0	80.0	86.8	90	100
									E36	25.5	2	70.8	106.0	112.9	110	125
									E54	40.6	2	112.7	158.4	165.2	175	175
	230	23.1	160.0	36.0	2.1	14.0	5.5	0.0	None	-	-	-	74.4	79.9	90	100
									E18	18.0	2	43.3	74.4	79.9	90	100
									E24	24.0	2	57.7	89.7	96.5	90	100
									E36	34.0	2	81.8	119.7	126.6	125	150
									E54	54.0	2	129.9	147.4	154.3	175	175
	460	12.2	87.0	19.0	1.3	6.6	2.2	0.0	None	-	-	-	39.1	41.3	50	50
									E18	18.0	2	21.7	39.1	41.3	50	50
									E24	24.0	2	28.9	44.3	47.1	50	50
									E36	34.0	2	40.9	59.4	62.1	60	70
									E54	54.0	2	65.0	73.2	76.0	80	90
	575	8.7	62.0	13.5	0.7	5.2	1.8	0.0	None	-	-	-	27.4	29.2	35	35
									E18	18.0	2	17.3	28.2	30.4	35	35
									E24	24.0	2	23.1	35.4	37.6	40	40
									E36	34.0	2	32.7	47.4	49.6	50	50
									E54	54.0	2	52.0	58.5	60.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ037-061 Standard Indoor Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	2.3	1	6.4	28.5	34.0	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	3.0	1	7.2	28.5	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.6	34.0	7.1	1.3	2.6	2.2	5.0	None	-	-	-	14.7	16.9	15	20
									E03	3.0	1	3.6	14.7	16.9	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.5	28.0	5.5	0.7	2.0	1.8	4.0	None	-	-	-	11.2	13.0	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.2	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.3	36.8	40	45
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.2	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.3	36.8	40	45
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.6	44.0	8.0	1.3	2.6	2.2	5.0	None	-	-	-	15.9	18.1	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.5	36.0	7.0	0.7	2.0	1.8	4.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	4.5	1	12.5	37.0	42.5	50	50
									E09	6.8	1	18.9	42.6	49.5	50	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
									E24	18.0	2	50.0	81.5	88.3	90	90
	230	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	6.0	1	14.4	37.0	43.9	50	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
									E24	24.0	2	57.7	91.2	98.0	100	100
	460	7.7	55.0	12.0	1.3	2.6	2.2	5.0	None	-	-	-	19.7	21.9	25	25
									E06	6.0	1	7.2	19.7	21.9	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
									E24	24.0	2	28.9	45.6	48.3	50	50
	575	5.1	36.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	13.7	15.5	15	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
									E24	24.0	2	23.1	36.4	38.6	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ078-150 Standard Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.3	68.0	14.5	2.1	5.2	5.5	10.0	None	-	-	-	40.5	46.0	50	50
									E09	6.8	1	18.9	42.6	49.5	50	50
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	9.3	68.0	14.5	2.1	5.2	5.5	10.0	None	-	-	-	40.5	46.0	50	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	4.9	34.0	7.6	1.3	2.6	2.2	5.0	None	-	-	-	21.2	23.4	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	3.8	28.0	6.0	0.7	2.0	1.8	4.0	None	-	-	-	15.9	17.7	20	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
090 (7.5)	208	11.9	88.0	18.5	3.0	5.2	5.5	10.0	None	-	-	-	48.0	53.5	50	60
									E09	6.8	1	18.9	48.0	53.5	50	60
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	11.9	88.0	18.5	3.0	5.2	5.5	10.0	None	-	-	-	48.0	53.5	50	60
									E09	9.0	1	21.7	48.0	53.5	50	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	5.2	44.0	8.1	1.6	2.6	2.2	5.0	None	-	-	-	22.5	24.7	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	4.8	36.0	7.5	1.4	2.0	1.8	4.0	None	-	-	-	19.5	21.3	20	25
									E09	9.0	1	8.7	19.5	21.3	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
102 (8.5)	208	12.2	88.0	19.0	3.0	6.8	5.5	10.0	None	-	-	-	50.3	55.8	60	60
									E09	6.8	1	18.9	50.3	55.8	60	60
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	12.2	88.0	19.0	3.0	6.8	5.5	10.0	None	-	-	-	50.3	55.8	60	60
									E09	9.0	1	21.7	50.3	55.8	60	60
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	5.8	44.0	9.0	1.6	3.4	2.2	5.0	None	-	-	-	24.7	26.9	30	30
									E09	9.0	1	10.8	24.7	26.9	30	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	4.4	36.0	5.5	1.4	2.4	1.8	4.0	None	-	-	-	19.0	20.8	20	25
									E09	9.0	1	8.7	19.0	21.1	20	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60

ZJ078-150 Standard Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
									E54	40.6	2	112.7	161.9	168.7	175	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
									E54	54.0	2	129.9	150.9	157.8	175	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	5.0	None	-	-	-	29.2	31.4	35	35
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
									E54	54.0	2	65.0	75.5	78.2	80	90
	575	5.7	38.9	8.9	1.4	2.4	1.8	4.0	None	-	-	-	21.9	23.7	25	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
									E54	54.0	2	52.0	60.0	62.2	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	9.6	5.5	10.0	None	-	-	-	80.0	85.5	100	100
									E18	13.5	2	37.5	80.0	85.5	100	100
									E24	18.0	2	50.0	87.0	93.8	100	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	23.1	160.0	36.0	2.1	9.6	5.5	10.0	None	-	-	-	80.0	85.5	100	100
									E18	18.0	2	43.3	80.0	85.5	100	100
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	12.2	87.0	19.0	1.3	4.7	2.2	5.0	None	-	-	-	42.2	44.4	50	50
									E18	18.0	2	21.7	42.2	44.4	50	50
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	8.7	62.0	13.5	0.7	3.6	1.8	4.0	None	-	-	-	29.8	31.6	35	40
									E18	18.0	2	17.3	31.2	33.4	35	40
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ037-061 Hi Static Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	2.3	1	6.4	28.5	34.0	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	3.0	1	7.2	28.5	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.6	34.0	7.1	1.3	2.6	2.2	5.0	None	-	-	-	14.7	16.9	15	20
									E03	3.0	1	3.6	14.7	16.9	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.5	28.0	5.5	0.7	2.0	1.8	4.0	None	-	-	-	11.2	13.0	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.2	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.3	36.8	40	45
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.2	88.0	17.5	2.1	5.2	5.5	10.0	None	-	-	-	31.3	36.8	40	45
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.6	44.0	8.0	1.3	2.6	2.2	5.0	None	-	-	-	15.9	18.1	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.5	36.0	7.0	0.7	2.0	1.8	4.0	None	-	-	-	12.3	14.1	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	4.5	1	12.5	38.6	44.1	50	50
									E09	6.8	1	18.9	44.6	51.5	50	60
									E15	11.3	2	31.4	60.2	67.1	70	70
									E20	15.0	2	41.6	73.0	79.9	80	80
									E24	18.0	2	50.0	83.5	90.3	90	100
	230	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	6.0	1	14.4	39.0	45.9	50	50
									E09	9.0	1	21.7	48.1	54.9	50	60
									E15	15.0	2	36.1	66.1	73.0	70	80
									E20	20.0	2	48.1	81.1	88.0	90	90
									E24	24.0	2	57.7	93.2	100.0	100	100
	460	7.7	55.0	12.0	1.3	3.4	2.2	5.0	None	-	-	-	20.5	22.7	25	30
									E06	6.0	1	7.2	20.5	22.7	25	30
									E09	9.0	1	10.8	24.0	26.8	25	30
									E15	15.0	2	18.0	33.1	35.8	35	40
									E20	20.0	2	24.1	40.6	43.3	45	45
									E24	24.0	2	28.9	46.6	49.3	50	50
	575	5.1	36.0	7.5	0.7	2.4	1.8	4.0	None	-	-	-	14.1	15.9	15	20
									E09	9.0	1	8.7	18.8	21.1	20	25
									E15	15.0	2	14.4	26.0	28.3	30	30
									E20	20.0	2	19.2	32.1	34.3	35	35
									E24	24.0	2	23.1	36.9	39.1	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ078-150 Hi Static Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	9.3	68.0	14.5	2.1	6.8	5.5	10.0	None	-	-	-	42.1	47.6	50	50
									E09	6.8	1	18.9	44.6	51.5	50	60
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	9.3	68.0	14.5	2.1	6.8	5.5	10.0	None	-	-	-	42.1	47.6	50	50
									E09	9.0	1	21.7	48.1	54.9	50	60
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	4.9	34.0	7.6	1.3	3.4	2.2	5.0	None	-	-	-	22.0	24.2	25	25
									E09	9.0	1	10.8	24.0	26.8	25	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	3.8	28.0	6.0	0.7	2.4	1.8	4.0	None	-	-	-	16.3	18.1	20	20
									E09	9.0	1	8.7	18.8	21.1	20	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
090 (7.5)	208	11.9	88.0	18.5	3.0	9.6	5.5	10.0	None	-	-	-	52.4	57.9	60	60
									E09	6.8	1	18.9	52.4	57.9	60	60
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	11.9	88.0	18.5	3.0	9.6	5.5	10.0	None	-	-	-	52.4	57.9	60	60
									E09	9.0	1	21.7	52.4	58.4	60	60
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	5.2	44.0	8.1	1.6	4.7	2.2	5.0	None	-	-	-	24.6	26.8	25	30
									E09	9.0	1	10.8	25.7	28.4	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	4.8	36.0	7.5	1.4	3.6	1.8	4.0	None	-	-	-	21.1	22.9	25	25
									E09	9.0	1	8.7	21.1	22.9	25	25
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
102 (8.5)	208	12.2	88.0	19.0	3.0	9.6	5.5	10.0	None	-	-	-	53.1	58.6	60	70
									E09	6.8	1	18.9	53.1	58.6	60	70
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	12.2	88.0	19.0	3.0	9.6	5.5	10.0	None	-	-	-	53.1	58.6	60	70
									E09	9.0	1	21.7	53.1	58.6	60	70
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	5.8	44.0	9.0	1.6	4.7	2.2	5.0	None	-	-	-	26.0	28.2	30	30
									E09	9.0	1	10.8	26.0	28.4	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	4.4	36.0	5.5	1.4	3.6	1.8	4.0	None	-	-	-	20.2	22.0	25	25
									E09	9.0	1	8.7	20.3	22.6	25	25
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60

ZJ078-150 Hi Static Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	5.0	None	-	-	-	30.5	32.7	35	40
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	5.7	38.9	8.9	1.4	3.6	1.8	4.0	None	-	-	-	23.1	24.9	25	30
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70
150 (12.5)	208	23.1	160.0	36.0	2.1	14.0	5.5	10.0	None	-	-	-	84.4	89.9	100	110
									E18	13.5	2	37.5	84.4	89.9	100	110
									E24	18.0	2	50.0	92.5	99.3	100	110
									E36	25.5	2	70.8	118.5	125.4	125	150
									E54	40.6	2	112.7	170.9	177.7	175	200
	230	23.1	160.0	36.0	2.1	14.0	5.5	10.0	None	-	-	-	84.4	89.9	100	110
									E18	18.0	2	43.3	84.4	91.0	100	110
									E24	24.0	2	57.7	102.2	109.0	110	110
									E36	34.0	2	81.8	132.2	139.1	150	150
									E54	54.0	2	129.9	159.9	166.8	175	175
	460	12.2	87.0	19.0	1.3	6.6	2.2	5.0	None	-	-	-	44.1	46.3	50	50
									E18	18.0	2	21.7	44.1	46.3	50	50
									E24	24.0	2	28.9	50.6	53.3	60	60
									E36	34.0	2	40.9	65.6	68.4	70	70
									E54	54.0	2	65.0	79.5	82.2	90	90
	575	8.7	62.0	13.5	0.7	5.2	1.8	4.0	None	-	-	-	31.4	33.2	40	40
									E18	18.0	2	17.3	33.2	35.4	40	40
									E24	24.0	2	23.1	40.4	42.6	45	45
									E36	34.0	2	32.7	52.4	54.6	60	60
									E54	54.0	2	52.0	63.5	65.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR037-061 Standard Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	2.3	1	6.4	18.2	23.7	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	3.0	1	7.2	18.2	23.7	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.6	34.0	7.1	1.3	2.6	2.2	0.0	None	-	-	-	9.6	11.8	15	15
									E03	3.0	1	3.6	9.6	11.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.5	28.0	5.5	0.7	2.0	1.8	0.0	None	-	-	-	7.0	8.8	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.9	88.0	18.5	2.1	5.2	5.5	0.0	None	-	-	-	24.3	29.8	35	40
									E06	4.5	1	12.5	24.3	29.8	35	40
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.9	88.0	18.5	2.1	5.2	5.5	0.0	None	-	-	-	24.3	29.8	35	40
									E06	6.0	1	14.4	24.5	31.4	35	40
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.2	44.0	8.1	1.3	2.6	2.2	0.0	None	-	-	-	11.6	13.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.8	36.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	9.3	11.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	4.5	1	12.5	27.0	32.5	35	45
									E09	6.8	1	18.9	30.1	37.0	40	45
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
	230	14.1	88.0	22.0	2.1	5.2	5.5	0.0	None	-	-	-	27.0	32.5	35	45
									E06	6.0	1	14.4	27.0	32.5	35	45
									E09	9.0	1	21.7	33.6	40.4	40	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
									E24	24.0	2	57.7	78.7	85.5	80	90
	460	7.7	55.0	12.0	1.3	2.6	2.2	0.0	None	-	-	-	14.7	16.9	20	20
									E06	6.0	1	7.2	14.7	16.9	20	20
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
									E24	24.0	2	28.9	39.3	42.1	40	45
	575	5.1	36.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	9.7	11.5	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
									E24	24.0	2	23.1	31.4	33.6	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR078-150 Standard Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	5.2	5.5	0.0	None	-	-	-	39.8	45.3	50	50
									E09	6.8	1	18.9	39.8	45.3	50	50
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	13.5	88.0	21.1	2.1	5.2	5.5	0.0	None	-	-	-	39.8	45.3	50	50
									E09	9.0	1	21.7	39.8	45.3	50	50
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	6.0	44.0	9.3	1.3	2.6	2.2	0.0	None	-	-	-	18.6	20.8	20	25
									E09	9.0	1	10.8	18.6	20.8	20	25
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	4.9	34.0	7.7	0.7	2.0	1.8	0.0	None	-	-	-	14.3	16.1	15	20
									E09	9.0	1	8.7	14.3	16.1	15	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
090 (7.5)	208	13.1	83.1	20.5	2.1	5.2	5.5	0.0	None	-	-	-	38.9	44.4	50	50
									E09	6.8	1	18.9	38.9	44.4	50	50
									E18	13.5	2	37.5	53.3	60.2	60	70
									E24	18.0	2	50.0	69.0	75.8	70	80
									E36	25.5	2	70.8	95.0	101.9	100	110
	230	13.1	83.1	20.5	2.1	5.2	5.5	0.0	None	-	-	-	38.9	44.4	50	50
									E09	9.0	1	21.7	38.9	44.4	50	50
									E18	18.0	2	43.3	60.6	67.5	70	70
									E24	24.0	2	57.7	78.7	85.5	80	90
									E36	34.0	2	81.8	108.7	115.6	110	125
	460	6.1	41.0	9.5	1.3	2.6	2.2	0.0	None	-	-	-	18.8	21.0	20	25
									E09	9.0	1	10.8	18.8	21.0	20	25
									E18	18.0	2	21.7	30.3	33.1	35	35
									E24	24.0	2	28.9	39.3	42.1	40	45
									E36	34.0	2	40.9	54.4	57.1	60	60
	575	4.4	33.0	6.8	0.7	2.0	1.8	0.0	None	-	-	-	13.2	15.0	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E18	18.0	2	17.3	24.2	26.4	25	30
									E24	24.0	2	23.1	31.4	33.6	35	35
									E36	34.0	2	32.7	43.4	45.6	45	50
102 (8.5)	208	14.5	98.0	22.6	2.1	6.8	5.5	0.0	None	-	-	-	43.6	49.1	50	60
									E09	6.8	1	18.9	43.6	49.1	50	60
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	14.5	98.0	22.6	2.1	6.8	5.5	0.0	None	-	-	-	43.6	49.1	50	60
									E09	9.0	1	21.7	43.6	49.1	50	60
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	6.3	55.0	9.9	1.3	3.4	2.2	0.0	None	-	-	-	20.1	22.3	25	25
									E09	9.0	1	10.8	20.1	22.3	25	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	6.0	41.0	9.4	0.7	2.4	1.8	0.0	None	-	-	-	17.2	19.0	20	25
									E09	9.0	1	8.7	17.2	19.0	20	25
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50

ZR078-150 Standard Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
									E54	40.6	2	112.7	149.4	156.2	150	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	0.0	None	-	-	-	48.9	54.4	60	70
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
									E54	54.0	2	129.9	138.4	145.3	150	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	0.0	None	-	-	-	24.2	26.4	30	30
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
									E54	54.0	2	65.0	69.2	72.0	80	80
	575	5.7	38.9	8.9	1.4	2.4	1.8	0.0	None	-	-	-	17.9	19.7	20	25
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
									E54	54.0	2	52.0	55.0	57.2	60	60
150 (12.5)	208	22.4	149.0	35.0	2.1	9.6	5.5	0.0	None	-	-	-	68.4	73.9	90	90
									E18	13.5	2	37.5	68.4	73.9	90	90
									E24	18.0	2	50.0	74.5	81.3	90	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	22.4	149.0	35.0	2.1	9.6	5.5	0.0	None	-	-	-	68.4	73.9	90	90
									E18	18.0	2	43.3	68.4	73.9	90	90
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	10.6	75.0	16.5	1.3	4.7	2.2	0.0	None	-	-	-	33.6	35.8	40	45
									E18	18.0	2	21.7	33.6	35.8	40	45
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	7.7	54.0	12.0	0.7	3.6	1.8	0.0	None	-	-	-	23.6	25.4	30	30
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR037-061 Hi Static Indoor Blower - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	2.3	1	6.4	18.2	23.7	25	30
									E06	4.5	1	12.5	22.1	29.0	25	30
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
	230	8.7	68.0	13.5	2.1	5.2	5.5	0.0	None	-	-	-	18.2	23.7	25	30
									E03	3.0	1	7.2	18.2	23.7	25	30
									E06	6.0	1	14.4	24.5	31.4	25	35
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
	460	4.6	34.0	7.1	1.3	2.6	2.2	0.0	None	-	-	-	9.6	11.8	15	15
									E03	3.0	1	3.6	9.6	11.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
	575	3.5	28.0	5.5	0.7	2.0	1.8	0.0	None	-	-	-	7.0	8.8	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
049 (4)	208	11.9	88.0	18.5	2.1	5.2	5.5	0.0	None	-	-	-	24.3	29.8	35	40
									E06	4.5	1	12.5	24.3	29.8	35	40
									E09	6.8	1	18.9	30.1	37.0	35	40
									E15	11.3	2	31.4	45.7	52.6	50	60
									E20	15.0	2	41.6	58.5	65.4	60	70
	230	11.9	88.0	18.5	2.1	5.2	5.5	0.0	None	-	-	-	24.3	29.8	35	40
									E06	6.0	1	14.4	24.5	31.4	35	40
									E09	9.0	1	21.7	33.6	40.4	35	45
									E15	15.0	2	36.1	51.6	58.5	60	60
									E20	20.0	2	48.1	66.6	73.5	70	80
	460	5.2	44.0	8.1	1.3	2.6	2.2	0.0	None	-	-	-	11.6	13.8	15	15
									E06	6.0	1	7.2	12.3	15.0	15	15
									E09	9.0	1	10.8	16.8	19.5	20	20
									E15	15.0	2	18.0	25.8	28.6	30	30
									E20	20.0	2	24.1	33.3	36.1	35	40
	575	4.8	36.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	9.3	11.1	15	15
									E09	9.0	1	8.7	13.3	15.6	15	20
									E15	15.0	2	14.4	20.5	22.8	25	25
									E20	20.0	2	19.2	26.6	28.8	30	30
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	4.5	1	12.5	28.6	34.1	40	45
									E09	6.8	1	18.9	32.1	39.0	40	45
									E15	11.3	2	31.4	47.7	54.6	50	60
									E20	15.0	2	41.6	60.5	67.4	70	70
									E24	18.0	2	50.0	71.0	77.8	80	80
	230	14.1	88.0	22.0	2.1	6.8	5.5	0.0	None	-	-	-	28.6	34.1	40	45
									E06	6.0	1	14.4	28.6	34.1	40	45
									E09	9.0	1	21.7	35.6	42.4	40	45
									E15	15.0	2	36.1	53.6	60.5	60	70
									E20	20.0	2	48.1	68.6	75.5	70	80
									E24	24.0	2	57.7	80.7	87.5	90	90
	460	7.7	55.0	12.0	1.3	3.4	2.2	0.0	None	-	-	-	15.5	17.7	20	25
									E06	6.0	1	7.2	15.5	17.7	20	25
									E09	9.0	1	10.8	17.8	20.5	20	25
									E15	15.0	2	18.0	26.8	29.6	30	30
									E20	20.0	2	24.1	34.3	37.1	35	40
									E24	24.0	2	28.9	40.3	43.1	45	45
	575	5.1	36.0	7.5	0.7	2.4	1.8	0.0	None	-	-	-	10.1	11.9	15	15
									E09	9.0	1	8.7	13.8	16.1	15	20
									E15	15.0	2	14.4	21.0	23.3	25	25
									E20	20.0	2	19.2	27.1	29.3	30	30
									E24	24.0	2	23.1	31.9	34.1	35	35

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR078-150 Hi Static Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	6.8	5.5	0.0	None	-	-	-	41.4	46.9	50	60
									E09	6.8	1	18.9	41.4	46.9	50	60
									E18	13.5	2	37.5	55.3	62.2	60	70
									E24	18.0	2	50.0	71.0	77.8	80	80
									E36	25.5	2	70.8	97.0	103.9	100	110
	230	13.5	88.0	21.1	2.1	6.8	5.5	0.0	None	-	-	-	41.4	46.9	50	60
									E09	9.0	1	21.7	41.4	46.9	50	60
									E18	18.0	2	43.3	62.6	69.5	70	70
									E24	24.0	2	57.7	80.7	87.5	90	90
									E36	34.0	2	81.8	110.7	117.6	125	125
	460	6.0	44.0	9.3	1.3	3.4	2.2	0.0	None	-	-	-	19.4	21.6	25	25
									E09	9.0	1	10.8	19.4	21.6	25	25
									E18	18.0	2	21.7	31.3	34.1	35	35
									E24	24.0	2	28.9	40.3	43.1	45	45
									E36	34.0	2	40.9	55.4	58.1	60	60
	575	4.9	34.0	7.7	0.7	2.4	1.8	0.0	None	-	-	-	14.7	16.5	15	20
									E09	9.0	1	8.7	14.7	16.5	15	20
									E18	18.0	2	17.3	24.7	26.9	25	30
									E24	24.0	2	23.1	31.9	34.1	35	35
									E36	34.0	2	32.7	43.9	46.1	45	50
090 (7.5)	208	13.1	83.1	20.5	2.1	9.6	5.5	0.0	None	-	-	-	43.3	48.8	50	60
									E09	6.8	1	18.9	43.3	48.8	50	60
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	13.1	83.1	20.5	2.1	9.6	5.5	0.0	None	-	-	-	43.3	48.8	50	60
									E09	9.0	1	21.7	43.3	48.8	50	60
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	6.1	41.0	9.5	1.3	4.7	2.2	0.0	None	-	-	-	20.9	23.1	25	25
									E09	9.0	1	10.8	20.9	23.1	25	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	4.4	33.0	6.8	0.7	3.6	1.8	0.0	None	-	-	-	14.8	16.6	15	20
									E09	9.0	1	8.7	15.3	17.6	20	20
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
102 (8.5)	208	14.5	98.0	22.6	2.1	9.6	5.5	0.0	None	-	-	-	46.4	51.9	60	60
									E09	6.8	1	18.9	46.4	51.9	60	60
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
	230	14.5	98.0	22.6	2.1	9.6	5.5	0.0	None	-	-	-	46.4	51.9	60	60
									E09	9.0	1	21.7	46.4	51.9	60	60
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
	460	6.3	55.0	9.9	1.3	4.7	2.2	0.0	None	-	-	-	21.4	23.6	25	25
									E09	9.0	1	10.8	21.4	23.6	25	25
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
	575	6.0	41.0	9.4	0.7	3.6	1.8	0.0	None	-	-	-	18.4	20.2	20	25
									E09	9.0	1	8.7	18.4	20.2	20	25
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50

ZR078-150 Hi Static Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	13.5	2	37.5	58.8	65.7	60	70
									E24	18.0	2	50.0	74.5	81.3	80	90
									E36	25.5	2	70.8	100.5	107.4	110	110
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	0.0	None	-	-	-	51.7	57.2	60	70
									E18	18.0	2	43.3	66.1	73.0	70	80
									E24	24.0	2	57.7	84.2	91.0	90	100
									E36	34.0	2	81.8	114.2	121.1	125	125
									E54	54.0	2	129.9	141.9	148.8	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	0.0	None	-	-	-	25.5	27.7	30	35
									E18	18.0	2	21.7	32.9	35.7	35	40
									E24	24.0	2	28.9	42.0	44.7	45	45
									E36	34.0	2	40.9	57.0	59.7	60	60
									E54	54.0	2	65.0	70.8	73.6	80	80
	575	5.7	38.9	8.9	1.4	3.6	1.8	0.0	None	-	-	-	19.1	20.9	20	25
									E18	18.0	2	17.3	26.2	28.4	30	30
									E24	24.0	2	23.1	33.4	35.6	35	40
									E36	34.0	2	32.7	45.4	47.6	50	50
									E54	54.0	2	52.0	56.5	58.7	70	70
150 (12.5)	208	22.4	149.0	35.0	2.1	14.0	5.5	0.0	None	-	-	-	72.8	78.3	90	100
									E18	13.5	2	37.5	72.8	78.3	90	100
									E24	18.0	2	50.0	80.0	86.8	90	100
									E36	25.5	2	70.8	106.0	112.9	110	125
									E54	40.6	2	112.7	158.4	165.2	175	175
	230	22.4	149.0	35.0	2.1	14.0	5.5	0.0	None	-	-	-	72.8	78.3	90	100
									E18	18.0	2	43.3	72.8	78.5	90	100
									E24	24.0	2	57.7	89.7	96.5	90	100
									E36	34.0	2	81.8	119.7	126.6	125	150
									E54	54.0	2	129.9	147.4	154.3	175	175
	460	10.6	75.0	16.5	1.3	6.6	2.2	0.0	None	-	-	-	35.5	37.7	45	45
									E18	18.0	2	21.7	35.5	38.1	45	45
									E24	24.0	2	28.9	44.3	47.1	45	50
									E36	34.0	2	40.9	59.4	62.1	60	70
									E54	54.0	2	65.0	73.2	76.0	80	90
	575	7.7	54.0	12.0	0.7	5.2	1.8	0.0	None	-	-	-	25.2	27.0	30	30
									E18	18.0	2	17.3	28.2	30.4	30	35
									E24	24.0	2	23.1	35.4	37.6	40	40
									E36	34.0	2	32.7	47.4	49.6	50	50
									E54	54.0	2	52.0	58.5	60.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR037-061 Standard Indoor Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	2.3	1	6.4	28.5	34.0	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	3.0	1	7.2	28.5	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.6	34.0	7.1	1.3	2.6	2.2	5.0	None	-	-	-	14.7	16.9	15	20
									E03	3.0	1	3.6	14.7	16.9	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.5	28.0	5.5	0.7	2.0	1.8	4.0	None	-	-	-	11.2	13.0	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.9	88.0	18.5	2.1	5.2	5.5	10.0	None	-	-	-	34.3	39.8	45	50
									E06	4.5	1	12.5	34.6	41.5	45	50
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.9	88.0	18.5	2.1	5.2	5.5	10.0	None	-	-	-	34.3	39.8	45	50
									E06	6.0	1	14.4	37.0	43.9	45	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.2	44.0	8.1	1.3	2.6	2.2	5.0	None	-	-	-	16.6	18.8	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.8	36.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	13.3	15.1	15	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	4.5	1	12.5	37.0	42.5	50	50
									E09	6.8	1	18.9	42.6	49.5	50	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
									E24	18.0	2	50.0	81.5	88.3	90	90
	230	14.1	88.0	22.0	2.1	5.2	5.5	10.0	None	-	-	-	37.0	42.5	50	50
									E06	6.0	1	14.4	37.0	43.9	50	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
									E24	24.0	2	57.7	91.2	98.0	100	100
	460	7.7	55.0	12.0	1.3	2.6	2.2	5.0	None	-	-	-	19.7	21.9	25	25
									E06	6.0	1	7.2	19.7	21.9	25	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
									E24	24.0	2	28.9	45.6	48.3	50	50
	575	5.1	36.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	13.7	15.5	15	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
									E24	24.0	2	23.1	36.4	38.6	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR078-150 Standard Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	5.2	5.5	10.0	None	-	-	-	49.8	55.3	60	60
									E09	6.8	1	18.9	49.8	55.3	60	60
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	13.5	88.0	21.1	2.1	5.2	5.5	10.0	None	-	-	-	49.8	55.3	60	60
									E09	9.0	1	21.7	49.8	55.3	60	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	6.0	44.0	9.3	1.3	2.6	2.2	5.0	None	-	-	-	23.6	25.8	25	30
									E09	9.0	1	10.8	23.6	25.8	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	4.9	34.0	7.7	0.7	2.0	1.8	4.0	None	-	-	-	18.3	20.1	20	25
									E09	9.0	1	8.7	18.3	20.6	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
090 (7.5)	208	13.1	83.1	20.5	2.1	5.2	5.5	10.0	None	-	-	-	48.9	54.4	60	60
									E09	6.8	1	18.9	48.9	54.4	60	60
									E18	13.5	2	37.5	65.8	72.7	70	80
									E24	18.0	2	50.0	81.5	88.3	90	90
									E36	25.5	2	70.8	107.5	114.4	110	125
	230	13.1	83.1	20.5	2.1	5.2	5.5	10.0	None	-	-	-	48.9	54.4	60	60
									E09	9.0	1	21.7	48.9	54.4	60	60
									E18	18.0	2	43.3	73.1	80.0	80	80
									E24	24.0	2	57.7	91.2	98.0	100	100
									E36	34.0	2	81.8	121.2	128.1	125	150
	460	6.1	41.0	9.5	1.3	2.6	2.2	5.0	None	-	-	-	23.8	26.0	25	30
									E09	9.0	1	10.8	23.8	26.0	25	30
									E18	18.0	2	21.7	36.6	39.3	40	40
									E24	24.0	2	28.9	45.6	48.3	50	50
									E36	34.0	2	40.9	60.6	63.4	70	70
	575	4.4	33.0	6.8	0.7	2.0	1.8	4.0	None	-	-	-	17.2	19.0	20	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E18	18.0	2	17.3	29.2	31.4	30	35
									E24	24.0	2	23.1	36.4	38.6	40	40
									E36	34.0	2	32.7	48.4	50.6	50	60
102 (8.5)	208	14.5	98.0	22.6	2.1	6.8	5.5	10.0	None	-	-	-	53.6	59.1	60	70
									E09	6.8	1	18.9	53.6	59.1	60	70
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	14.5	98.0	22.6	2.1	6.8	5.5	10.0	None	-	-	-	53.6	59.1	60	70
									E09	9.0	1	21.7	53.6	59.1	60	70
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	6.3	55.0	9.9	1.3	3.4	2.2	5.0	None	-	-	-	25.1	27.3	30	30
									E09	9.0	1	10.8	25.1	27.3	30	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	6.0	41.0	9.4	0.7	2.4	1.8	4.0	None	-	-	-	21.2	23.0	25	25
									E09	9.0	1	8.7	21.2	23.0	25	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60

ZR078-150 Standard Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
									E54	40.6	2	112.7	161.9	168.7	175	175
	230	16.0	110.0	24.9	3.0	6.8	5.5	10.0	None	-	-	-	58.9	64.4	70	80
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
									E54	54.0	2	129.9	150.9	157.8	175	175
	460	7.8	52.0	12.1	1.6	3.4	2.2	5.0	None	-	-	-	29.2	31.4	35	35
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
									E54	54.0	2	65.0	75.5	78.2	80	90
	575	5.7	38.9	8.9	1.4	2.4	1.8	4.0	None	-	-	-	21.9	23.7	25	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
									E54	54.0	2	52.0	60.0	62.2	70	70
150 (12.5)	208	22.4	149.0	35.0	2.1	9.6	5.5	10.0	None	-	-	-	78.4	83.9	100	100
									E18	13.5	2	37.5	78.4	83.9	100	100
									E24	18.0	2	50.0	87.0	93.8	100	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	22.4	149.0	35.0	2.1	9.6	5.5	10.0	None	-	-	-	78.4	83.9	100	100
									E18	18.0	2	43.3	78.6	85.5	100	100
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	10.6	75.0	16.5	1.3	4.7	2.2	5.0	None	-	-	-	38.6	40.8	45	50
									E18	18.0	2	21.7	39.2	41.9	45	50
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	7.7	54.0	12.0	0.7	3.6	1.8	4.0	None	-	-	-	27.6	29.4	35	35
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR037-061 Hi Static Indoor Blower - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
037 (3)	208	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	2.3	1	6.4	28.5	34.0	35	40
									E06	4.5	1	12.5	34.6	41.5	40	45
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
	230	8.7	68.0	13.5	2.1	5.2	5.5	10.0	None	-	-	-	28.5	34.0	35	40
									E03	3.0	1	7.2	28.5	34.9	35	40
									E06	6.0	1	14.4	37.0	43.9	40	45
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
	460	4.6	34.0	7.1	1.3	2.6	2.2	5.0	None	-	-	-	14.7	16.9	15	20
									E03	3.0	1	3.6	14.7	16.9	15	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
	575	3.5	28.0	5.5	0.7	2.0	1.8	4.0	None	-	-	-	11.2	13.0	15	15
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
049 (4)	208	11.9	88.0	18.5	2.1	5.2	5.5	10.0	None	-	-	-	34.3	39.8	45	50
									E06	4.5	1	12.5	34.6	41.5	45	50
									E09	6.8	1	18.9	42.6	49.5	45	50
									E15	11.3	2	31.4	58.2	65.1	60	70
									E20	15.0	2	41.6	71.0	77.9	80	80
	230	11.9	88.0	18.5	2.1	5.2	5.5	10.0	None	-	-	-	34.3	39.8	45	50
									E06	6.0	1	14.4	37.0	43.9	45	50
									E09	9.0	1	21.7	46.1	52.9	50	60
									E15	15.0	2	36.1	64.1	71.0	70	80
									E20	20.0	2	48.1	79.1	86.0	80	90
	460	5.2	44.0	8.1	1.3	2.6	2.2	5.0	None	-	-	-	16.6	18.8	20	20
									E06	6.0	1	7.2	18.5	21.3	20	25
									E09	9.0	1	10.8	23.0	25.8	25	30
									E15	15.0	2	18.0	32.1	34.8	35	35
									E20	20.0	2	24.1	39.6	42.3	40	45
	575	4.8	36.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	13.3	15.1	15	20
									E09	9.0	1	8.7	18.3	20.6	20	25
									E15	15.0	2	14.4	25.5	27.8	30	30
									E20	20.0	2	19.2	31.6	33.8	35	35
061 (5)	208	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	4.5	1	12.5	38.6	44.1	50	50
									E09	6.8	1	18.9	44.6	51.5	50	60
									E15	11.3	2	31.4	60.2	67.1	70	70
									E20	15.0	2	41.6	73.0	79.9	80	80
									E24	18.0	2	50.0	83.5	90.3	90	100
	230	14.1	88.0	22.0	2.1	6.8	5.5	10.0	None	-	-	-	38.6	44.1	50	50
									E06	6.0	1	14.4	39.0	45.9	50	50
									E09	9.0	1	21.7	48.1	54.9	50	60
									E15	15.0	2	36.1	66.1	73.0	70	80
									E20	20.0	2	48.1	81.1	88.0	90	90
									E24	24.0	2	57.7	93.2	100.0	100	100
	460	7.7	55.0	12.0	1.3	3.4	2.2	5.0	None	-	-	-	20.5	22.7	25	30
									E06	6.0	1	7.2	20.5	22.7	25	30
									E09	9.0	1	10.8	24.0	26.8	25	30
									E15	15.0	2	18.0	33.1	35.8	35	40
									E20	20.0	2	24.1	40.6	43.3	45	45
									E24	24.0	2	28.9	46.6	49.3	50	50
	575	5.1	36.0	7.5	0.7	2.4	1.8	4.0	None	-	-	-	14.1	15.9	15	20
									E09	9.0	1	8.7	18.8	21.1	20	25
									E15	15.0	2	14.4	26.0	28.3	30	30
									E20	20.0	2	19.2	32.1	34.3	35	35
									E24	24.0	2	23.1	36.9	39.1	40	40

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR078-150 Hi Static Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	6.8	5.5	10.0	None	-	-	-	51.4	56.9	60	70
									E09	6.8	1	18.9	51.4	56.9	60	70
									E18	13.5	2	37.5	67.8	74.7	70	80
									E24	18.0	2	50.0	83.5	90.3	90	100
									E36	25.5	2	70.8	109.5	116.4	110	125
	230	13.5	88.0	21.1	2.1	6.8	5.5	10.0	None	-	-	-	51.4	56.9	60	70
									E09	9.0	1	21.7	51.4	56.9	60	70
									E18	18.0	2	43.3	75.1	82.0	80	90
									E24	24.0	2	57.7	93.2	100.0	100	100
									E36	34.0	2	81.8	123.2	130.1	125	150
	460	6.0	44.0	9.3	1.3	3.4	2.2	5.0	None	-	-	-	24.4	26.6	30	30
									E09	9.0	1	10.8	24.4	26.8	30	30
									E18	18.0	2	21.7	37.6	40.3	40	45
									E24	24.0	2	28.9	46.6	49.3	50	50
									E36	34.0	2	40.9	61.6	64.4	70	70
	575	4.9	34.0	7.7	0.7	2.4	1.8	4.0	None	-	-	-	18.7	20.5	20	25
									E09	9.0	1	8.7	18.8	21.1	20	25
									E18	18.0	2	17.3	29.7	31.9	30	35
									E24	24.0	2	23.1	36.9	39.1	40	40
									E36	34.0	2	32.7	48.9	51.1	50	60
090 (7.5)	208	13.1	83.1	20.5	2.1	9.6	5.5	10.0	None	-	-	-	53.3	58.8	60	70
									E09	6.8	1	18.9	53.3	58.8	60	70
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	13.1	83.1	20.5	2.1	9.6	5.5	10.0	None	-	-	-	53.3	58.8	60	70
									E09	9.0	1	21.7	53.3	58.8	60	70
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	6.1	41.0	9.5	1.3	4.7	2.2	5.0	None	-	-	-	25.9	28.1	30	30
									E09	9.0	1	10.8	25.9	28.4	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	4.4	33.0	6.8	0.7	3.6	1.8	4.0	None	-	-	-	18.8	20.6	20	25
									E09	9.0	1	8.7	20.3	22.6	25	25
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
102 (8.5)	208	14.5	98.0	22.6	2.1	9.6	5.5	10.0	None	-	-	-	56.4	61.9	70	70
									E09	6.8	1	18.9	56.4	61.9	70	70
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
	230	14.5	98.0	22.6	2.1	9.6	5.5	10.0	None	-	-	-	56.4	61.9	70	70
									E09	9.0	1	21.7	56.4	61.9	70	70
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
	460	6.3	55.0	9.9	1.3	4.7	2.2	5.0	None	-	-	-	26.4	28.6	30	30
									E09	9.0	1	10.8	26.4	28.6	30	30
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
	575	6.0	41.0	9.4	0.7	3.6	1.8	4.0	None	-	-	-	22.4	24.2	25	30
									E09	9.0	1	8.7	22.4	24.2	25	30
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60

ZR078-150 Hi Static Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	13.5	2	37.5	71.3	78.2	80	80
									E24	18.0	2	50.0	87.0	93.8	90	100
									E36	25.5	2	70.8	113.0	119.9	125	125
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	16.0	110.0	24.9	3.0	9.6	5.5	10.0	None	-	-	-	61.7	67.2	70	80
									E18	18.0	2	43.3	78.6	85.5	80	90
									E24	24.0	2	57.7	96.7	103.5	100	110
									E36	34.0	2	81.8	126.7	133.6	150	150
									E54	54.0	2	129.9	154.4	161.3	175	175
	460	7.8	52.0	12.1	1.6	4.7	2.2	5.0	None	-	-	-	30.5	32.7	35	40
									E18	18.0	2	21.7	39.2	41.9	40	45
									E24	24.0	2	28.9	48.2	51.0	50	60
									E36	34.0	2	40.9	63.2	66.0	70	70
									E54	54.0	2	65.0	77.1	79.8	90	90
	575	5.7	38.9	8.9	1.4	3.6	1.8	4.0	None	-	-	-	23.1	24.9	25	30
									E18	18.0	2	17.3	31.2	33.4	35	35
									E24	24.0	2	23.1	38.4	40.6	40	45
									E36	34.0	2	32.7	50.4	52.6	60	60
									E54	54.0	2	52.0	61.5	63.7	70	70
150 (12.5)	208	22.4	149.0	35.0	2.1	14.0	5.5	10.0	None	-	-	-	82.8	88.3	100	110
									E18	13.5	2	37.5	82.8	88.3	100	110
									E24	18.0	2	50.0	92.5	99.3	100	110
									E36	25.5	2	70.8	118.5	125.4	125	150
									E54	40.6	2	112.7	170.9	177.7	175	200
	230	22.4	149.0	35.0	2.1	14.0	5.5	10.0	None	-	-	-	82.8	88.3	100	110
									E18	18.0	2	43.3	84.1	91.0	100	110
									E24	24.0	2	57.7	102.2	109.0	110	110
									E36	34.0	2	81.8	132.2	139.1	150	150
									E54	54.0	2	129.9	159.9	166.8	175	175
	460	10.6	75.0	16.5	1.3	6.6	2.2	5.0	None	-	-	-	40.5	42.7	50	50
									E18	18.0	2	21.7	41.6	44.3	50	50
									E24	24.0	2	28.9	50.6	53.3	60	60
									E36	34.0	2	40.9	65.6	68.4	70	70
									E54	54.0	2	65.0	79.5	82.2	90	90
	575	7.7	54.0	12.0	0.7	5.2	1.8	4.0	None	-	-	-	29.2	31.0	35	35
									E18	18.0	2	17.3	33.2	35.4	35	40
									E24	24.0	2	23.1	40.4	42.6	45	45
									E36	34.0	2	32.7	52.4	54.6	60	60
									E54	54.0	2	52.0	63.5	65.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Electric Heat Multipliers

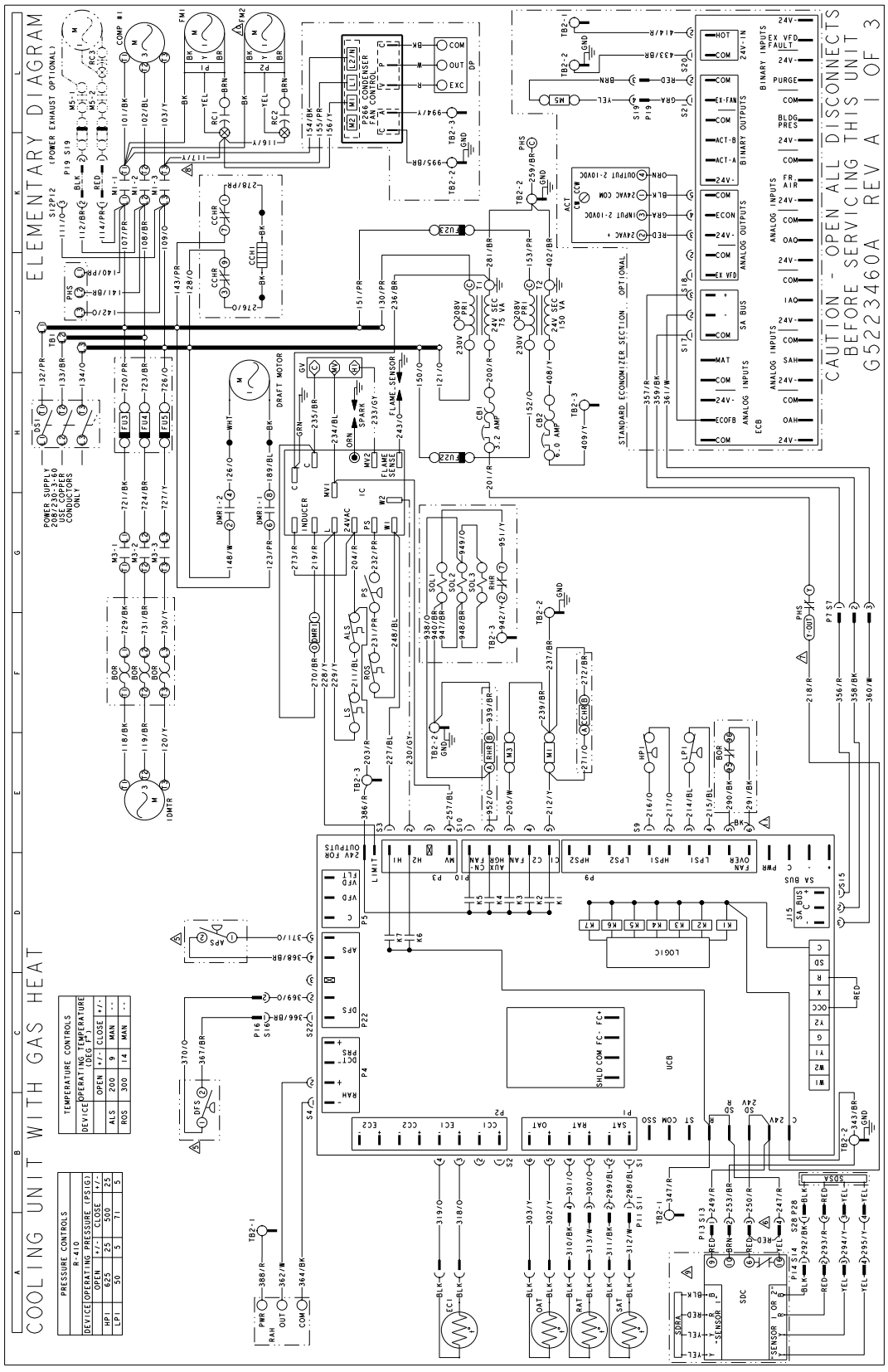
Voltage		kW Capacity Multipliers[1]
Nominal	Applied	
240	208	0.75
	230	0.92
480	460	0.92
600	575	0.92

1. Electric heaters are rated at nominal voltage. Use this table to determine the electric heat capacity for heaters applied at lower voltages.

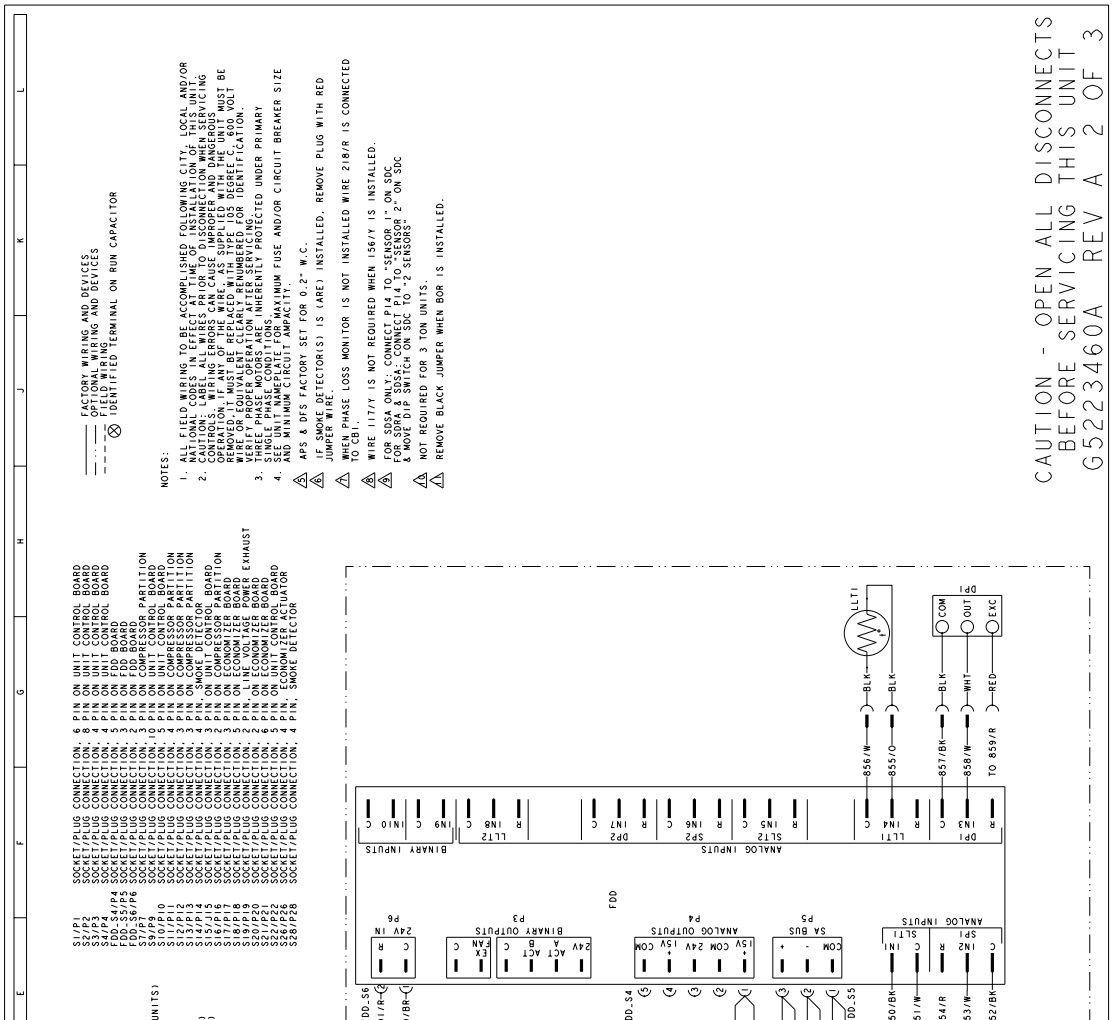
Typical Wiring Diagrams

ZH/ZJ037-150 Typical Wiring Diagrams

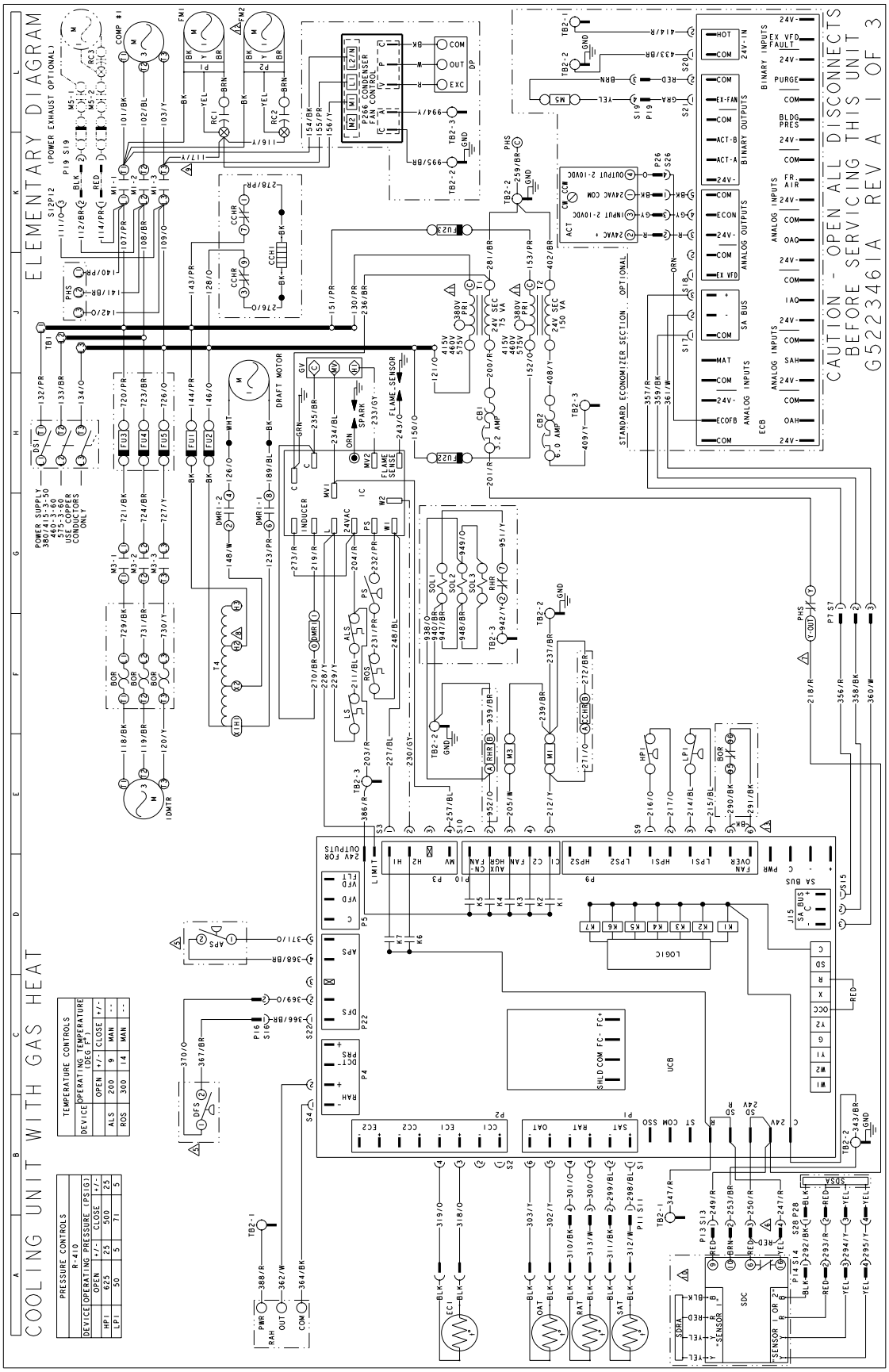
Typical ZH/ZJ/ZR037-061 Cooling Unit with Gas Heat 208/230 Volt Wiring Diagram



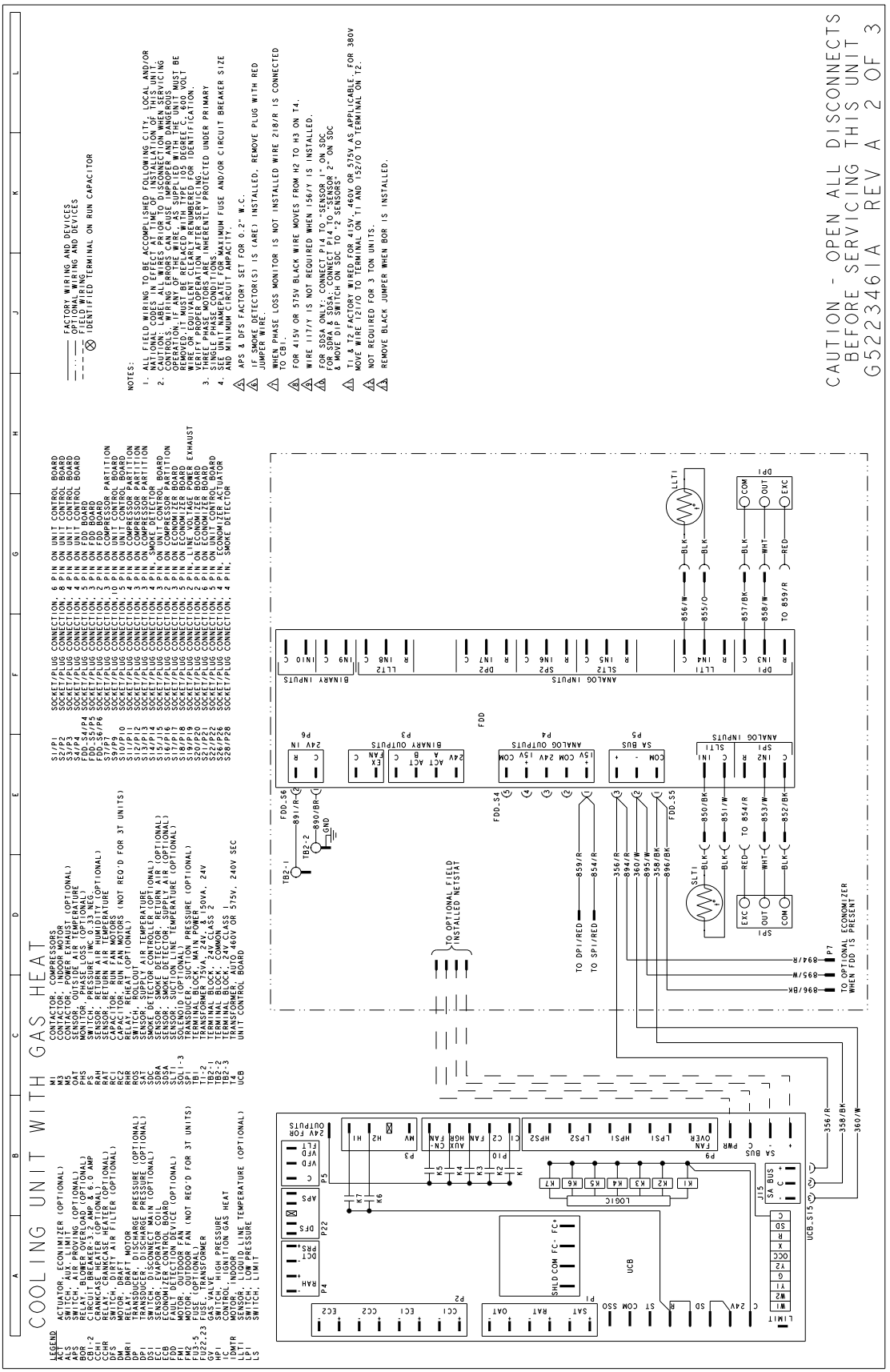
Typical ZH/ZJ/ZR037-061 Cooling Unit with Gas Heat 208/230 Volt Unit (Options)



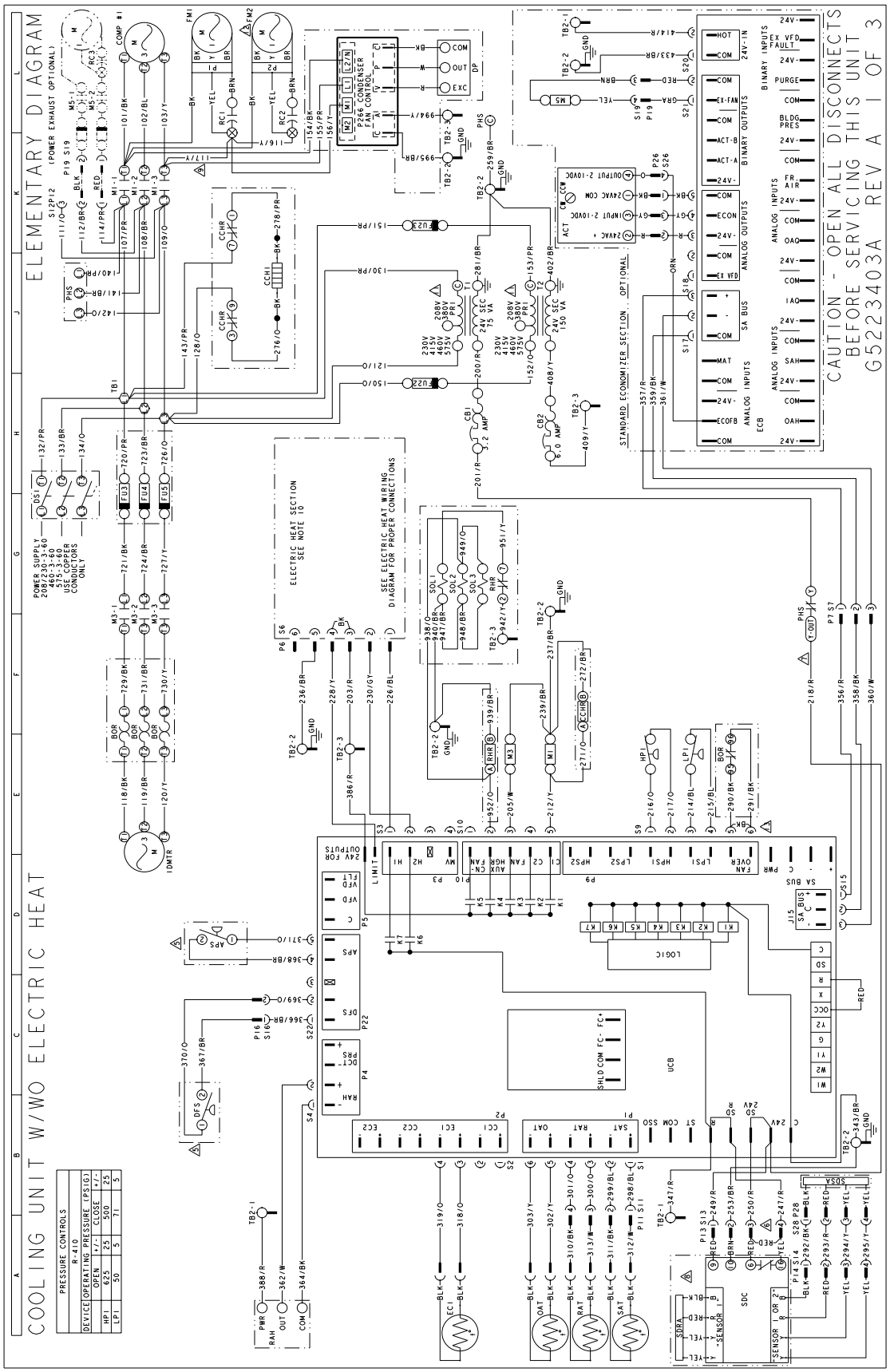
Typical ZH/ZJ/ZR037-061 Cooling Unit with Gas Heat 460/575 Volt Wiring Diagram



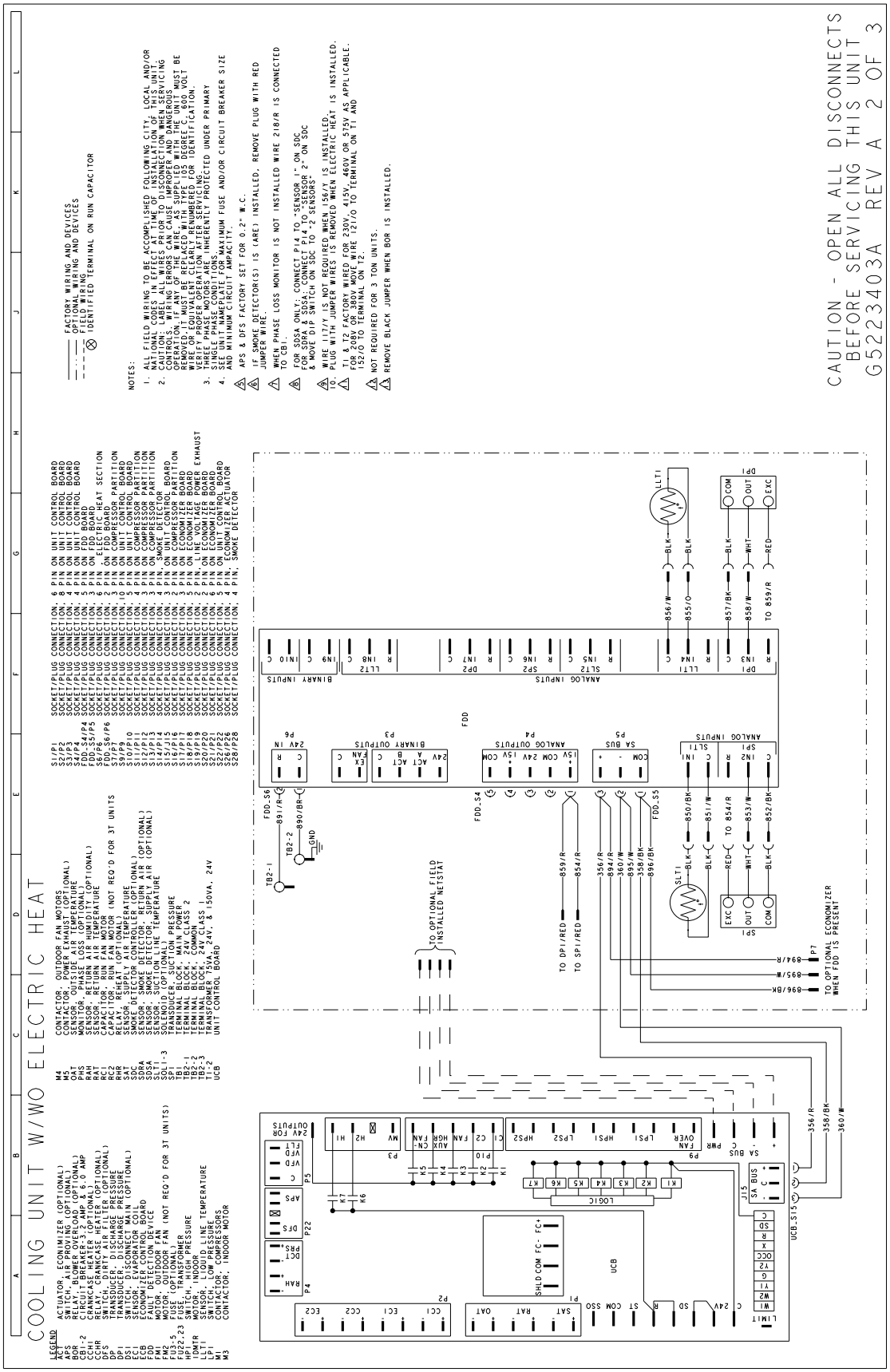
Typical ZH/ZJ/ZR037-061 Cooling Unit with Gas Heat 460/575 Volt Unit (Options)



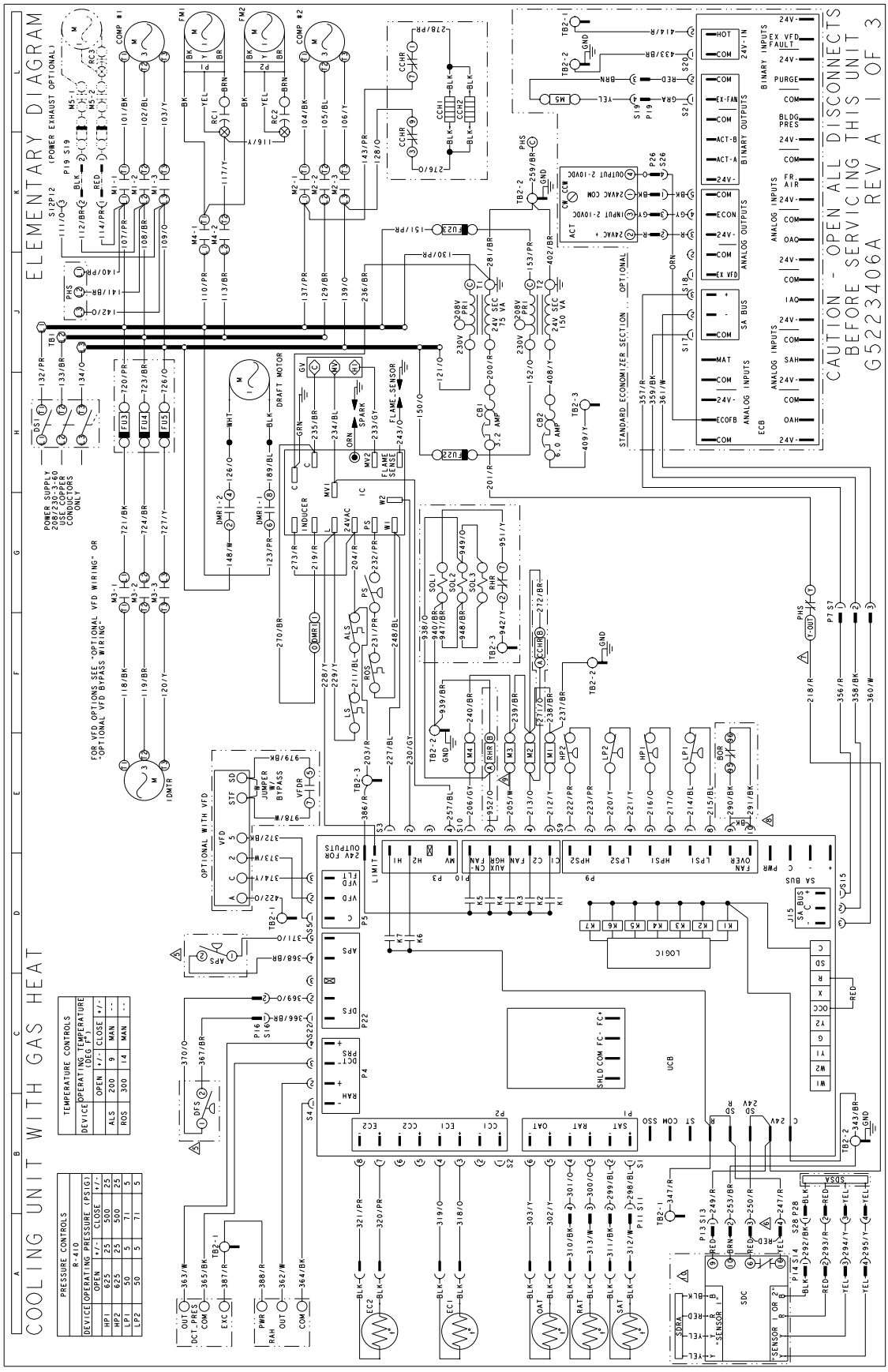
Typical ZH/ZJ/ZR037-061 Cooling Unit with/without Electric Heat Wiring Diagram



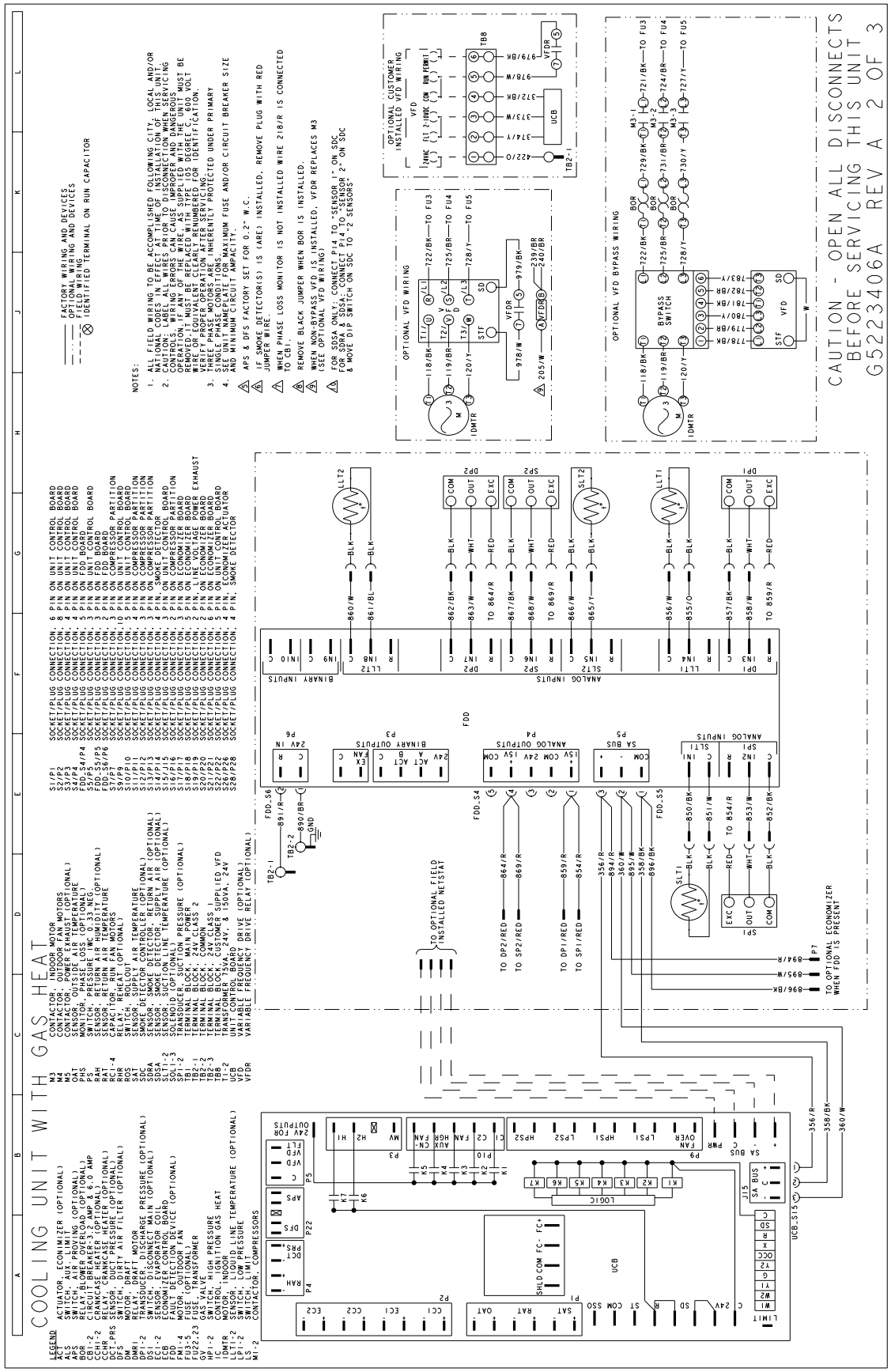
Typical ZH/ZJ/ZR037-061 Cooling Unit with/without Electric Heat Unit (Options)



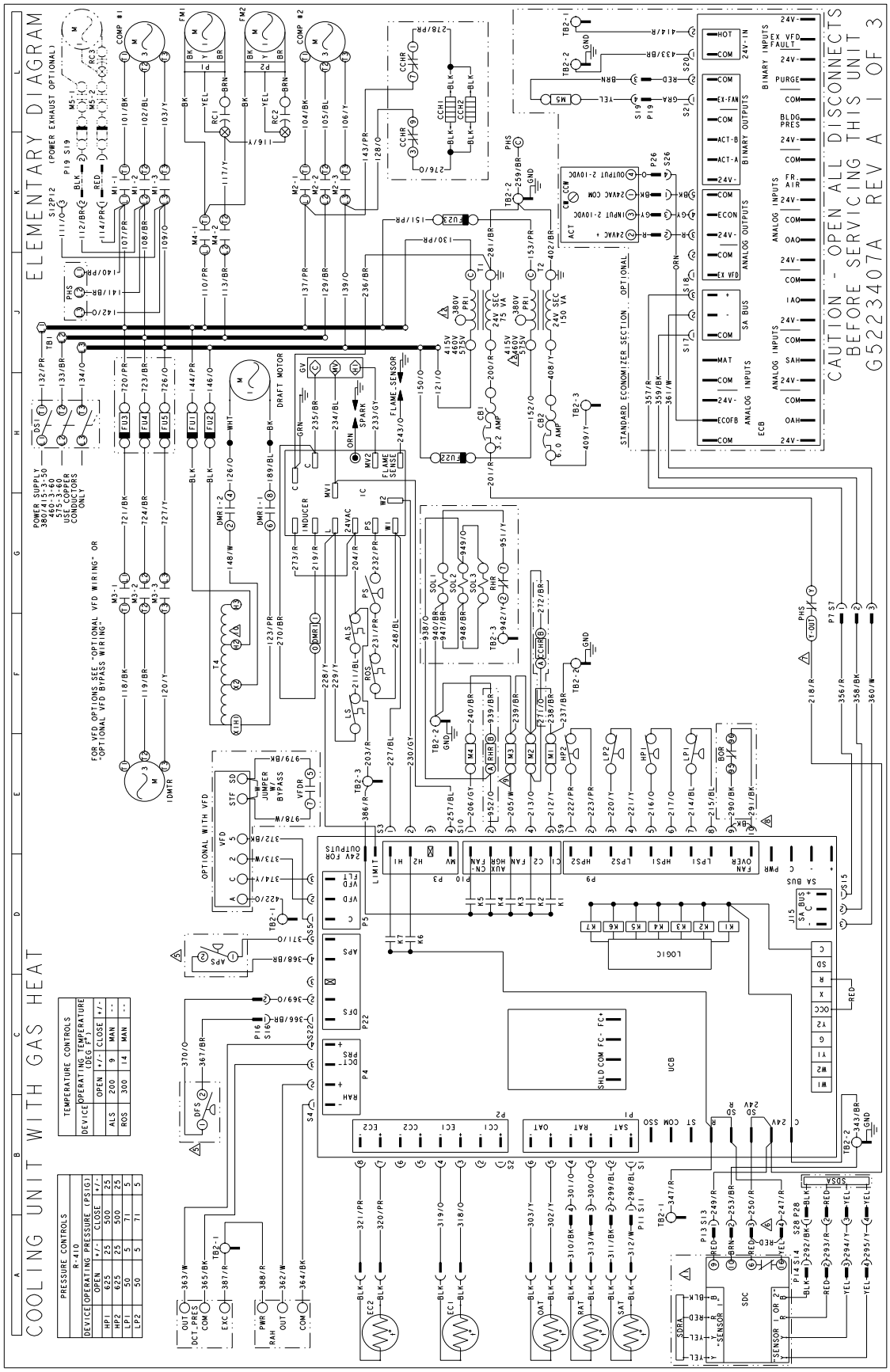
Typical ZH/ZJ/ZR078-120 Cooling Unit with Gas Heat 208/230 Volt Wiring Diagram



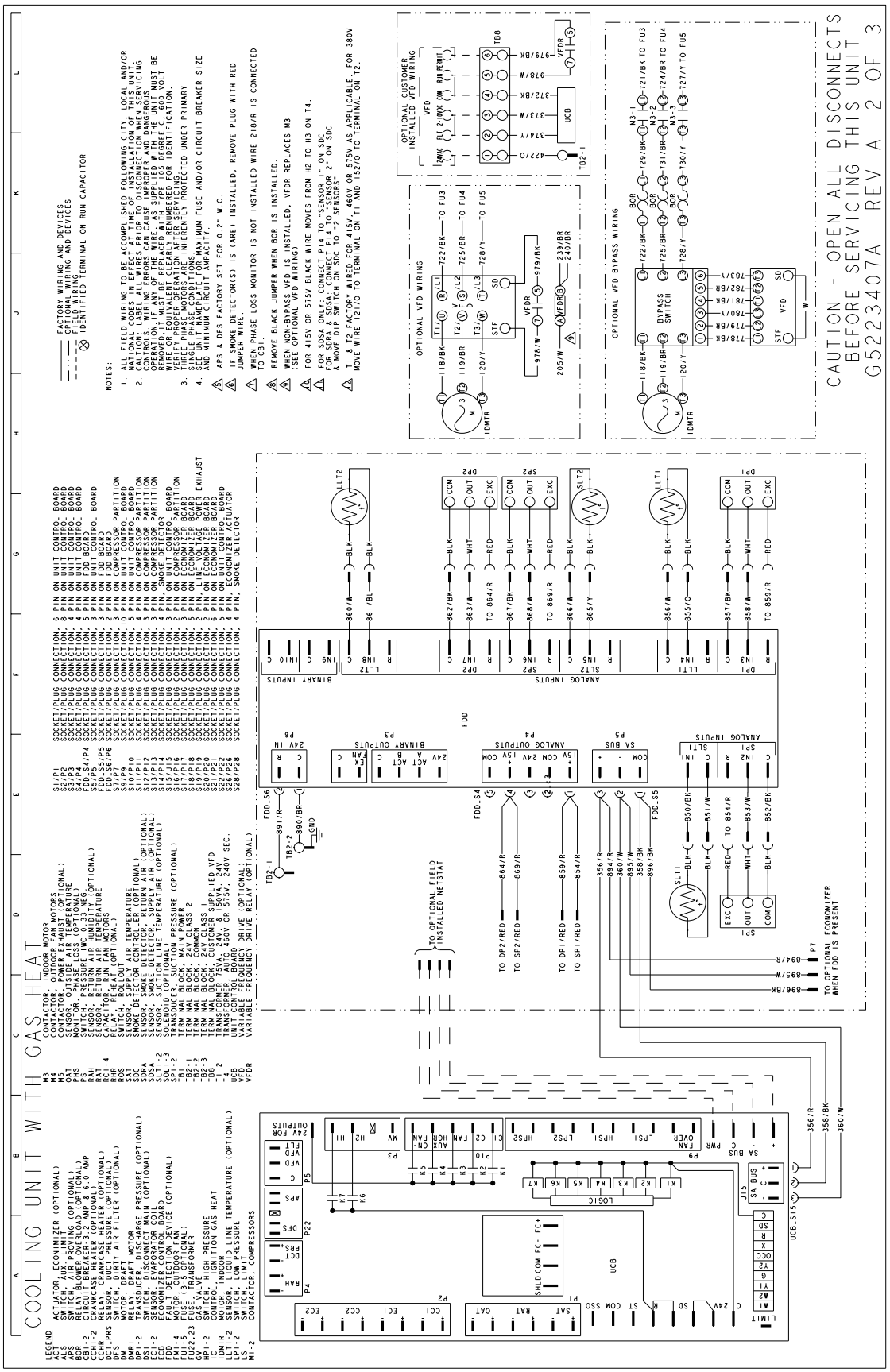
Typical ZH/ZJ/ZR078-120 Cooling Unit with Gas Heat 208/230 Volt Unit (Options)



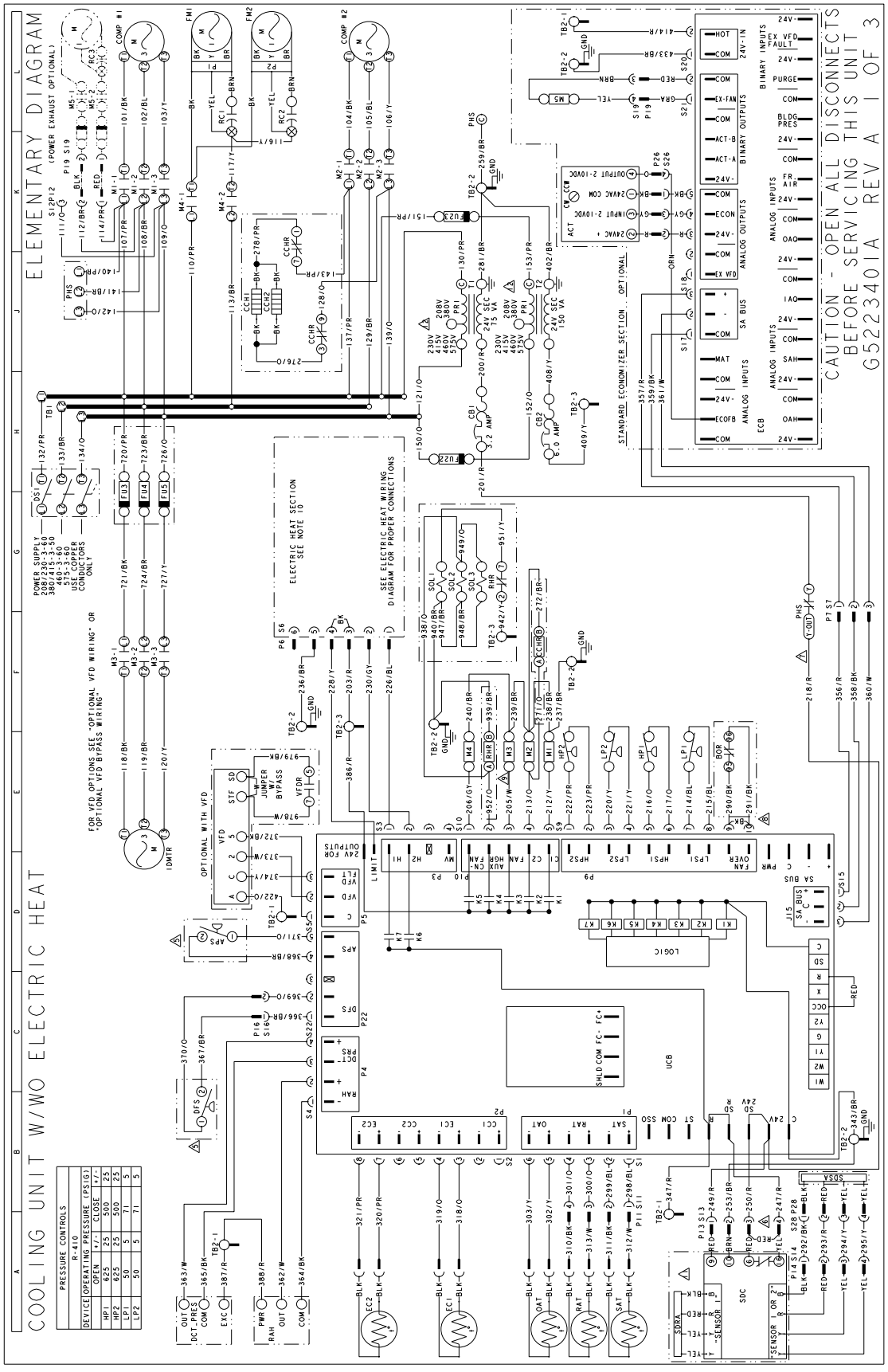
Typical ZH/ZJ/ZR078-120 Cooling Unit with Gas Heat 460/575 Volt Wiring Diagram



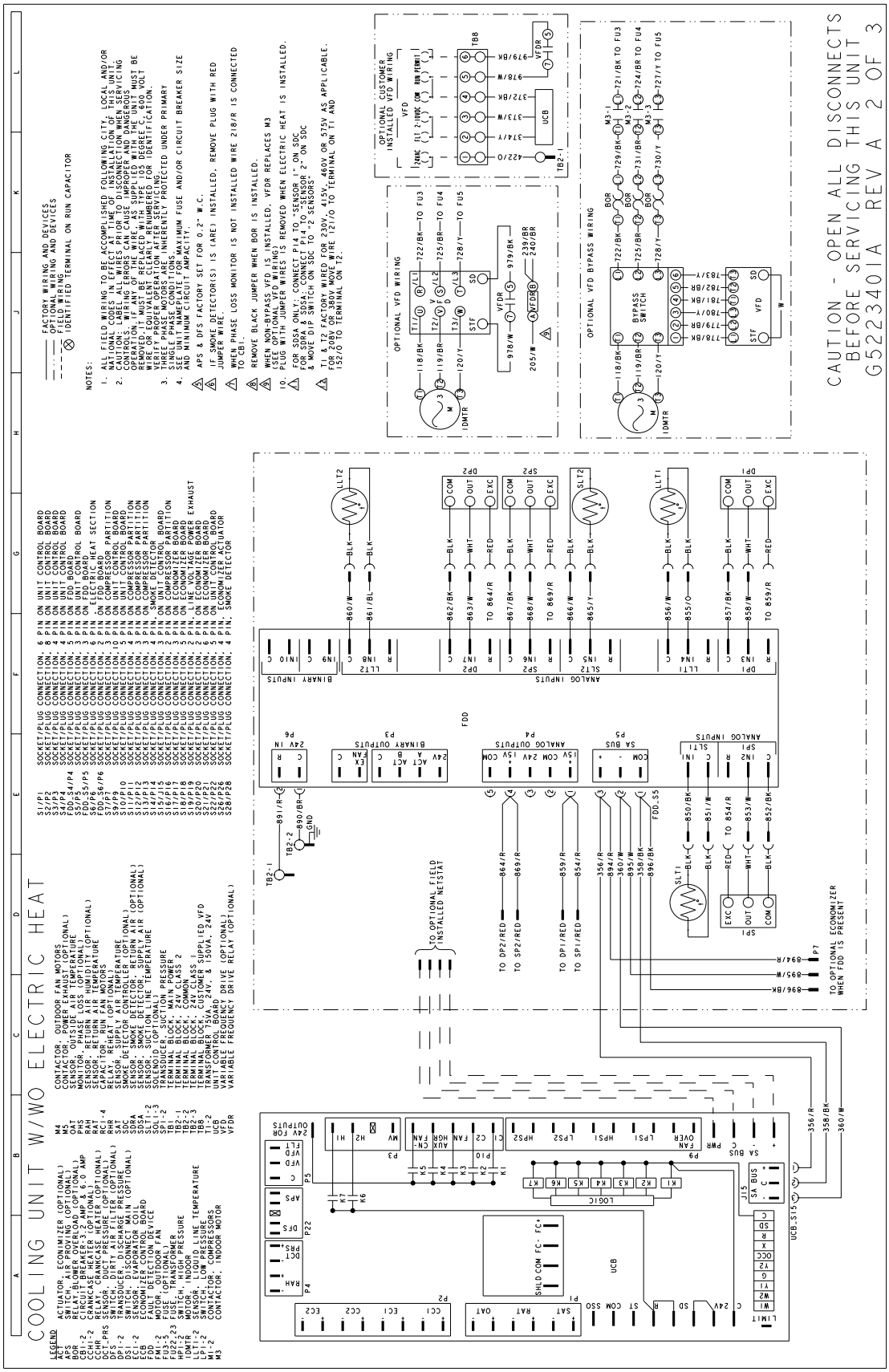
Typical ZH/ZJ/ZR078-120 Cooling Unit with Gas Heat 460/575 Volt Unit (Options)



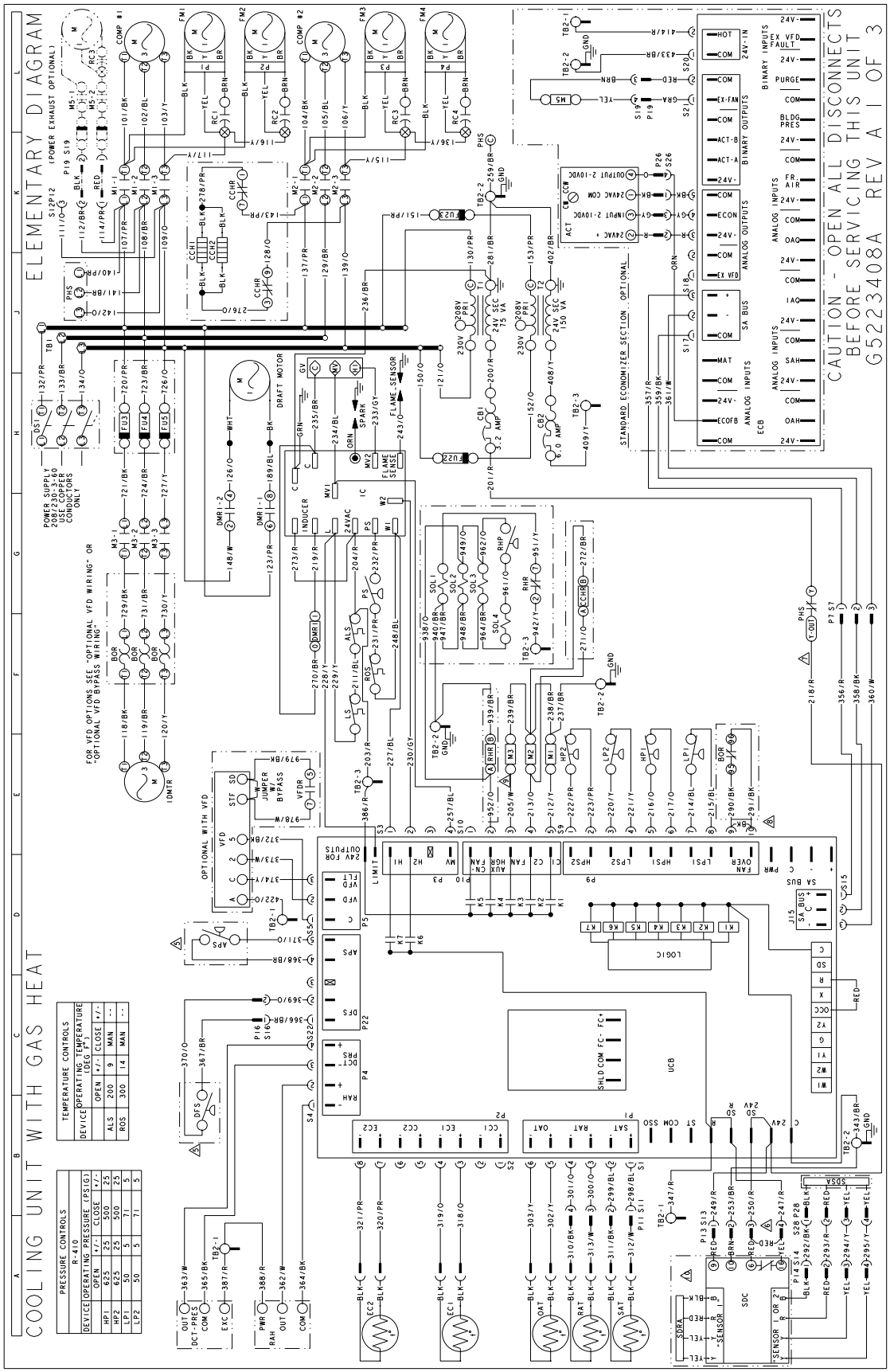
Typical ZH/ZJ/ZR078-120 Cooling Unit with/without Electric Heat Wiring Diagram



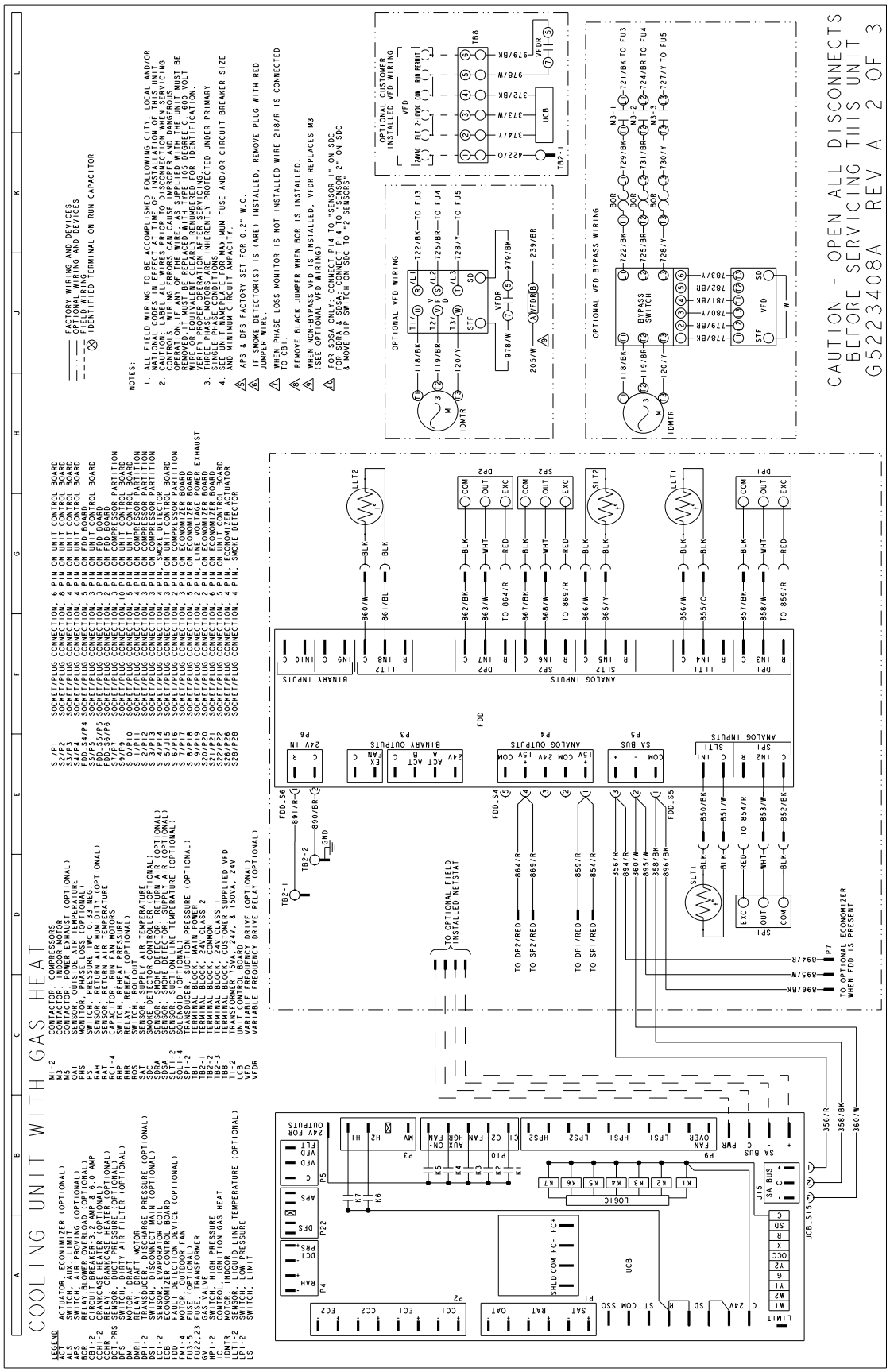
Typical ZH/ZJ/ZR078-120 Cooling Unit with/without Electric Heat Unit (Options)



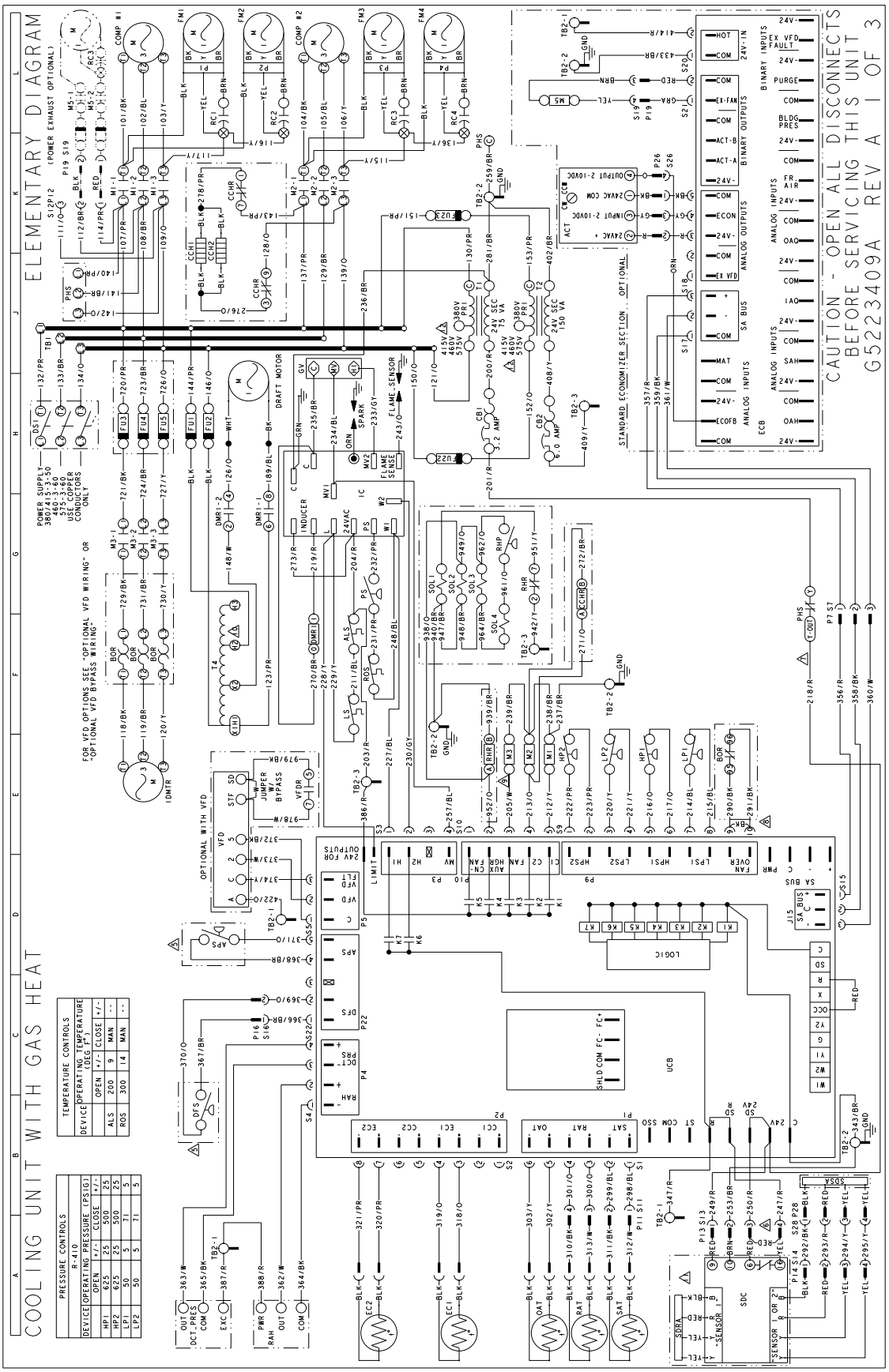
Typical ZH/ZJ/ZR150 Cooling Unit with Gas Heat 208/230 Volt Wiring Diagram



Typical ZH/ZJ/ZR150 Cooling Unit with Gas Heat 208/230 Volt Unit (Options)



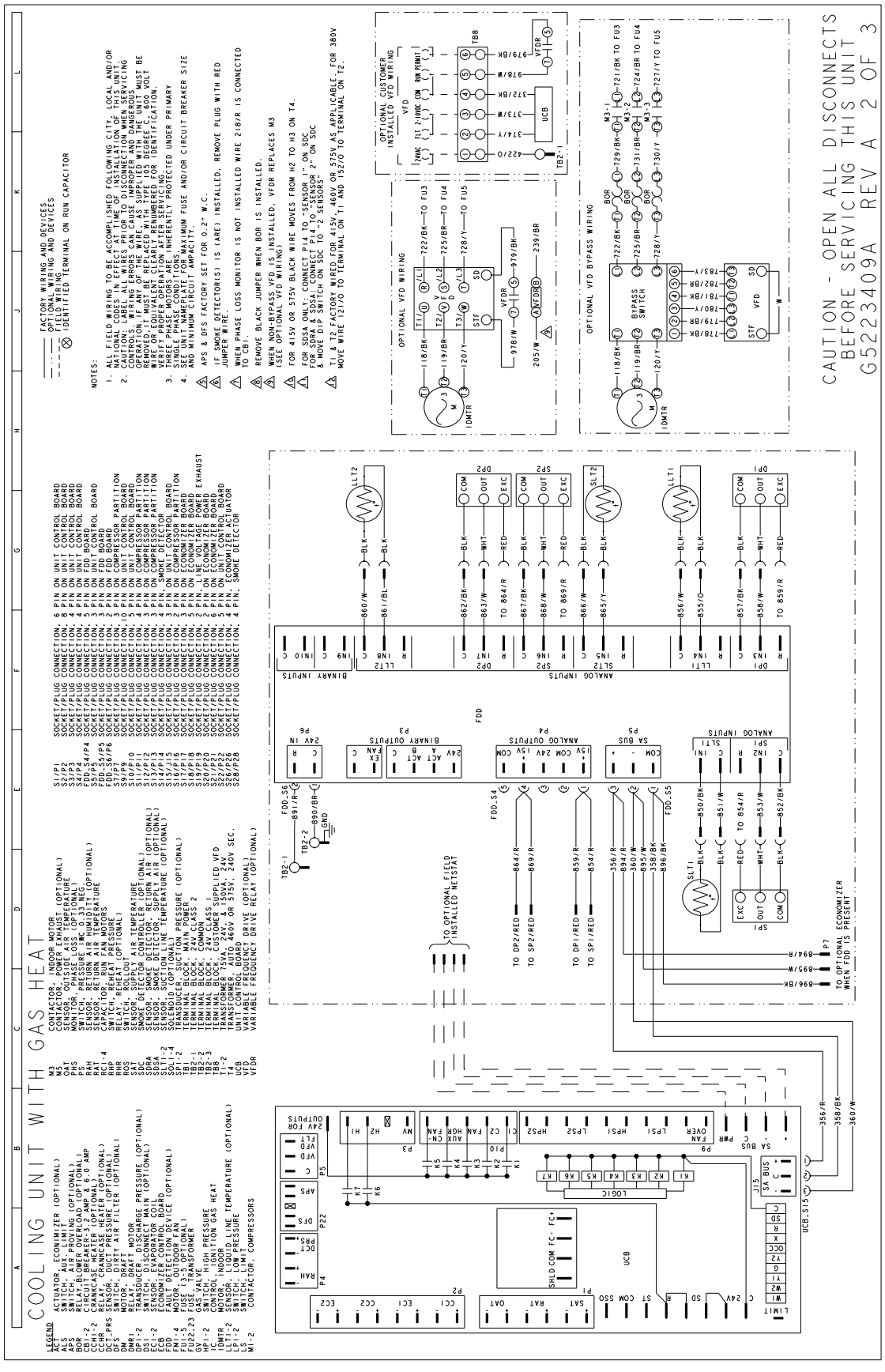
Typical ZH/ZJ/ZR150 Cooling Unit with Gas Heat 460/575 Volt Wiring Diagram



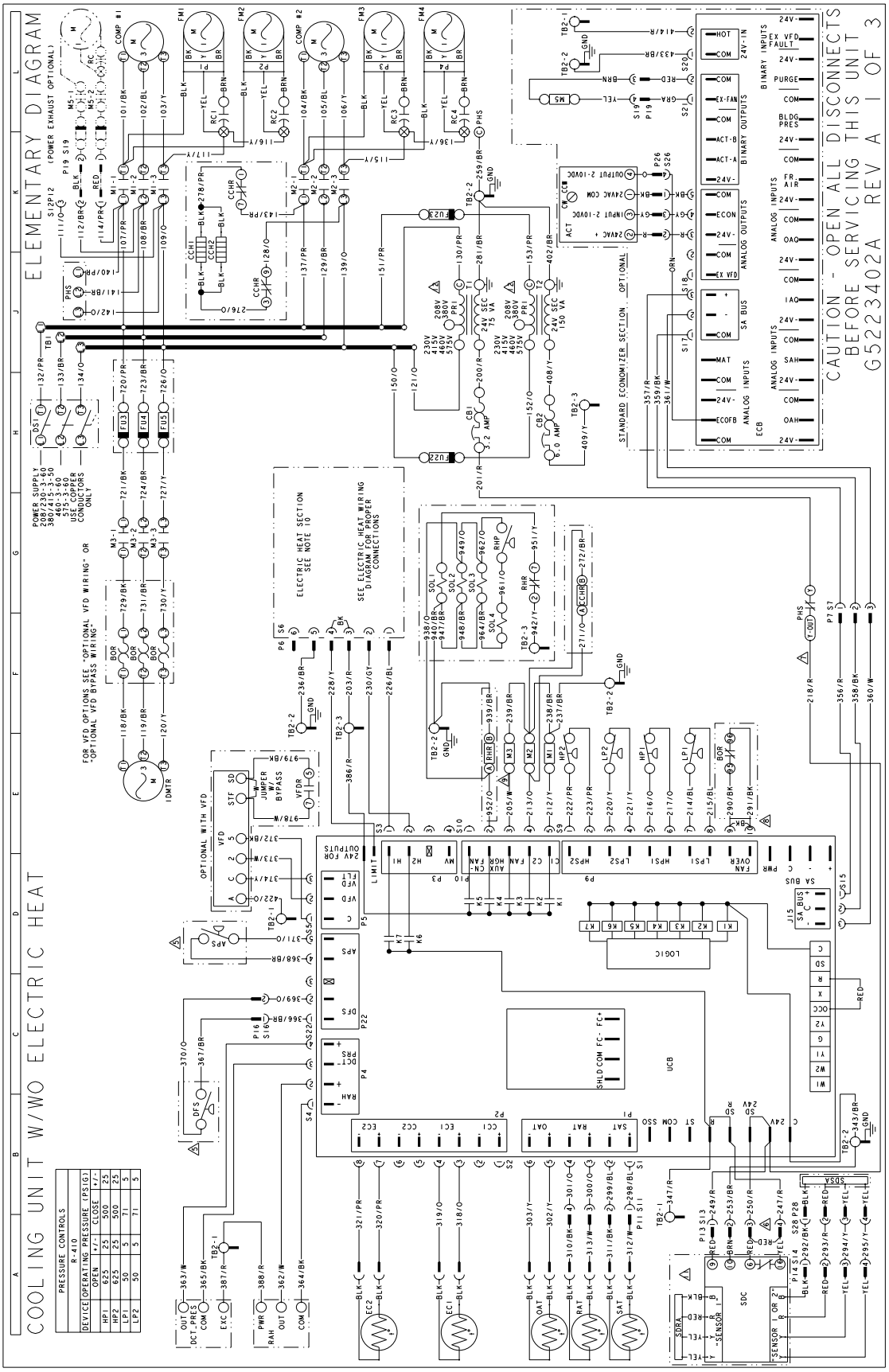
PRESSURE CONTROLS R-410				
DEVICE	OPERATING PRESSURE (PSIG) OPEN	+/-	CLOSE	+/-
HP1	625	25	500	25
HP2	625	25	500	25
LP1	50	5	71	5
LP2	50	5	71	5

TEMPERATURE CONTROLS				
DEVICE	OPERATING TEMPERATURE (DEG F) OPEN	+/-	CLOSE	+/-
ALS	200	9	MAN	--
ROS	300	14	MAN	--

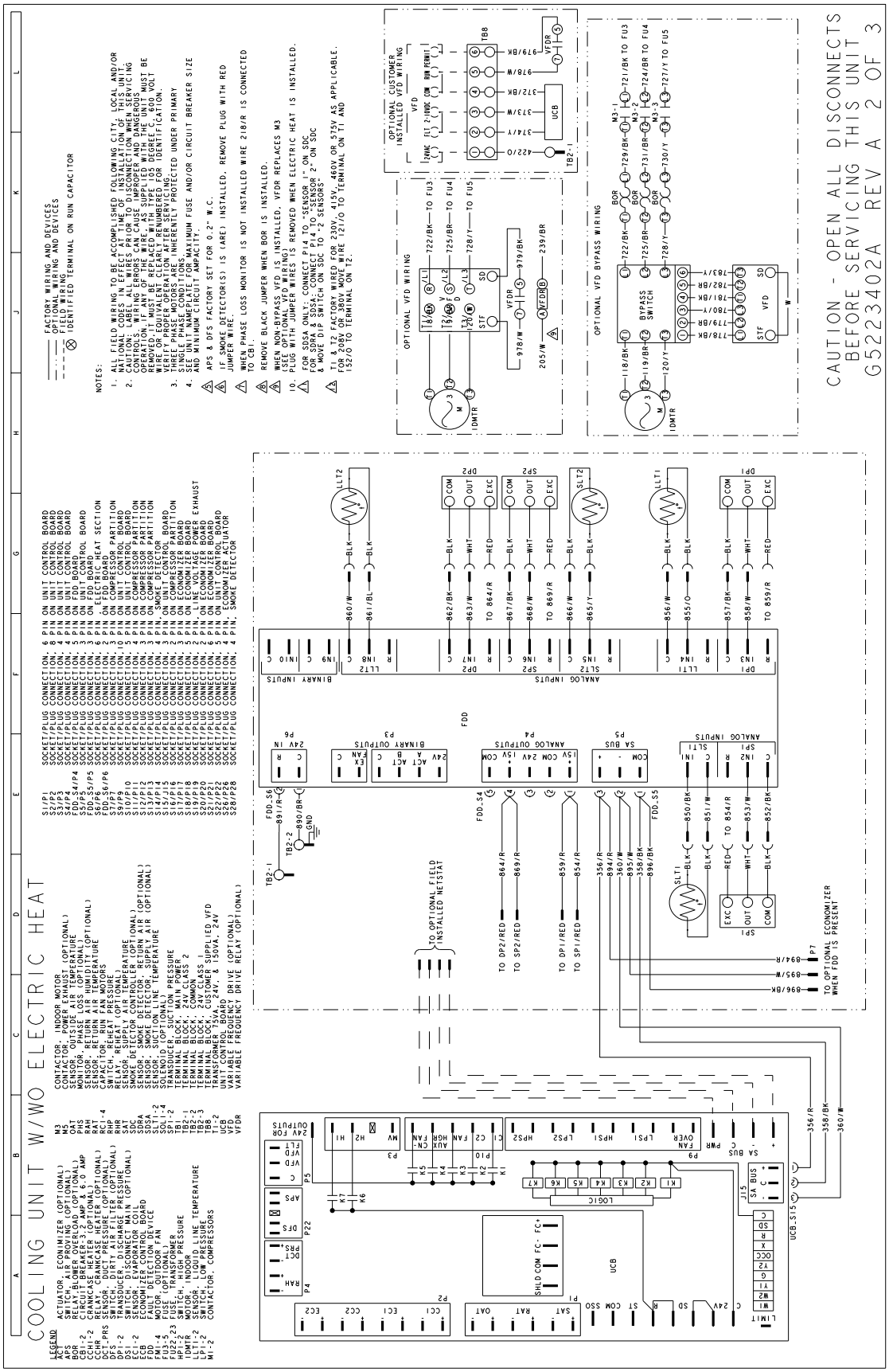
Typical ZH/ZJ/ZR150 Cooling Unit with Gas Heat 460/575 Volt Unit (Options)



Typical ZH/ZJ/ZR150 Cooling Unit with/without Electric Heat Wiring Diagram

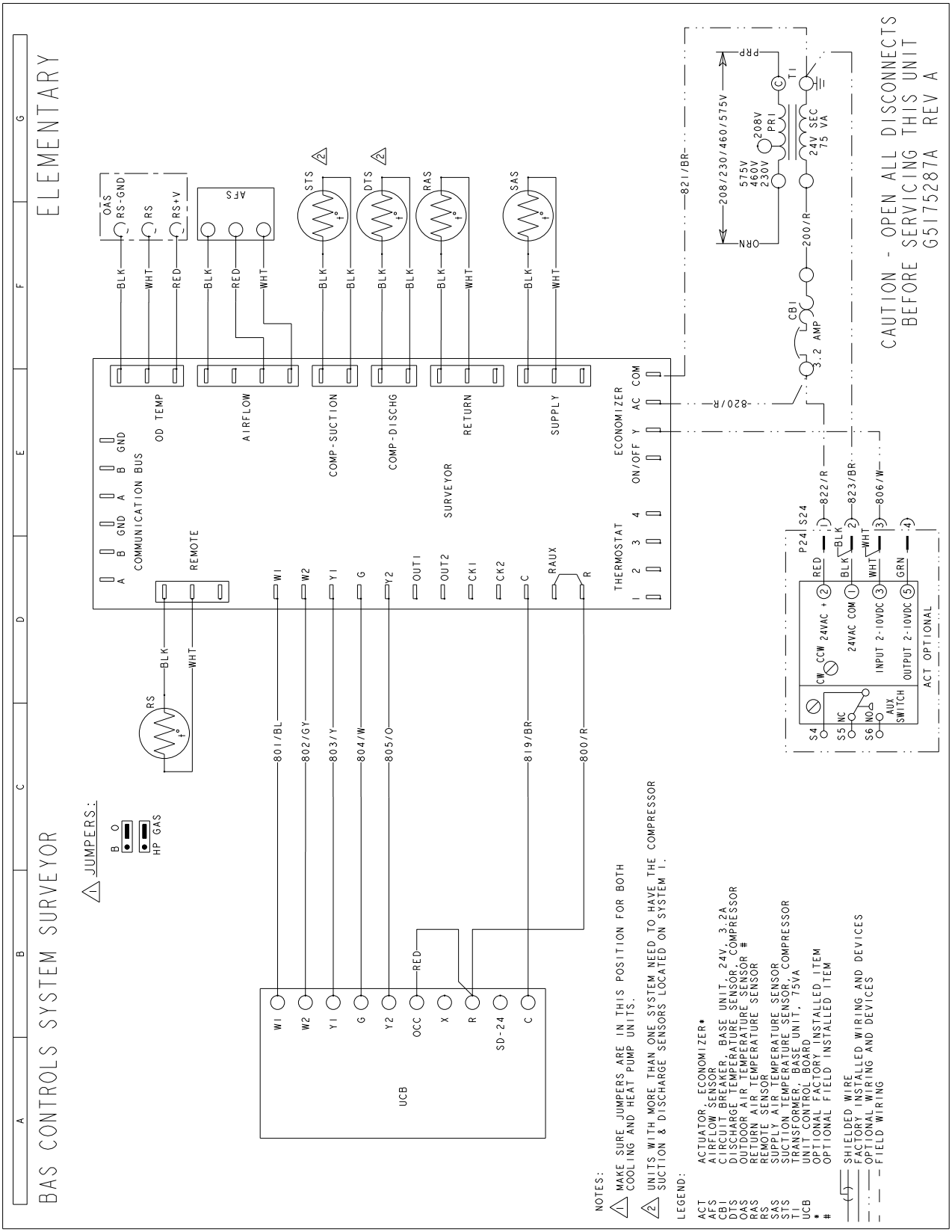


Typical ZH/ZJ/ZR150 Cooling Unit with/without Electric Heat Unit (Options)

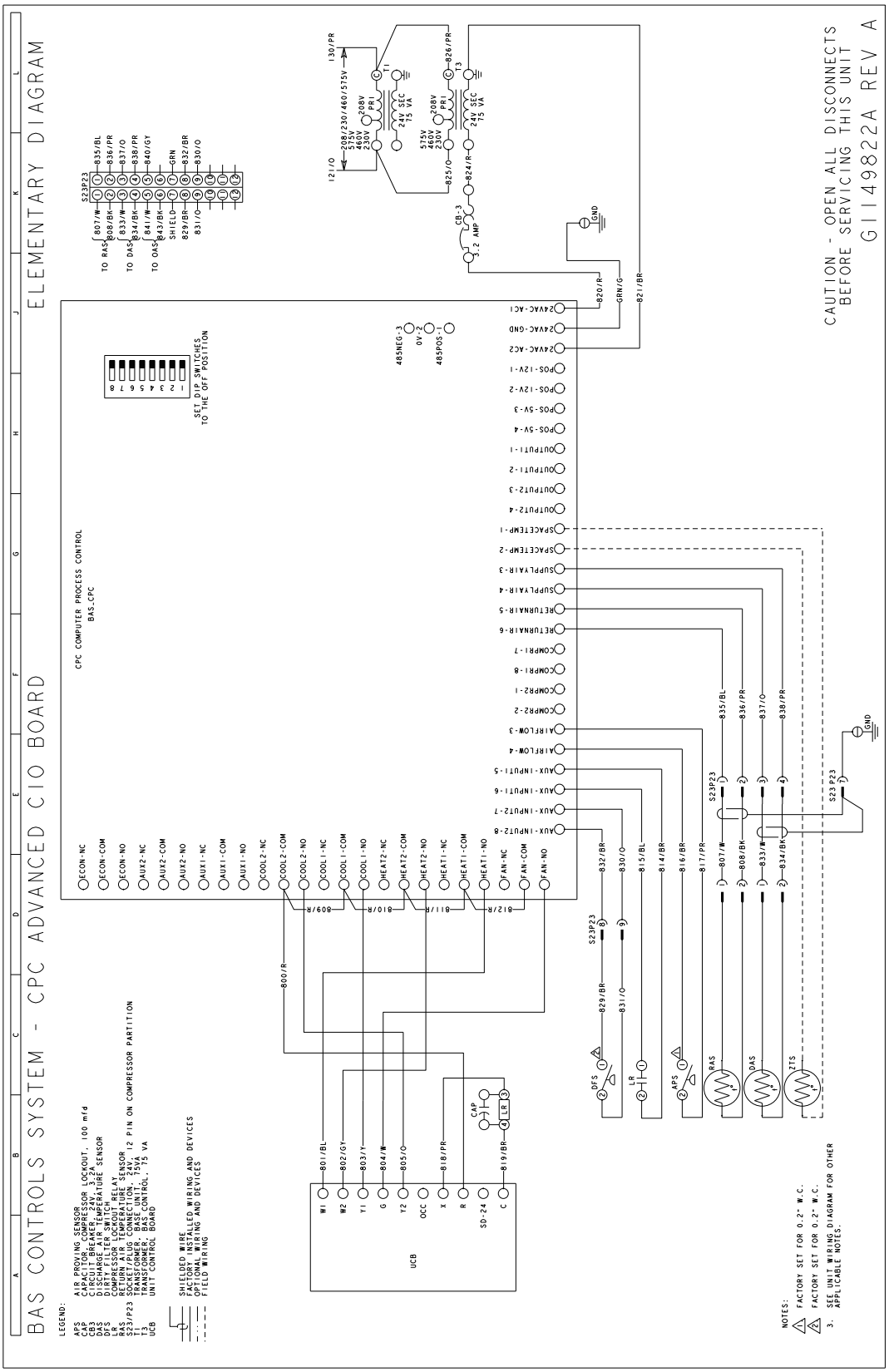


BAS Controls Typical Wiring Diagrams

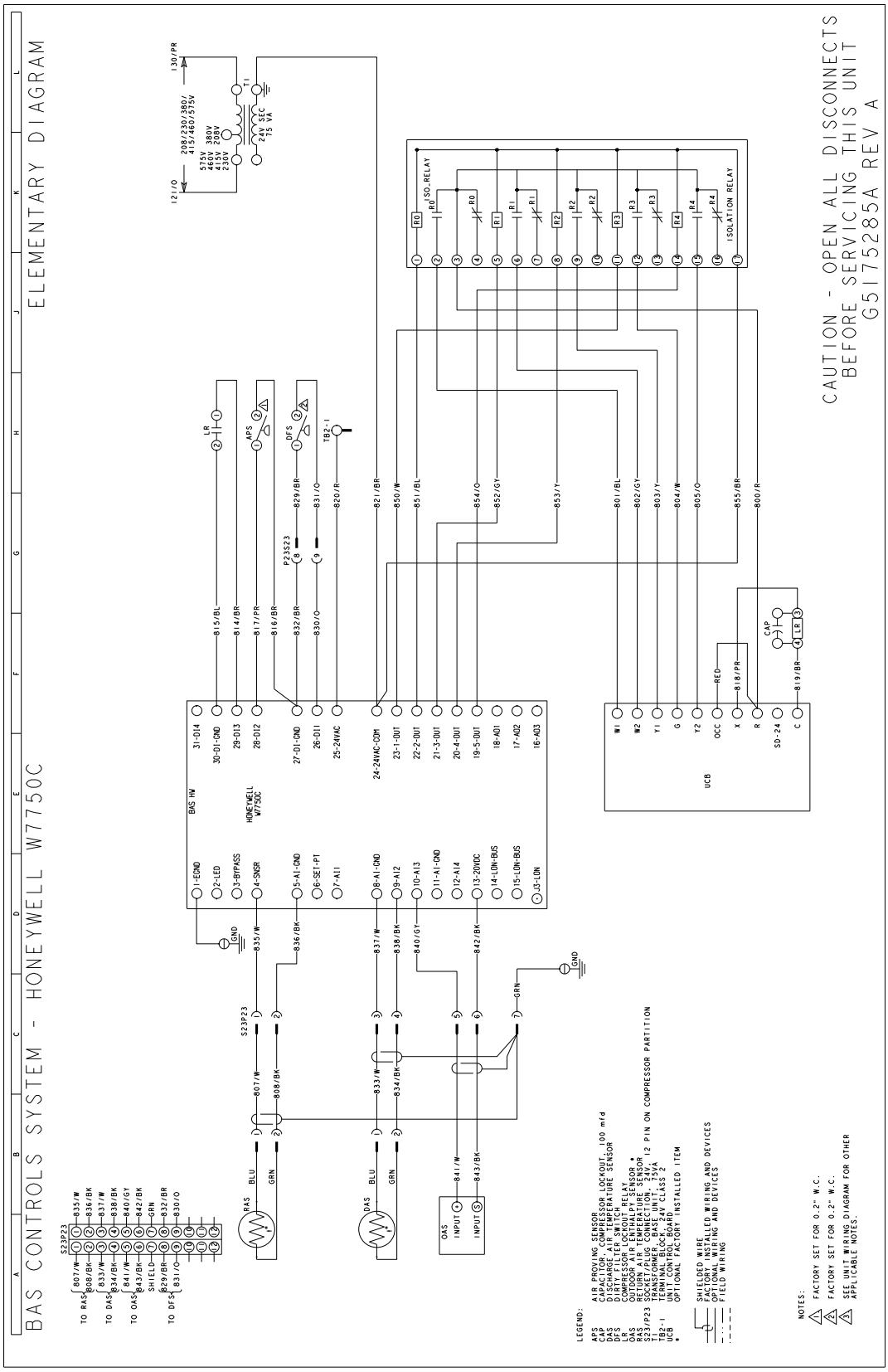
Typical SURVEYOR BAS Control Wiring Diagram



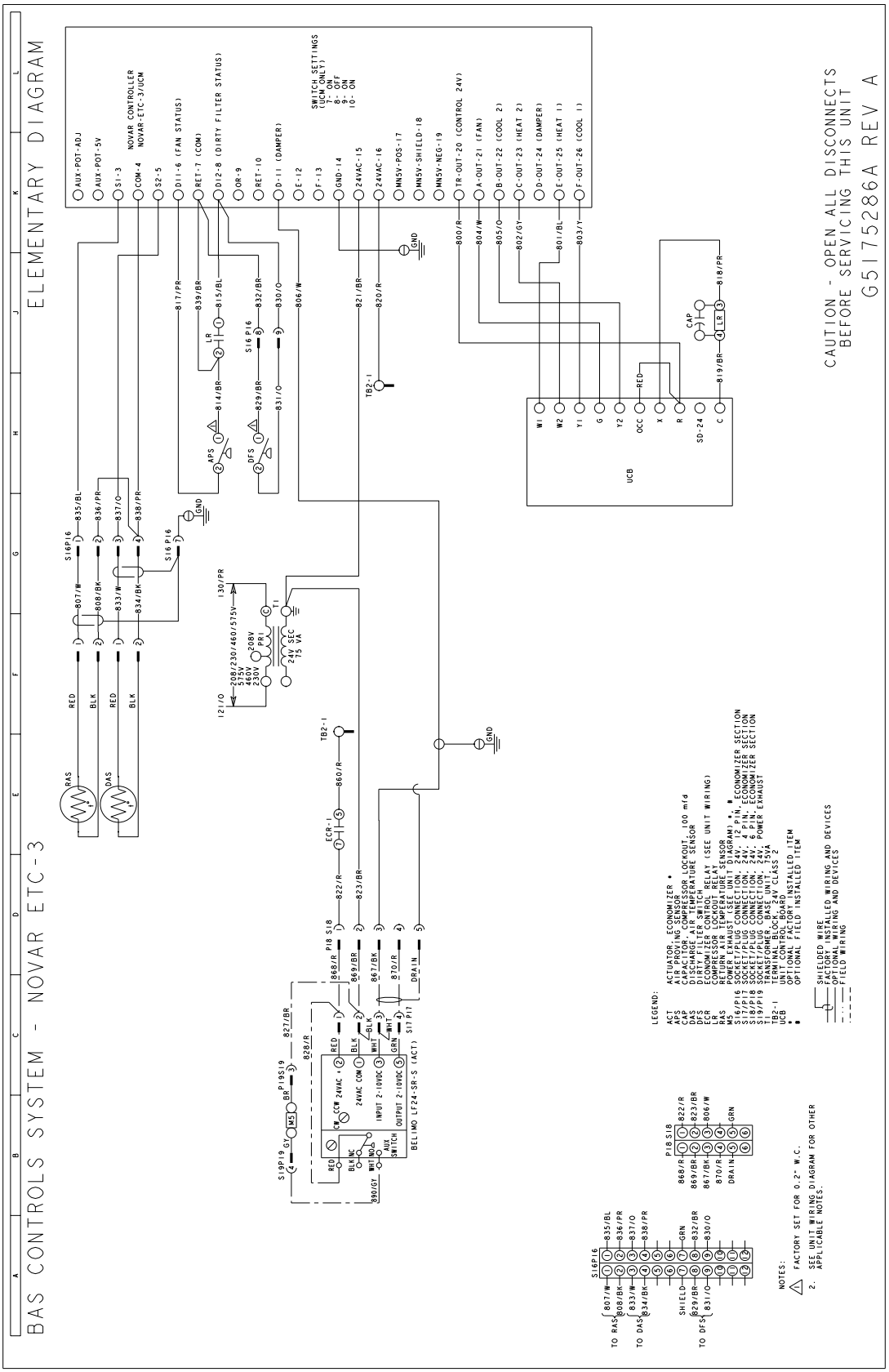
Typical CPC BAS Control Wiring Diagram



Typical HONEYWELL BAS Control Wiring Diagram



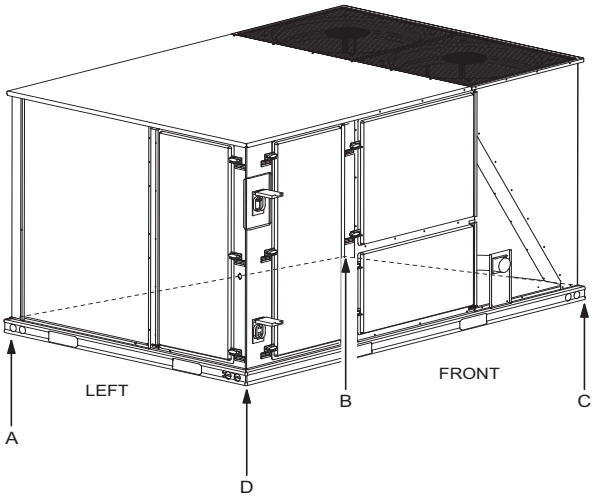
Typical NOVAR BAS Control Wiring Diagram



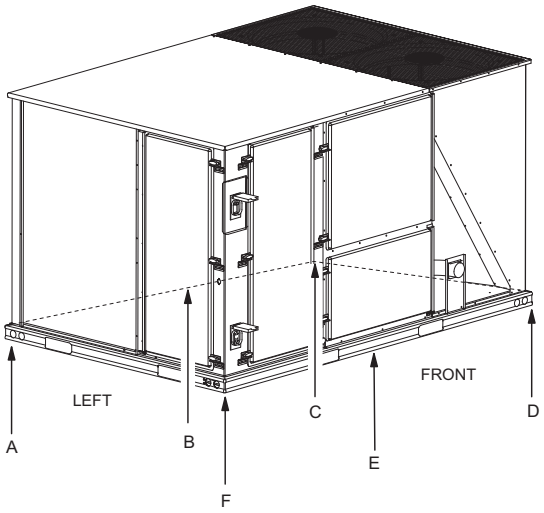
Weights and Dimensions

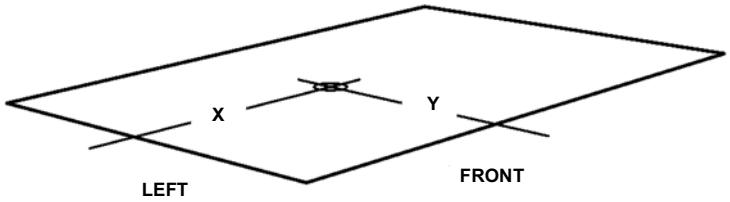
ZH/ZJ037-150 Unit Weights

Unit 4 Point Load Weight



Unit 6 Point Load Weight

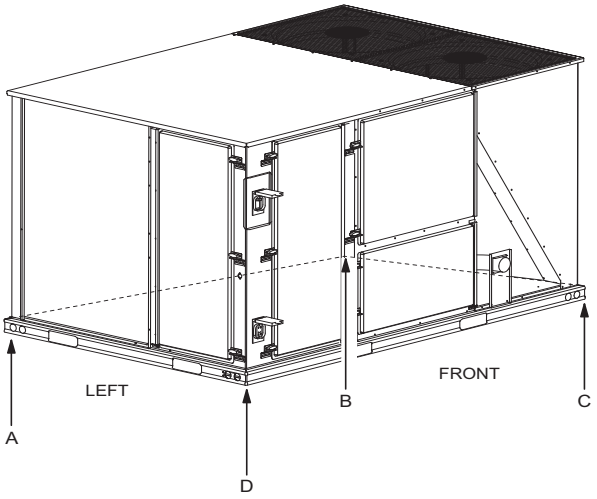




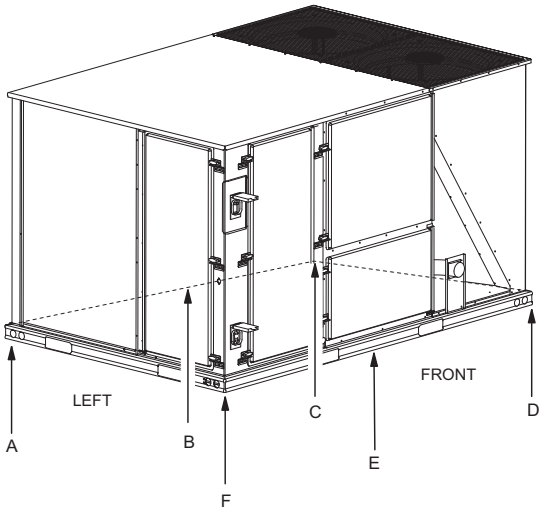
Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
037 (3)	ZH	728	723	40	26	175	143	182	223	121	105	92	117	134	154
049 (4)	ZH	768	763	40	26	185	151	192	235	128	111	97	124	141	162
061 (5)	ZH	869	864	40	26	210	171	217	266	145	126	110	140	160	184
078 (6.5)	ZH	915	910	38	24	212	158	230	309	149	121	100	147	177	217
090 (7.5)	ZH	915	910	38	24	212	158	230	309	149	121	100	147	177	217
102 (8.5)	ZH	1052	1047	38	24	244	182	265	356	171	139	116	169	203	249
120 (10)	ZH	1095	1090	38	24	254	189	276	371	178	145	120	176	211	260
150 (12.5)	ZH	1285	1280	48	24	240	281	410	350	156	173	192	280	252	227
037 (3)	ZJ	745	740	40	26	180	147	186	228	124	108	95	120	137	157
049 (4)	ZJ	780	775	40	24	174	142	207	253	120	104	91	133	152	175
061 (5)	ZJ	775	770	40	24	172	141	205	251	119	103	91	132	151	174
078 (6.5)	ZJ	1035	1030	39	25	245	191	260	333	170	144	122	167	195	232
090 (7.5)	ZJ	1055	1050	39	25	250	195	265	340	174	146	125	170	199	236
102 (8.5)	ZJ	1065	1060	38	24	247	184	268	360	173	141	117	171	206	253
120 (10)	ZJ	1075	1070	39	24	245	191	278	357	170	143	122	178	209	248
150 (12.5)	ZJ	1285	1280	48	24	240	281	410	350	156	173	192	280	252	227

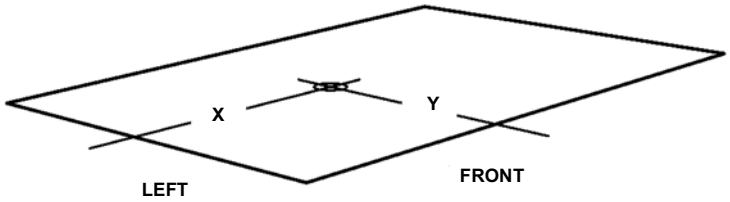
ZR037-150 Unit Weights

Unit 4 Point Load Weight



Unit 6 Point Load Weight





Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
037 (3)	ZR	872	867	40.3	25.5	205	170	223	269	141	124	110	144	163	185
049 (4)	ZR	885	880	40.9	25.1	202	172	232	273	139	124	112	151	168	187
061 (5)	ZR	872	867	41	25	198	169	230	269	136	122	110	150	166	184
078 (6.5)	ZR	962	957	38	23	214	159	249	335	150	122	101	159	191	234
090 (7.5)	ZR	970	965	38	23	216	161	251	337	151	123	102	160	193	236
102 (8.5)	ZR	1205	1200	38	25.5	297	221	291	390	208	170	141	185	223	274
120 (10)	ZR	1205	1200	38	25.5	297	221	291	390	208	170	141	185	223	274
150 (12.5)	ZR	1470	1465	51	25.5	270	363	477	355	172	207	254	334	272	226

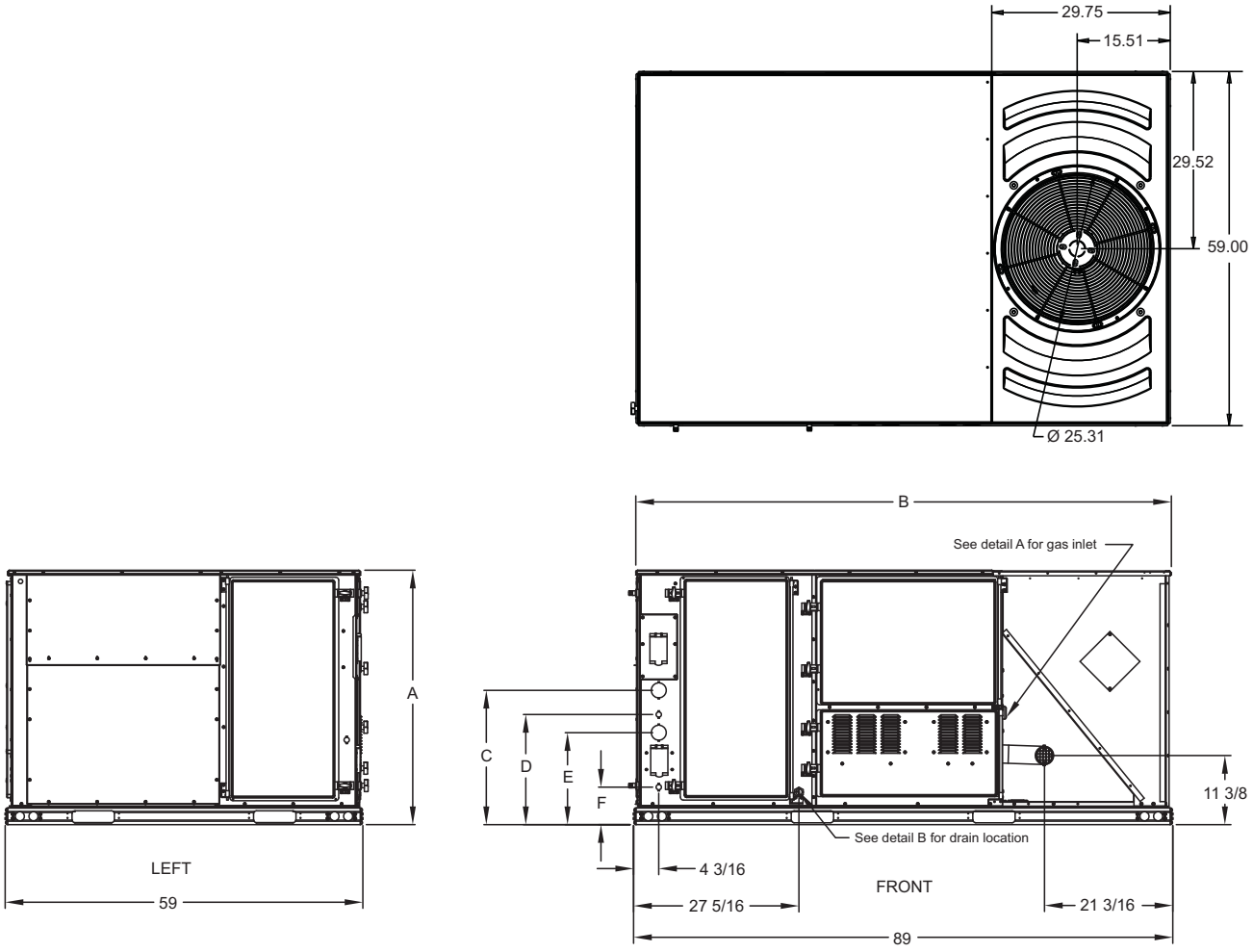
ZH/ZJ/ZR037-150 Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	90	85
Power Exhaust	40	35
Electric Heat[1]	49	49
Gas Heat[2]	110	110
Variable Frequency Drive[3]	30	30

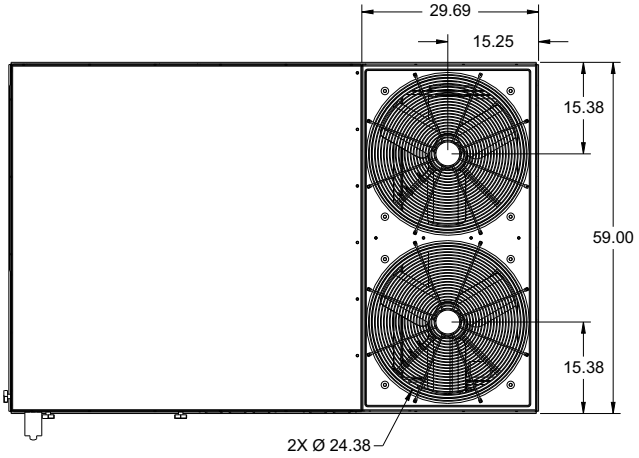
1. Weight given is for the maximum heater size available (54KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).
3. Weight includes mounting hardware, controls and manual bypass option (6-1/2 to 12-1/2 ton only).

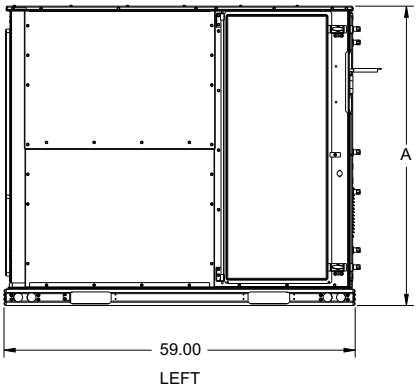
ZH/ZJ/ZR037-150 Unit Dimensions

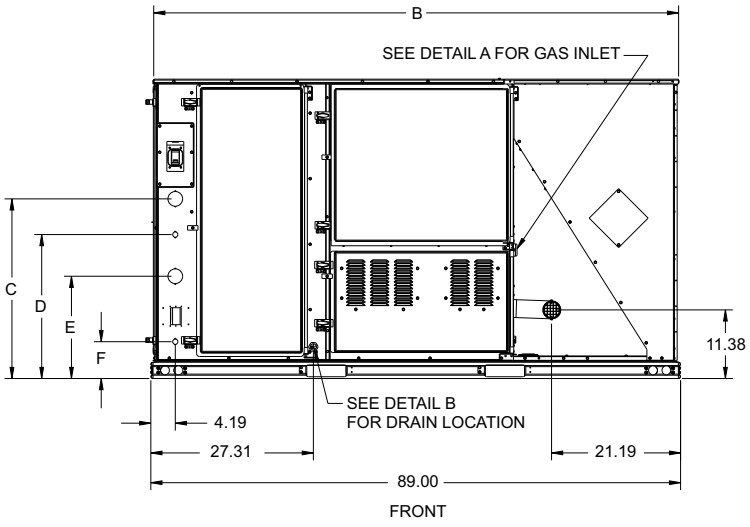
ZH/ZJ037-049 and ZR037



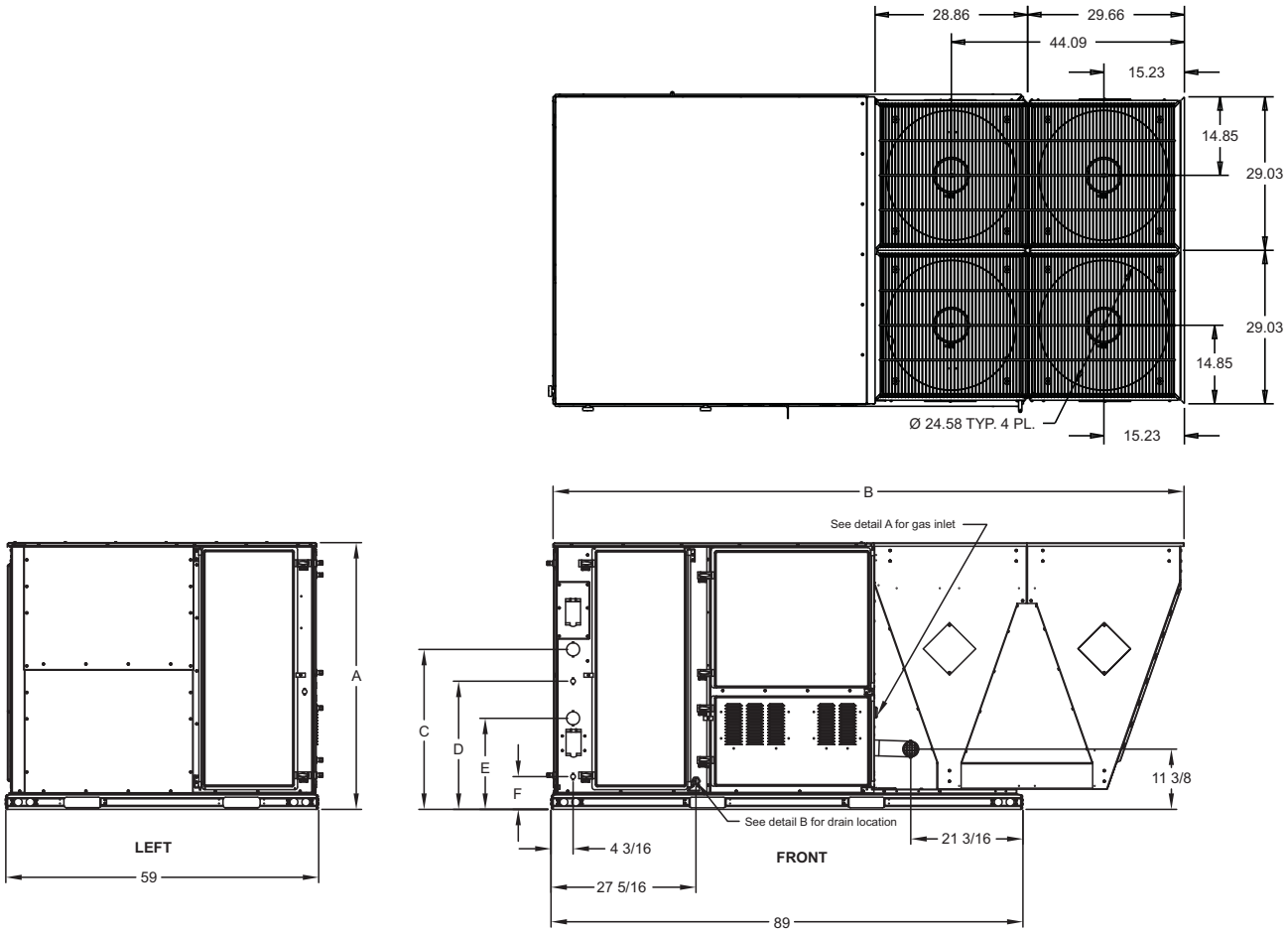
ZH/ZJ 061, ZR049 - 061 and ZH/ZJ/ZR078 thru 120







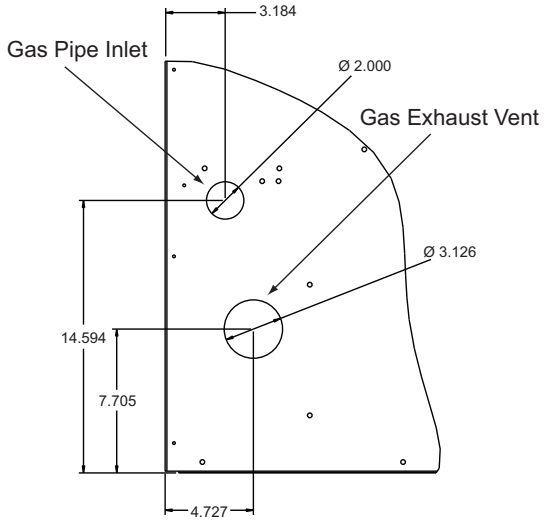
ZH/ZJ/ZR150



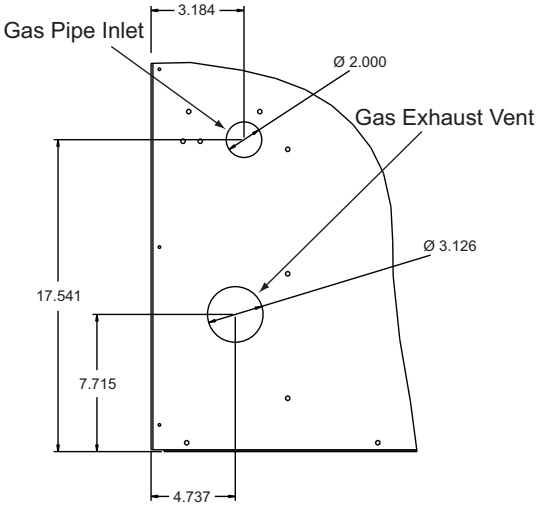
ZH/ZJ/ZR037-150 Unit Physical Dimensions

Unit Model Number	Dimension (in.)					
	A	B	C	D	E	F
ZH037, 049, 061, 078, 090	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZH102, 120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
ZH150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16
ZJ037, 049, 061	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZJ078, 090, 102, 120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
ZJ150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16
ZR037, 049, 061	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZR078, 090	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZR102, 120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
ZR150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16

Detail A

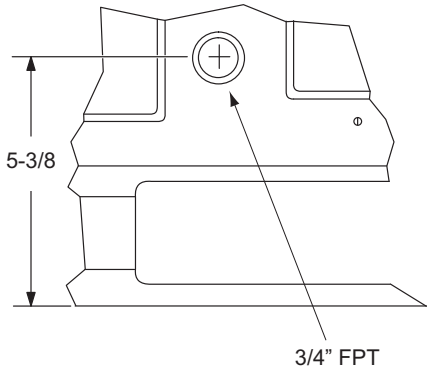


42” CABINET



50 3/4” CABINET

Detail B

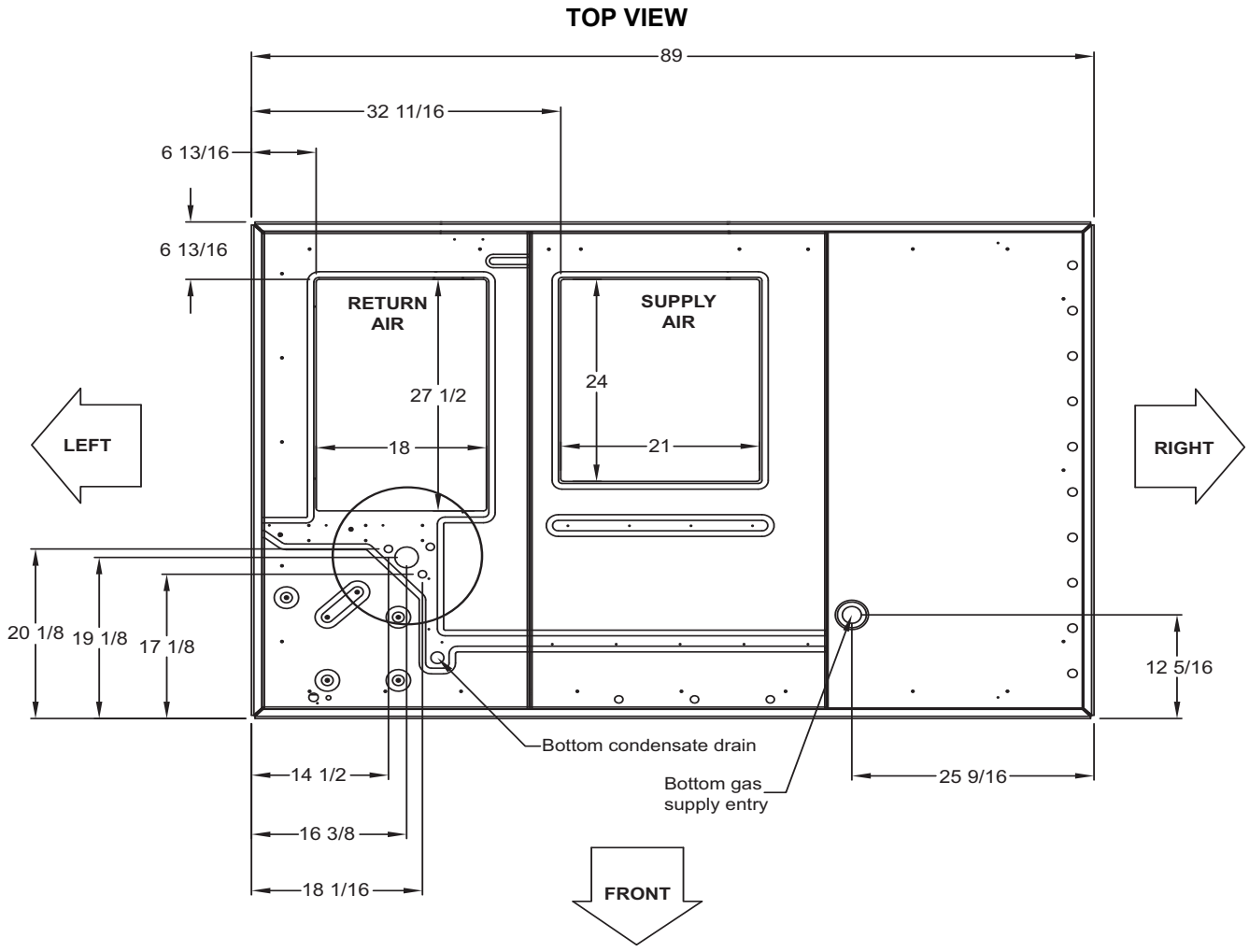


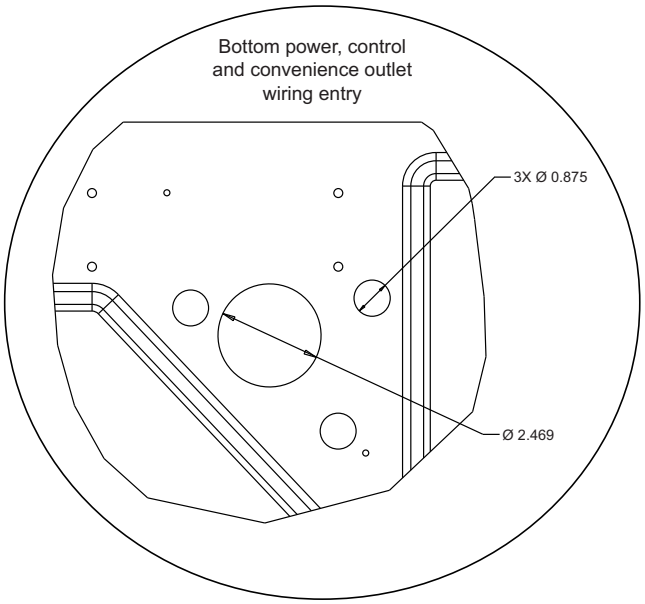
ZH/ZJ/ZR037-150 Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72	Right	12
Front	36	Left	36
Rear	36	Bottom[2]	0

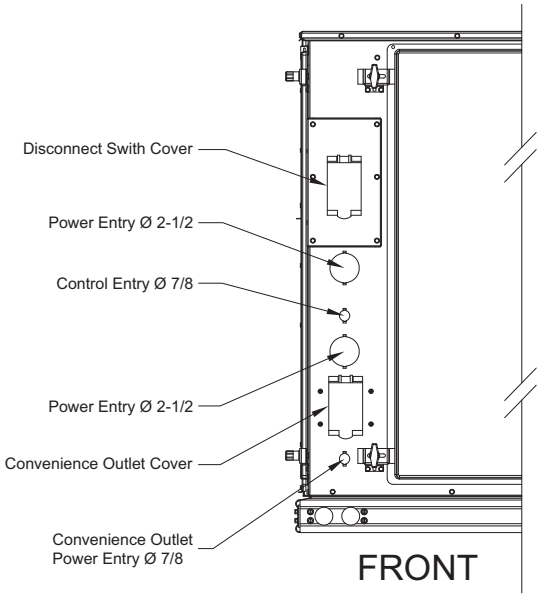
1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustible floors made from wood or class A, B or C roof covering materials.

ZH/ZJ/ZR037-150 Unit Bottom Duct Openings

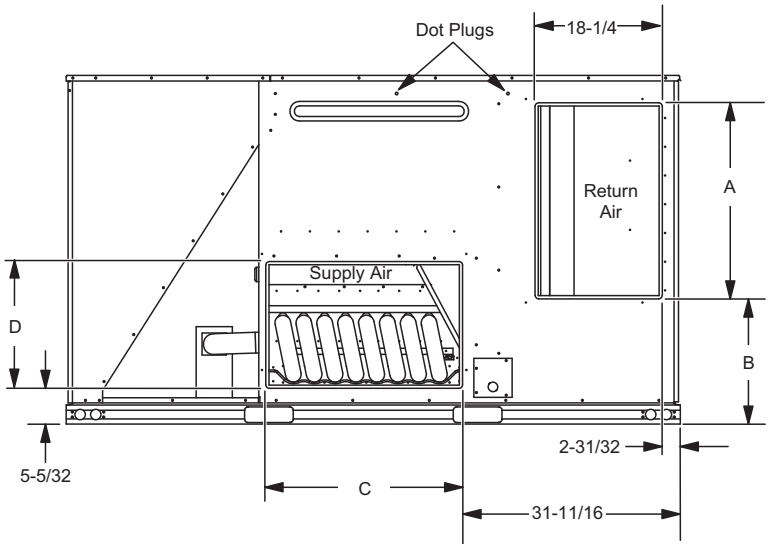




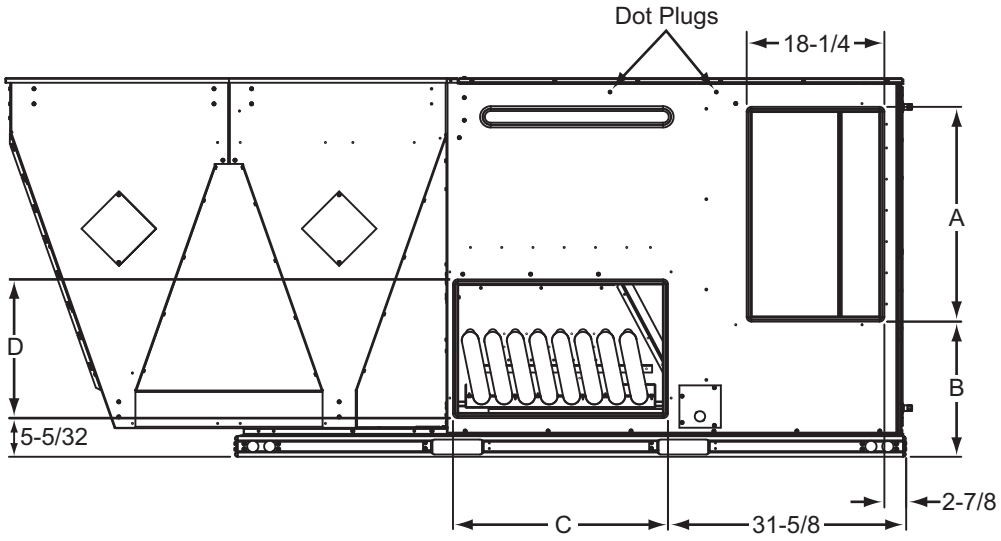
ZH/ZJ/ZR037-150 Unit Electrical Entry



ZH/ZJ/ZR037-120 Unit Side Duct Openings



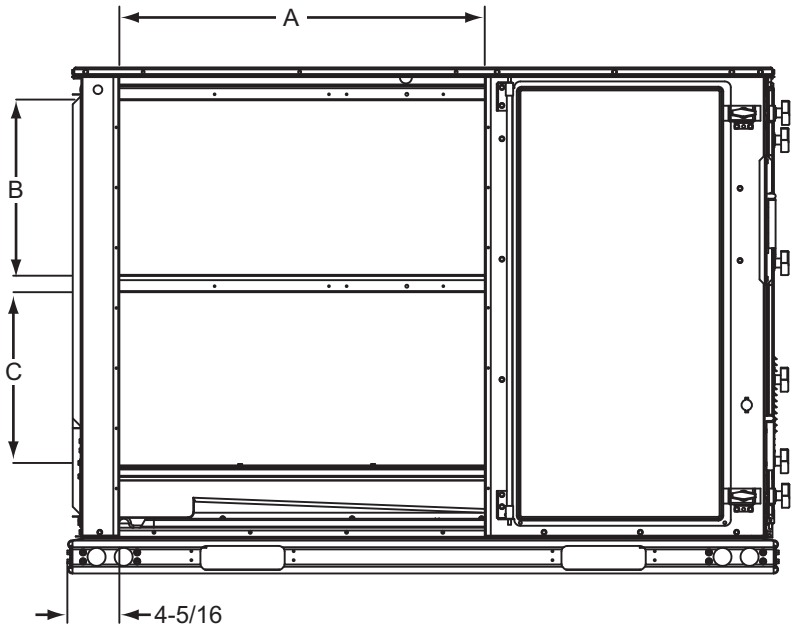
ZH/ZJ/ZR150 Unit Side Duct Openings



ZH/ZJ/ZR037-150 Side Duct Dimensions

Unit Model Number	Dimension (in.)			
	A	B	C	D
ZH037, 049, 061, 078, 090	27 3/4	12 1/16	27 1/2	16
ZH102, 120	28 1/4	18 1/16	28 1/4	18 1/4
ZH150	28 1/4	18 1/16	28 1/4	18 1/4
ZJ037, 049, 061	27 3/4	12 1/16	27 1/2	16
ZJ078, 090, 102, 120	28 1/4	18 1/16	28 1/4	18 1/4
ZJ150	28 1/4	18 1/16	28 1/4	18 1/4
ZR037, 049, 061	27 3/4	12 1/16	27 1/2	16
ZR078, 090	27 3/4	12 1/16	27 1/2	16
ZR102, 120	28 1/4	18 1/16	28 1/4	18 1/4
ZR150	28 1/4	18 1/16	28 1/4	18 1/4

ZH/ZJ/ZR037-150 Unit Left/End Duct Opening

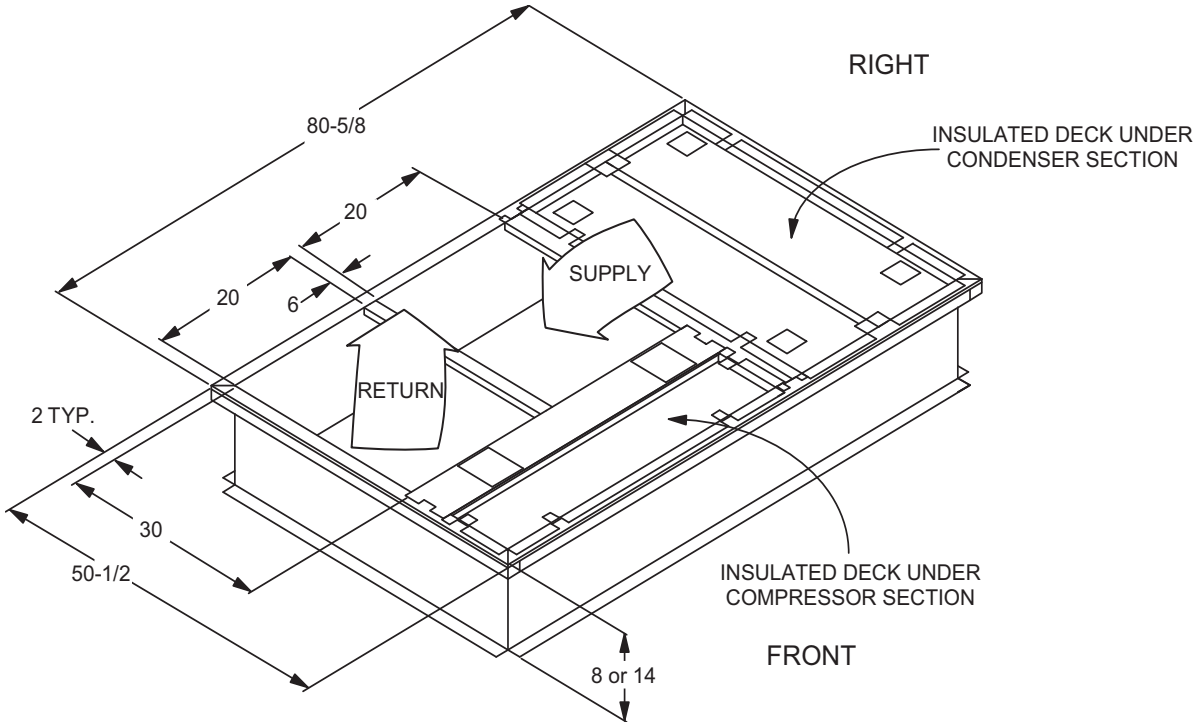


ZH/ZJ/ZR037-150 Left/End Duct Dimensions

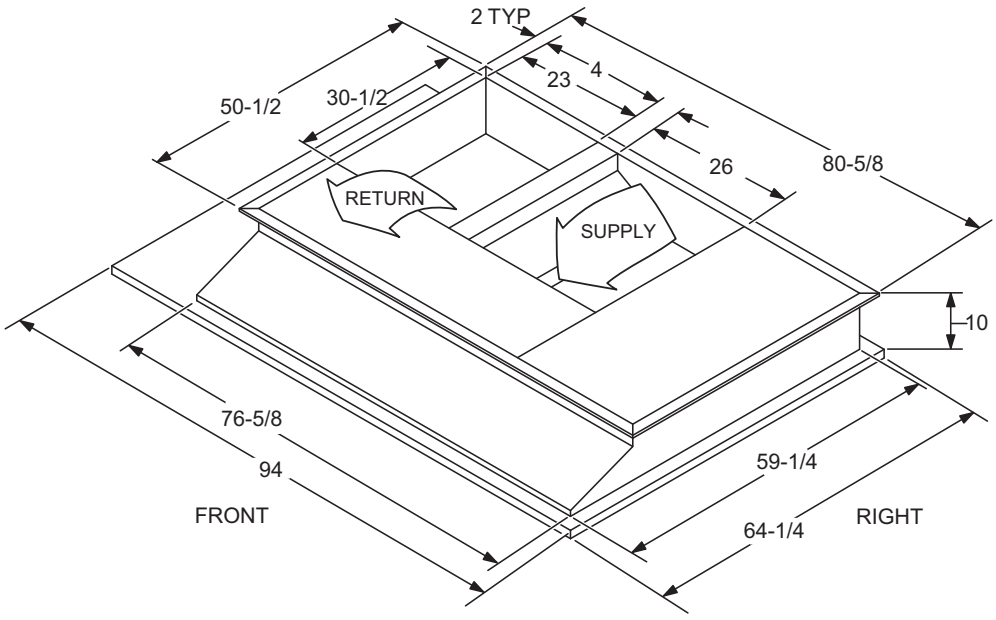
Unit Model Number	Dimension (in.)		
	A	B	C
ZH037, 049, 061, 078, 090	30.357	13.365	22.516
ZH102, 120	30.358	22.580	22.330
ZH150	30.358	22.580	22.330
ZJ037, 049, 061	30.357	13.365	22.516
ZJ078, 090, 102, 120	30.358	22.580	22.330
ZJ150	30.358	22.580	22.330
ZR037, 049, 061	30.357	13.365	22.516
ZR078, 090	30.357	13.365	22.516
ZR102, 120	30.358	22.580	22.330
ZR150	30.358	22.580	22.330

ZH/ZJ/ZR037-150 Unit Accessory Dimensions

ZH/ZJ/ZR037-150 Roof Curb



ZH/ZJ/ZR037-150 Transition Roof Curb



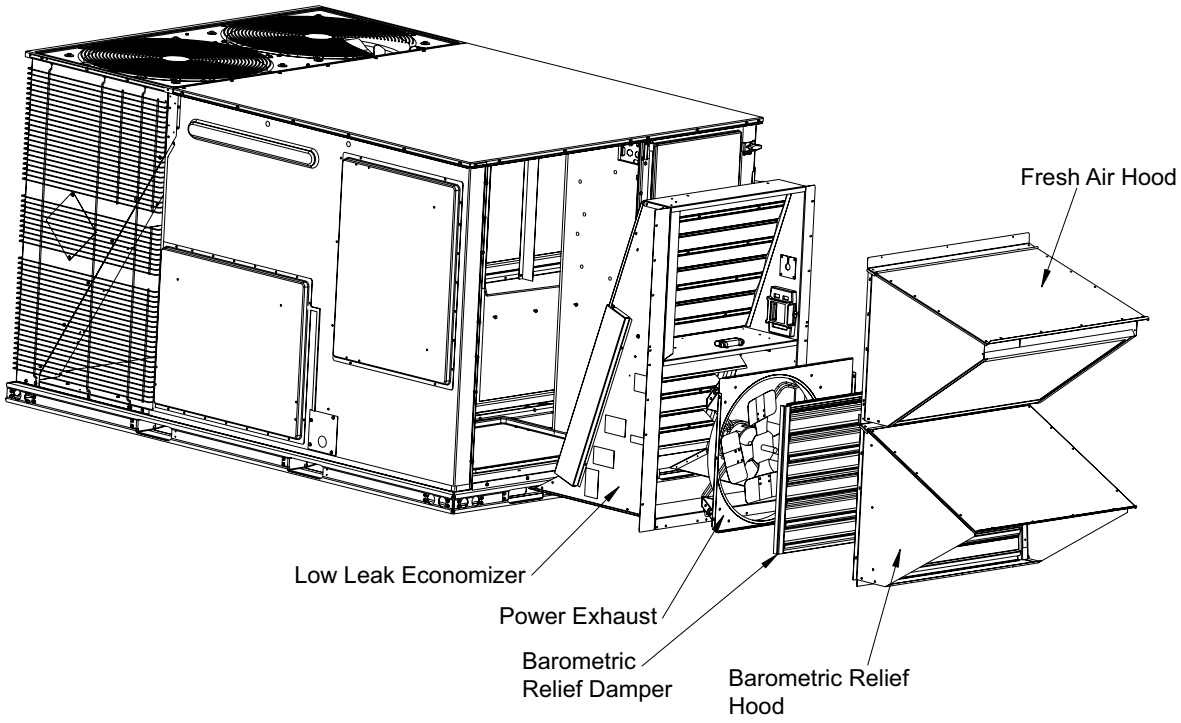
Economizer Options

Economizer Usage

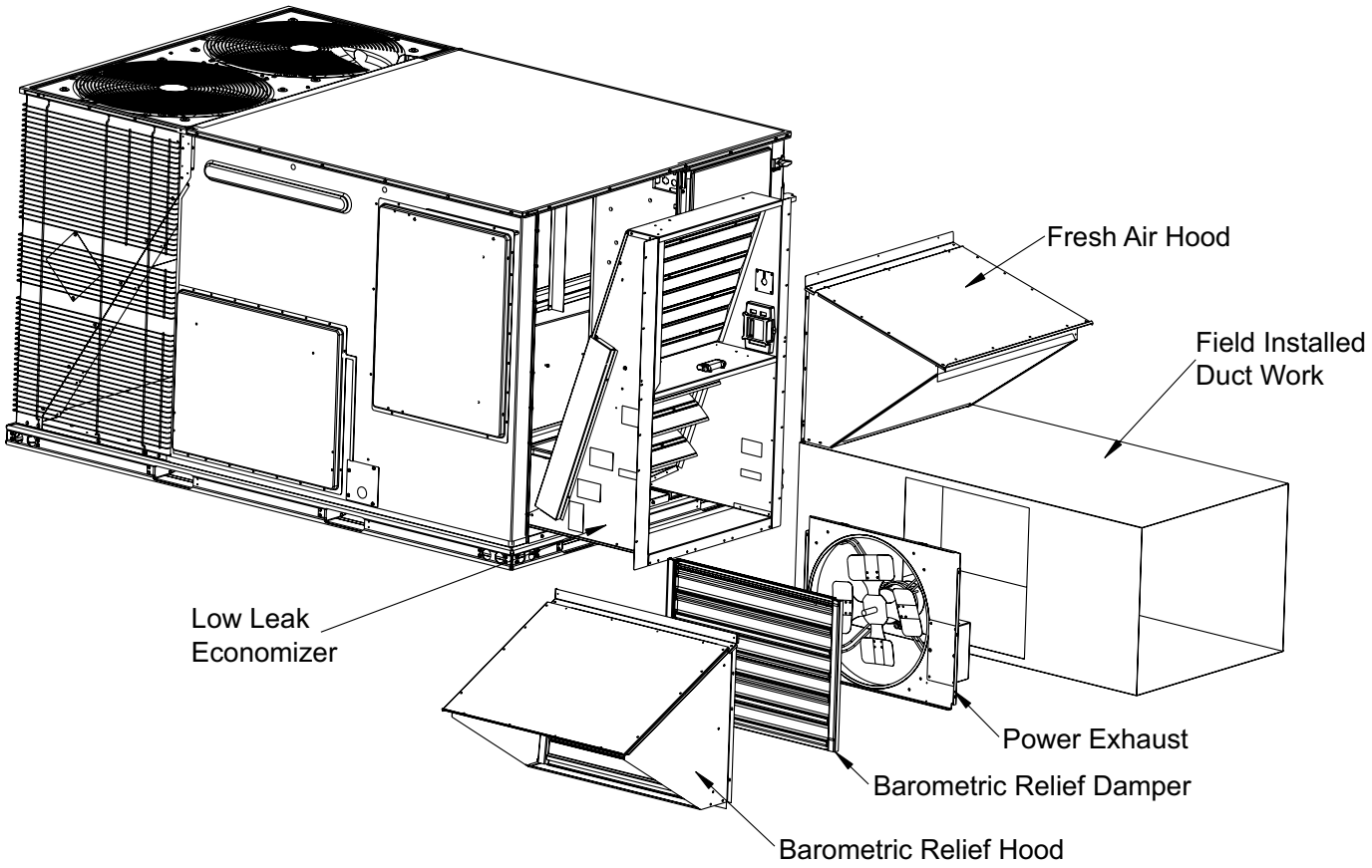
Application	Cabinet Height	Description	Model
Side Return	All	Horizontal economizer without barometric relief	2EE04706924[1]
Downflow, End Return Horizontal or ERV	42"	Economizer, 42” tall cabinet	2EE04707424[2]
	50"	Economizer, 50” tall cabinet	2EE04707624[2]

1. Barometric relief must be ordered separately and installed in duct work.
2. Includes fresh air hood, exhaust hood and barometric relief.

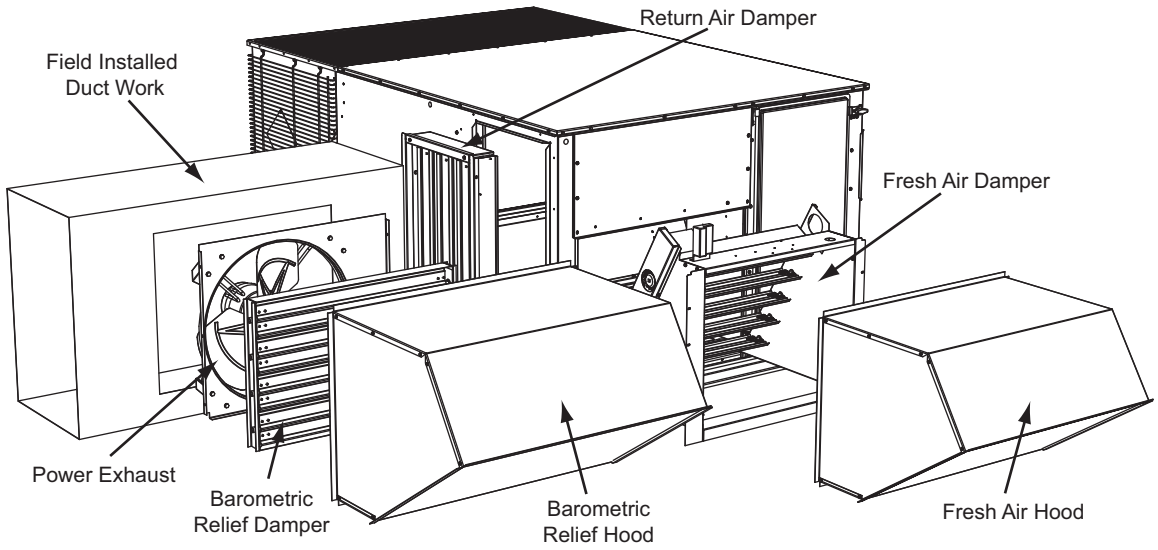
Economizer Downflow W/Power Exhaust



Economizer End Return W/Power Exhaust



Field Installed Horizontal Economizer W/Power Exhaust



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5167795-YTG-J-0218
Supersedes: 5167795-YTG-I-0118

York International Corporation
5005 York Drive
Norman, OK 73069

TECHNICAL GUIDE

R-410A
ZJ/ZR/ZF SERIES
15 - 25 TON
60 Hertz



ZJ/ZR Shown

Description

YORK® ZJ Series Sunline Magnum™ /ZR Series MagnaDRY™/ZF Series Sunline™ units are convertible single package high efficiency rooftops. All models have independent refrigeration circuits for efficient part load operation.

Although the units are primarily designed for curb mounting on a roof, they can also be mounted at ground level or set on steel beams above a finished roof.

All ZJ/ZR/ZF units are self-contained and assembled on rigid full perimeter base rails allowing for overhead rigging. Every unit is completely charged, wired, piped, and tested at the factory to provide a quick and easy field installation.

All models (including those with an economizer) are convertible between bottom and horizontal duct connections.

ZJ/ZR/ZF units are available in the following configurations: cooling only, cooling with electric heat, and cooling with gas heat. Electric heaters are available as field-installed accessory only.

Tested in accordance with:

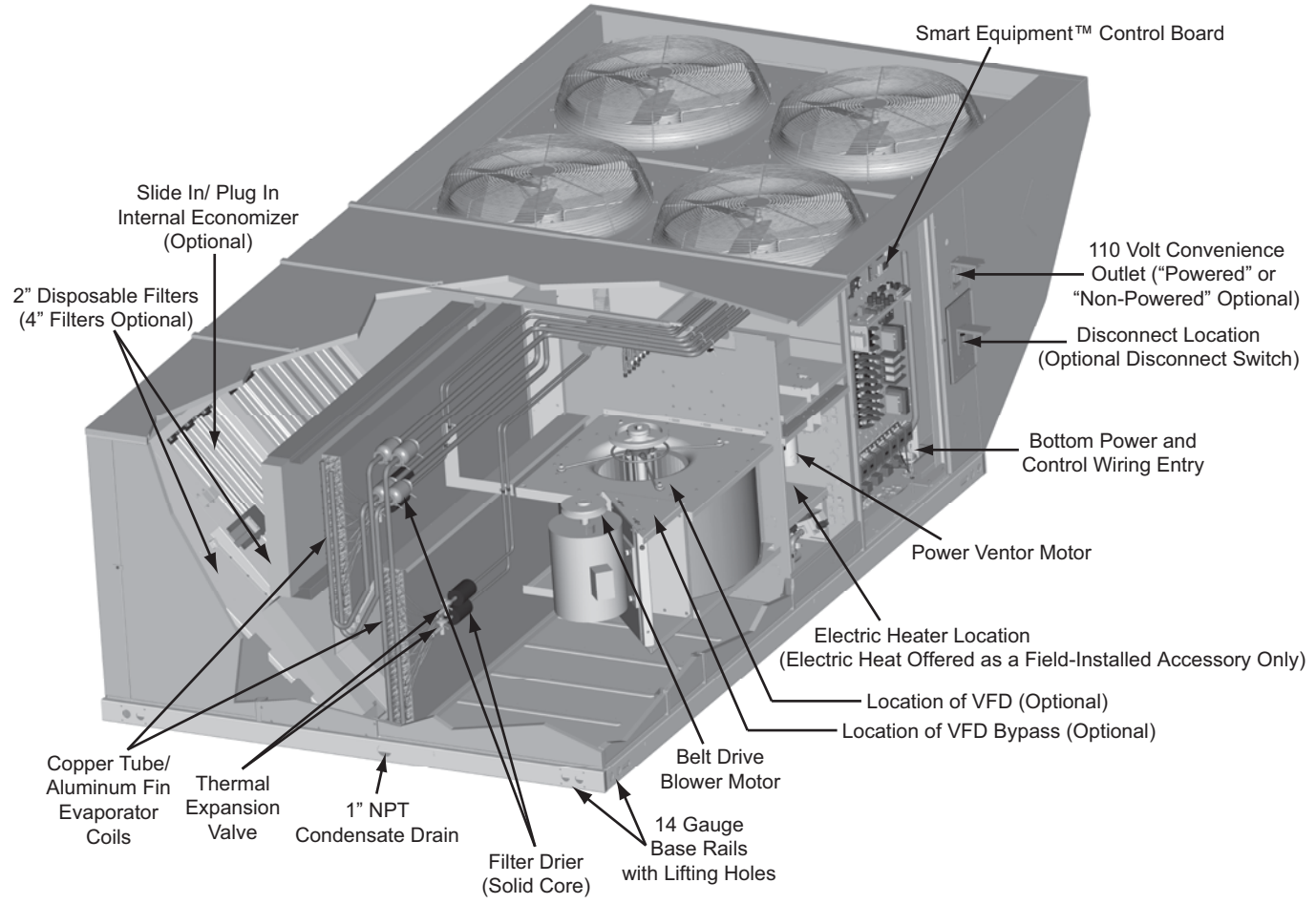
FOR DISTRIBUTION USE ONLY - NOT TO BE USED AT POINT OF RETAIL SALE

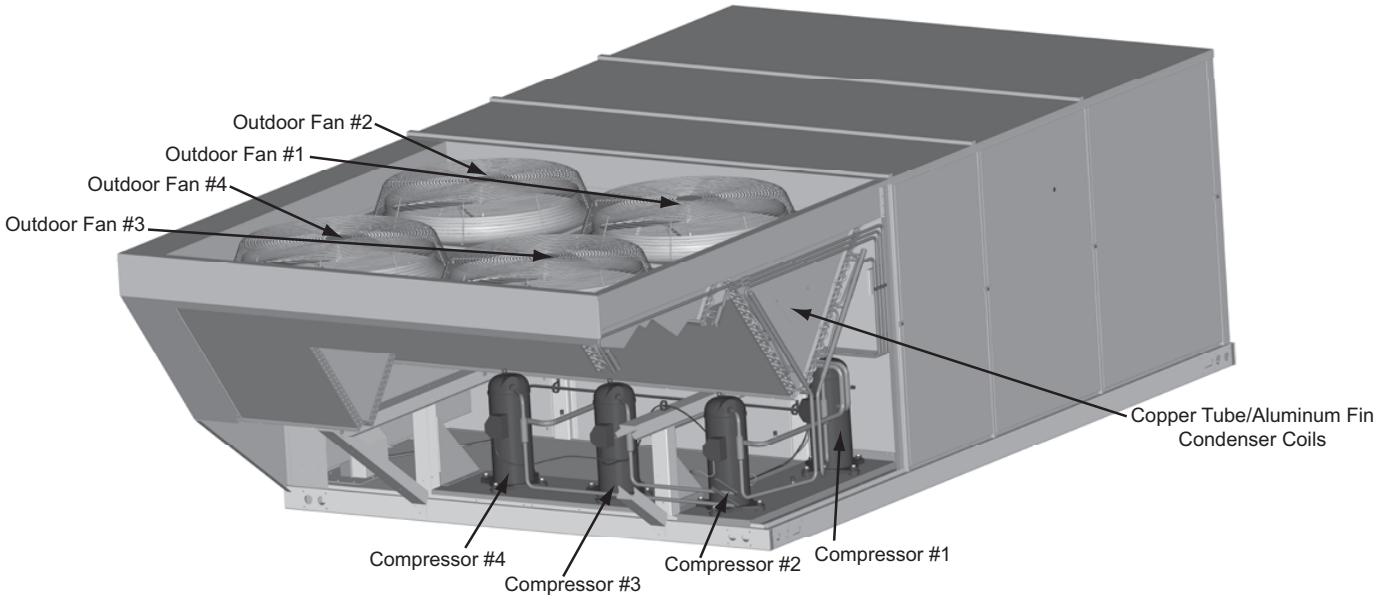
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Weights and Dimensions 96

Component Location

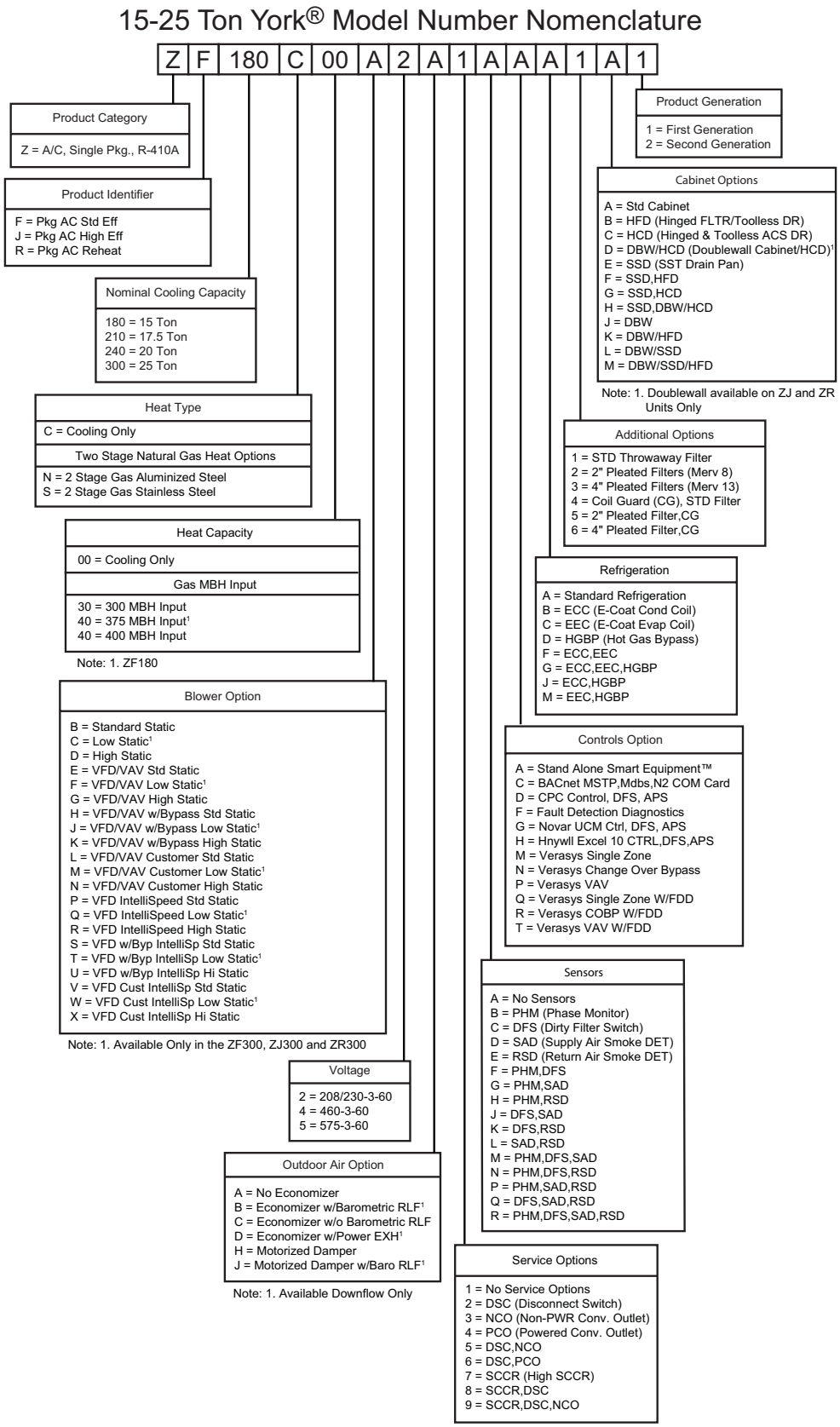
(ZJ shown)





High Efficiency Scroll Compressors

Nomenclature



Prior Nomenclature

15-25 Ton Sunline Magnum™ Model Number Nomenclature
For Units Produced Before 2-01-2016

Z	J	180	N24	A	2	A	AA	3	0	1	2	4	A

Product Category
Z = A/C, Single Pkg., R-410A

Product Identifier
J = 11.0+ EER A/C
R = 90.1 w/Reheat
F = 10 thru 11 EER A/C

Nominal Cooling Capacity
180 = 15 Ton
210 = 17.5 Ton
240 = 20 Ton
300 = 25 Ton

Heat Type and Nominal Heat Capacity
C00 = Cooling Only.

Gas Heat Options
N24 = 240 MBH Output Aluminized Steel
N32 = 300 MBH Output Aluminized Steel[1]
N32 = 320 MBH Output Aluminized Steel
S24 = 240 MBH Output Stainless Steel
S32 = 300 MBH Output Stainless Steel[1]
S32 = 320 MBH Output Stainless Steel

Electric Heat (Field-Installed Accessory Only)
E18 = 18 KW
E36 = 36 KW
E54 = 54 KW
E72 = 72 KW

Note:
1. ZF180 Only

Airflow
A = Std. Motor
D = Std. Motor/Motorized Damper
E = Std. Motor/Motorized Damper/Barometric Relief
F = Std. Motor/Low Leak Econ
G = Std. Motor/Low Leak Econ/Power Exhaust [1]
H = Std. Motor/Low Leak Econ/Barometric Relief
N = Hi Static
R = Hi Static/Motorized Damper
K = Hi Static/Motorized Damper/Barometric Relief
L = Hi Static/Low Leak Econ
M = Hi Static/Low Leak Econ/Power Exhaust [1]
T = Hi Static/Low Leak Econ/Barometric Relief
2 = Low Static [2]
5 = Low Static/Motorized Damper [2]
6 = Low Static/Motorized Damper/Barometric Relief [2]
U = Low Static/Low Leak Econ [2]
V = Low Static/Low Leak Econ/Power Exhaust [1,2]
W = Low Static/Low Leak Econ/Barometric Relief [2]

Notes:
1. Downflow Only
2. Available only in the ZJ300, ZR300 and ZF300.

Voltage
2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Product Style
A = Style A

Configuration Options (not required for all units)
These four digits will not be assigned until a quote is requested, or an order placed.

- SS Drain Pan
- CPC Controller, DFS, APS
- Johnson Controller UNT 1126 (N2 protocol), DFS, APS
- Honeywell Controller, DFS, APS
- Novar Controller, DFS, APS
- Simplicity®Smart Equipment w/ BAS Option (BACnet, MS/TP)
- Fault Detection and Diagnostics (FDD)
- York Commercial Comfort System (YCCS) Rtu Controller
- Hot Gas Bypass (Standard on VAV, Optional on CV)
- IntelliSpeed with VFD
- IntelliSpeed, VFD and Manual Bypass
- IntelliSpeed, VFD Ready (for customer-provided, field-installed drive)
- Variable Air Volume, VFD (not available with factory installed BAS options)
- Variable Air Volume, VFD with BAS Option (BACnet, MS/TP) (not available with factory installed BAS options)
- Variable Air Volume, VFD and Manual Bypass (not available with factory installed BAS options)
- Variable Air Volume, VFD and Manual Bypass with BAS Option (BACnet, MS/TP) (not available with factory installed BAS options)
- Variable Air Volume, VFD (BAS ready)
- Variable Air Volume, VFD and Manual Bypass (BAS ready)
- Variable Air Volume, VFD Ready (for customer provided, field installed drive)
- Variable Air Volume, VFD Ready with BAS Option (BACnet, MS/TP) (for customer-provided, field-installed drive)
- 2" Pleated Filters, MERV 7
- 4" Pleated Filters, MERV 13
- BAS Ready Economizer w/Belimo [1]
- Double Wall Construction [2]
- Any Combination of Additional Options that Don't Have an Option Code Pre-assigned

Notes:
1. BAS Ready econ requires input from a field installed BAS control. Not available with factory installed BAS controls.
2. Double wall available on ZJ and ZR units only

Product Generation
3 = Third Generation

Additional Options

Standard Cabinet	Hinged Filter Door & Tool Free Access Cabinet
AA = None AB = Phase Monitor AC = Coil Guard AD = Dirty Filter Switch AE = Phase Monitor & Coil Guard AF = Phase Monitor & Dirty Filter Switch AG = Coil Guard & Dirty Filter Switch AH = Phase Monitor, Coil Guard & Dirty Filter Switch RC = Coil Guard & American Flag TA = Technicoat Condenser Coil TJ = Technicoat Evaporator Coil TS = Technicoat Evaporator & Condenser Coils EA = E-Coat Condenser Coil EJ = E-Coat Evaporator Coil ES = E-Coat Cond & Evap Coils	BA = Hinged Filter Door & Tool Free Access Panels BB = Phase Monitor, Hinged Filter Door & Tool Free Access Panels BC = Coil Guard, Hinged Filter Door & Tool Free Access Panels BD = Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BE = Phase Monitor & Coil Guard, Hinged Filter Door & Tool Free Access Panels BF = Phase Monitor & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BG = Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BH = Phase Monitor, Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels

ZZ = If desired option combination is not listed above, ZZ will be assigned and configuration options will be located in digits 15-18.

Installation Options

A = No Options Installed B = Option 1 C = Option 2 D = Options 1 & 2 E = Option 3 F = Option 4 G = Options 1 & 3 H = Options 1 & 4 J = Options 1, 2 & 3 K = Options 1, 2, & 4 L = Options 1,3 & 4 M = Options 1, 2, 3, & 4	N = Options 2 & 3 P = Options 2 & 4 Q = Options 2, 3, & 4 R = Options 3 & 4 S = Option 5 T = Options 1 & 5 U = Options 1, 3, & 5 V = Options 1, 4, & 5 W = Options 1, 3, 4, & 5 X = Options 3 & 5 Y = Options 4 & 5 Z = Options 3, 4 & 5

Options

1 = Disconnect 2 = Non-Pwr'd Conv. Outlet 3 = Smoke Detector S.A.	4 = Smoke Detector R.A. 5 = Pwr'd Conv. Outlet

Features and Benefits

Standard Features

- **High Efficiency** - High efficiency units reach as high as 12.2 EER. Gas/electric units have electronic spark ignition and power vented combustion with steady state efficiencies of 80%. These efficiencies exceed all legislated minimum levels and provide low operating costs.
- **Balanced Heating** -
  - **Gas Heat** - All gas heat units are built with two heating sections for two equal stages of capacity control. Each section includes a durable heat exchanger with aluminized steel or optional stainless steel tubes, a redundant gas valve, spark ignition, power venting, an ignition module for 100% shut-off and all of the safety controls required to meet the latest ANSI standards.

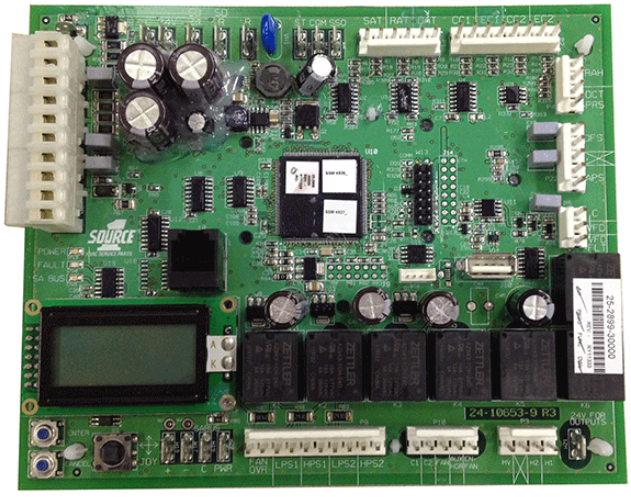
    The gas supply piping can be routed into the heating compartment through a hole in the base pan of the unit or through a knockout in the piping panel on the front of the unit.
  - **Electric Heat** - All electric heat models (field installed accessory only) are wired for a single power source and include a bank of nickel chromium elements mounted at the discharge of the supply air blower to provide a high velocity and uniform distribution of air across the heating elements. Every element is fully protected against excessive current and temperature by fuses and two thermal limit switches.

    The power supply wiring can be routed into the control box through a threaded pipe connection in the base pan of the unit or through a knockout in the wiring panel on the front of the unit.
- **Unit Controllers** - York's Sunline™ series offer factory mounted Smart Equipment™ UCB, with optional Communication board, a 4-stage board if 4 stages are required, an Economizer board, and an FDD (Fault Detection and Diagnostic) board. A MAP Device can be used to remotely access.
- **Convertible Airflow Design** - All models (including those with an economizer) are suitable for either bottom or horizontal duct connections. **Models with factory installed power exhaust are suitable for bottom duct connections** only. For bottom duct, you remove the sheet metal panels from the supply and return air openings through the base of the unit. For horizontal duct, you replace the supply and return air panels on the rear of the unit with a side duct flange accessory.
- **Factory Mounted Outdoor Air Dampers** - All models are available with these "factory mounted" outdoor air damper options:
  - Dry Bulb economizer with or without power exhaust
  - Motorized outdoor air damper
  - Barometric Relief Damper

  A fixed outdoor air intake assembly will be shipped in the return air compartment of all units ordered without an economizer or motorized outdoor air damper option. The assembly includes a rain hood with a baffle that can be set for 10, 15 or 25% outdoor air. With bottom duct connections, the fixed outdoor air intake assembly should be mounted over the opening in the return air panel. With horizontal ductwork, it should be mounted on the return air duct.
- **System Protection** - Suction line freezestats are supplied on all units to protect against loss of charge and coil frosting when the economizer operates at low outdoor air temperatures while the compressors are running. Every unit has solid-core liquid line filter-driers and high and low-pressure switches. Internal compressor protection is standard on all compressors. Phase Monitors are optional on all units. This accessory monitors the incoming power to the unit and protects the unit from phase loss and reversed phase rotation.
- **Advanced Controls** - ZJ/ZR/ZF Models have Smart Equipment™ control boards that standardized a number of features previously available only as options or by utilizing additional controls.

⚠ CAUTION

The Smart Equipment™ control board used in this product will effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When applying this product for process cooling applications (computer rooms, switchgear, etc.), please call the applications department for Unitary Products @ 1-877-UPG-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.



- **Units will come with the new state of the art Smart Equipment™ control system.** The new unit control incorporates the best of the already proven Simplicity™ unitary controls and creates a more robust, intelligent control. The goal of this control is to utilize cutting edge technology making the equipment easier to install,

operate, and service. All units are Factory commissioned, configured, and run tested.

- **Versatile -** The Smart Equipment™ control can be configured to use with a standard thermostat (easy to connect screw terminals), A zone sensor, or can be setup to communicate with multiple BAS communication protocols to integrate with building automation systems.
- **Reduce field installed complexity -** Each unit will come equipped with factory installed supply air, return air, and outdoor air temperature sensors providing key temperature readings thus reduce field installed complexity.
- **On-board USB Port -** The new control comes with a long list of features including data logging, current and previous system faults and software update capabilities using the on board USB port and common flash drive. Energy use monitoring capabilities allow custom tailoring to allow a system to work more efficiently at all times and occupancy levels. Self test and start-up reports also available from the board VIA the USB port.
- **Embedded LCD Display -** The board has a easy to read, built-in LCD display and easy to use navigation joystick and buttons allowing the user to quickly navigate the menus displaying unit status, options, current function, supply, return and outdoor temperatures, fault codes and other information.
- **Safety Monitoring -** The control monitors the outdoor, supply, and return air temperatures and the high and low pressure switch status on the independent refrigerant circuits. On units with heating the gas valve and high temperature limit switches are monitored on gas and electric heating units. The control also monitors the voltage supplied to the unit and will protect the unit if low voltage due to a brown out, or other electrical issue occurs.
- **Low Ambient -** An integrated low-ambient control allows units to operate in the cooling mode down to 0°F outdoor ambient without additional components or intervention. Optionally, the control board can be programmed to lockout the compressors when the outdoor air temperature is low or when free cooling is available.
- **Anti-Short Cycle Protection -** To aid compressor life, an anti- short cycle delay is incorporated into the standard control. Compressor reliability is further ensured by programmable minimum run times. For testing, the anti-short cycle delay can be temporarily overridden with the push of a button.
- **Fan Delays -** Fan on and fan off delays are fully programmable. Furthermore, the heating and cooling fan delay times are independent of one another. All units are programmed with default values based upon their configuration of cooling and/or heating capacity.
- **Nuisance Trip Protection and Three Strikes -** To prevent nuisance calls, the control board uses a three times, you're out philosophy. The high, low-pressure switch, anti-freeze protection, low voltage or heating high limit must trip three times within two hours before the unit control board will lock out the associated compressor.An alarm message will be displayed on the LCD screen.
  - **Lead-Lag** - An integrated Lead-Lag option allows equal run time hours on all compressors, thereby extending the life of all compressors. This option is selectable on the unit control board.
- **Reliable** - From the beginning - All units undergo computer automated testing before they leave the factory. Units are tested for refrigerant charge and pressure, unit amperage, and 100% functionality. For the long term - All units are painted with a long lasting, powder paint that stands up over the life of the unit. The paint used has been proven by a 1000 hour salt spray test.
- **Full Perimeter Base Rails** - The permanently attached base rails provide a solid foundation for the entire unit and protect the unit during shipment. The rails offer rigging holes so that an overhead crane can be used to place the units on a roof.
- **Easy Installation** - Gas and electric utility knockouts are supplied in the unit underside as well as the side of the unit. Utility connections can be made quickly and with a minimum amount of field labor. All units are shipped with 2" throw-away filters installed.
- **Wide Range of Indoor Airflows** - All supply air blowers are equipped with a belt drive that can be adjusted to meet the exact requirements of the job. A high static drive option is available for applications with a higher CFM and/or static pressure requirement.
- **Warranty** - All models include a 1-year limited warranty on the complete unit. Compressors carry a 5-year warranty. Aluminized steel tubular heat exchangers carry a 10 year warranty. Stainless steel heat exchangers a 15 year warranty.

Factory Installed Options

YORK® offers several equipment options factory installed, for the ZJ/ZR/ZF Series.

- **Dry Bulb Economizers** - All units offer a variety of optional factory installed down flow economizers that are shipped, installed and wired with low leak dampers designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. Each economizer goes through a rigorous 60,000 cycle test. Dry bulb, single enthalpy, and dual enthalpy (with field installed kit) can be selected. All economizer options are fully integrated into the Smart Equipment™ controls. The economizer has spring return, fully modulating damper actuators and is capable of introducing up to 100% outdoor air. As the outdoor air intake dampers open, the return air dampers close. The changeover from mechanical refrigeration to economizer operation is regulated by the outdoor air dry bulb temperature or the outdoor air enthalpy input. The dual enthalpy kit provides a second input used to monitor the return air (field installed). The installer needs only to assemble the outdoor air hood, attach the enthalpy control the hood and

mount the hood to the unit (Hood and control are provided).

- **Power Exhaust** - Our economizer options are available with power exhaust. Whenever the outdoor air intake dampers are opened for free cooling, the exhaust fan will be energized to prevent the conditioned space from being over-pressurized during economizer operation.

  The exhaust fan, motor and controls are installed and wired at the factory. The rain hood must be assembled and installed in the field.

  The power exhaust option can only be used on bottom duct configurations.
- **Motorized Outdoor Air Intake Damper** - Includes a slide-in / plug-in damper assembly with a 2- position, spring return motor actuator which opens to a pre-set position whenever the supply air blower is operating and will drive fully closed when the blower unit shuts down.

  The rain hood is painted to match the basic unit and must be field assembled before installing.
- **Barometric Relief Damper** - This damper option can be used to relieve internal building air pressure on units with an economizer without power exhaust. This accessory includes a rain hood, a bird screen and a fully assembled damper. With bottom duct connections, the damper should be mounted over the opening in the return air panel. With horizontal ductwork, the accessory should be mounted on the return air duct.
- **E-Coat Condenser Coils -** The condenser coils are coated with an epoxy polymer coating to protect against corrosion.
- **E-Coat Evaporator Coils -** The evaporator coils are coated with an epoxy polymer coating to protect against corrosion.
- **Variable Air Volume (VAV)** - A factory-installed variable frequency drive (VFD), mounted in the Blower Access compartment, is used to control the speed of the indoor blower motor in order to maintain a constant static pressure in the supply duct. A pressure transducer and VAV control board are mounted inside the control box. The drive comes completely wired and pre-programmed from the factory.

  An optional, factory-installed manual bypass switch available with factory-installed VFD can be found in the Blower Motor Access compartment. The switch can be used to either route power to the VFD for modulating control of the blower motor, to bypass the drive and operate the motor at full speed, or to power the drive (and not the motor) for diagnostic purposes.

  Due to space limitations, VAV is not available with any of the factory-installed BAS options described below, but is available with ‘BAS-ready’ models. Terminal blocks are provided in the control box for field wiring of the customer-installed BAS.

  A ‘VFD-ready’ option provides the provisions for a customer-installed drive. The unit comes with a mounting bracket installed in the Blower Access compartment which may accommodate other vendor’s drives depending on their size. In order to utilize the unit’s mounting bracket, the maximum recommended drive dimensions are as follows:

  For 5-hp motor applications .....13” H x 6” W x 7” D

  For 7.5 thru 15-hp motor applications .....13” H x 8” W x 8” D

  If the drive will not fit in the allotted space, then it will have to be mounted elsewhere; either within the building on a perpendicular wall which is not subjected to excessive temperature, vibration, humidity, dust, corrosive gas, explosive gas, etc., or within an appropriate enclosure rated for outside installation to safeguard against moisture, dust and excessive heat.

  A terminal block located in the control box is provided for field connection of the VFD controls.
- ***IntelliSpeed*™ Supply Fan Control Option (ASHRAE 90.1 compliant)** - Units configured with the ***IntelliSpeed***™ Supply Fan Option will contain a VFD for multi-speed supply fan operation. This option allows the supply fan RPM to vary based on the number of compressors or heating stages energized. The economizer's minimum position will also be configurable to vary based on the supply fan VFD frequency output.
- **Hot Gas Bypass** - To allow for low cooling load operation, a direct-acting pressure-modulating bypass control valve installed on the system #1 discharge line is used to divert high temperature, high pressure refrigerant around the TXV in order to maintain a desired minimum evaporator pressure. HGBP is standard on all units with VAV and optional with CV units.
- **Filter Options** - Standard units are shipped with 2" throw-away filters installed. 2" pleated and 4" pleated filters are offered as a factory installed option.
- **Convenience Outlet** - This 110 volt outlet can be "powered" by the unit with a stepdown transformer or you may order the unit with a "non-powered" convenience outlet that can be wired in the field.
- **Disconnect Switch** - For gas heat units a HACR breaker sized to the unit is provided. For cooling only units, a disconnect switch sized to the largest electric heat (field installed accessory) available for the particular unit is provided. Factory installed option only.
- **Double Wall Construction** - Optional double wall construction is available to provide smooth inner surfaces for easy and effective cleaning to reduce risk of dirt and bacterial accumulation. Fiberglass insulation is sandwiched between heavy gauge steel sheets to form a durable, rigid casing to withstand higher working pressures and impact forces. The heavy-duty construction provides excellent acoustic and thermal insulation and eliminates erosion of insulation material and contamination of the air stream.
- **Smoke Detectors** - (supply air & return air) The smoke detectors stop operation if smoke is detected within the air compartment.

⚠WARNING

Factory installed smoke detectors in the return air, may be subjected to freezing temperatures during “off” times due to out side air infiltration. these smoke detectors have an operational limit of 32°F to 131°F. smoke detectors installed in areas that could be out side those limitations will have to be moved to prevent having false alarms.

- **Coil Guard** - Customers can purchase a coil guard kit to protect the condenser coil from damage. This is not a hail guard kit.
- **Stainless Steel Heat Exchanger** - For applications in corrosive environments, this option provides a full stainless steel heat exchanger assembly.
- **Stainless Steel Drain Pan** - An optional rustproof stainless steel drain pan is available to provide years of trouble-free operation in corrosive environments.
- **Phase Monitors** - Designed to prevent unit damage. The phase monitor will shut the unit down in an out-of phase condition.
- **High Static Drive** - May include a belt, blower pulley, motor pulley or a motor change to enhance blower performance.
- **Low Static Drive** - May include a belt, blower pulley, motor pulley or a motor change when standard airflow is not required. (**ZJ/ZR/ZF300 only**).
- **Dirty Filter Switch** - This kit includes a differential pressure switch that energizes the fault light on the unit thermostat, indicating that there is an abnormally high pressure drop across the filters. Factory installed option or field installed accessory.
- **Hinged Filter Door/"Tool Free" Blower And Access Panels (Not Hinged)** - This option allows for easy access and maintenance.
- **Hinged/"Tool Free" Blower, Blower Motor, Filter And Electric Access Panels** - This option allows for complete hinged and tool free access to the unit’s blower, blower motor, filters and electrical panel sections.

Field Installed Accessories

YORK® offers several equipment accessories for field installation, for the ZJ/ZR/ZF Series.

- **Dry Bulb Economizers** - All units offer a variety of optional factory installed down flow economizers that are shipped, installed and wired with low leak dampers designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. Each economizer goes through a rigorous 60,000 cycle test. Dry bulb, single enthalpy, and dual enthalpy (with field installed kit) can be selected. All economizer options are fully integrated into the Smart Equipment™ controls. The economizer has spring return, fully modulating damper actuators and is capable of introducing up to 100% outdoor air. As the outdoor air intake dampers open, the return air dampers close. The changeover from mechanical refrigeration to economizer operation is regulated by the outdoor air dry bulb temperature or the outdoor air enthalpy input. The dual enthalpy kit provides a second input used to monitor the return air (field installed). The installer needs only to assemble the outdoor air hood, attach the enthalpy control the hood and mount the hood to the unit (Hood and control are provided).
- **Motorized Outdoor Air Intake Damper -** Includes a slide-in / plug-in damper assembly with a 2-position, spring return motor actuator which opens to some pre-set position whenever the supply air blower is operating and will drive fully closed when the blower unit shuts down.

  The rain hood is painted to match the basic unit and must be field assembled before installing.
- **Roof Curbs -** Fourteen-inch high roof curbs provide a water-tight seal between the unit and the finished roof.

  These full perimeter curbs meet the requirements of the National Roofing Contractors Association (NRCA) and are shipped knocked-down for field assembly.

  They're designed to fit inside the base rails of the unit and include both a wood nailing strip and duct hanger supports.
- **High Altitude Natural Gas -** Burner orifices and pilot orifices are provided for proper furnace operation at altitudes up to 6,000 feet.
- **Propane -** Burner orifices, pilot orifices and gas valve parts are provided to convert a natural gas furnace to propane.
- **High Altitude Propane -** Burner orifices and pilot orifices are provided for proper furnace operation at altitudes up to 6,000 feet. This accessory supplements the basic propane conversion kit.
- **Side Duct Flanges -** One-inch flanges replace the supply and return air panels on the rear of the unit to accommodate horizontal duct connections. These flanges can also be used individually for bottom supply / horizontal return or horizontal supply/bottom return. They cannot be used on units with power exhaust.
- **Barometric Relief Damper -** This damper accessory can be used to relieve internal building air pressure on units with an economizer without power exhaust. This accessory includes a rain hood, a bird screen and a fully assembled damper. With bottom duct connections, the damper should be mounted over the opening in the return air panel. With horizontal ductwork, the accessory should be mounted on the return air duct.
- **High Static Drive -** May include a belt, blower pulley, motor pulley or a motor change to enhance blower performance.
- **Enthalpy Accessory Control Kit -** This kit contains the required components to convert a single enthalpy economizer to dual enthalpy.
- **Burglar Bars -** Mount in the supply and return openings to prevent entry into the duct work.
- **Flue Exhaust Extension Kit -** In locations with wind or weather conditions which may interfere with proper exhausting of furnace combustion products, this kit can be

installed to prevent the flue exhaust from entering nearby fresh air intakes.

- **Wood Skid -** Allows unit to be handled with 90" forks.
- **CO_2 Sensor -** Senses CO_2 levels and automatically overrides the economizer when levels rise above the present limits.
- **Coil Guard -** Customers can purchase a coil guard kit to protect the condenser coil from damage. This is not a hail guard kit.
- **Phase Monitors -** Designed to prevent unit damage. The phase monitor will shut the unit down in an out-of phase condition.
- **Electric Heaters** - wired for single point power supply. These nickel chromium heater elements are provided with limit and automatic reset capability to prevent operation at excessive temperatures.

Control Options

Smart Equipment™ with Communication Option Control - The York® Smart Equipment™ with Communication Option Control is factory installed. It includes all the features of the Smart Equipment™ control with an additional gateway to BACnet MS/TP (programmable to Modbus or N2 protocols).

FDD (Fault Detection and Diagnostics) - Refrigerant side A factory installed control system option on the commercial equipment that constantly monitors refrigerant circuit pressures, refrigerant circuit temperatures, as well as the environmental temperatures and humidity via multiple sensor inputs.

- Provides a building owner, technician or contractor with the operational characteristics of the RTUs entire refrigerant circuit to ensure the unit is functioning at its specified performance level.
- Provides alarms if the unit is not functioning optimally.
- Remotely accessible via the Mobile Access Portal (MAP) gateway as well as scrolled on the UCB LCD screen.

Novar® BAS Control - The Novar® building automation system controller is factory installed. Includes supply air sensor, return air sensor, dirty filter indicator switch, and air proving switch.

CPC BAS Control - The Computer Process Controls Model 810-3060 ARTC Advanced Rooftop building automation system controller is factory installed. Includes supply air sensor, return air sensor, with optional dirty filter indicator switch and air proving switch.

Honeywell BAS Control - The Honeywell W7750C building automation system controller is factory installed. Includes air supply sensor, return air sensor, with optional dirty filter indicator switch, and air proving switch.

Verasys - Verasys provides a simple user experience with configurable self-recognizing controllers without the need for any additional tools. Verasys creates enhanced integration of HVACR equipment, zoning, and controls. Contractors are able to offer a complete bundled solution of equipment and controls to serve the light commercial market.

Guide Specifications

General

Units shall be manufactured by Johnson Controls Unitary Products in an ISO 9001 certified facility.

York's ZJ/ZR/ZF units are convertible single package units. ZJ models have four independent refrigerant circuits and ZR/ZF models have dual independent refrigerant circuits for efficient part load operation and maximum comfort control. Although the units are primarily designed for curb mounting on a roof, they can also be slab-mounted at ground level or set on steel beams above a finished roof. Cooling only and cooling with gas heat models are available with a wide variety of factory-mounted options and field-installed accessories to make them suitable for almost every application. All units are self-contained and assembled on full perimeter base rails with holes in the four corners for overhead rigging. Every unit is completely piped, wired, charged and tested at the factory to simplify the field installation and to provide years of dependable operation. All models (including those with an economizer) are suitable for either bottom or horizontal duct connections. Models with power exhaust are suitable for bottom duct connections only. For bottom duct, remove the sheet metal panels from the supply and return air openings through the base of the unit. For horizontal duct, replace the supply and return air panels on the rear of the unit with a side duct flange accessory. All supply air blowers are equipped with a belt drive that can be adjusted to meet the exact requirements of the job. A high static drive option is available for applications with a higher CFM and/or static pressure requirement.

ZJ/ZR models have 4 condenser fan motors and ZF models have 2 condenser fan motors. All compressors include crankcase heat and internal pressure relief. Every refrigerant circuit includes an expansion valve, a liquid line filter-drier, a discharge line high pressure switch and a suction line with a freezestat and low pressure/loss of charge switch. The unit control circuit includes a 75 VA transformer, a 24-volt circuit breaker and a relay board with two compressor lockout circuits, a terminal strip for thermostat wiring, plus an additional set of pin connectors to simplify the interface of additional field controls. All units have long lasting powder paint cabinets with 1000 hour salt spray test approval under ASTM-B117 procedures. All models are CSA approved. All models include a 1-year limited warranty on the complete unit. Compressors carry an additional 4-year warranty. Aluminized steel tubular heat exchangers carry an additional 9-year warranty.

Description

ZJ units shall be factory-assembled, single packaged, ZJ***N Electric Cooling/Gas Heat, ZJ***C00 Electric Cooling/Field Installed Electric Heat Accessory designed for outdoor mounted installation. The 15 ton unit shall have a minimum EER rating of 12.2. The 17.5 ton unit shall have a minimum EER rating of

12.1. The 20 ton unit shall have a minimum EER rating of 11.0. The 25 ton unit shall have a minimum EER rating of 10.6.

ZR units shall be factory-assembled, single packaged, ZR***N Electric Cooling/Gas Heat, ZR***C00 Electric Cooling/Field Installed Electric Heat Accessory designed for outdoor mounted installation. The 15 ton unit shall have a minimum EER rating of 11.2. The 20 ton unit shall have a minimum EER rating of 11.0. The 25 ton unit shall have a minimum EER rating of 10.0.

ZF units shall be factory-assembled, single packaged, ZF***N Electric Cooling/Gas Heat, ZF***C00 Electric Cooling/Field Installed Electric Heat Accessory designed for outdoor mounted installation. The 15 and 17.5 ton units shall have a minimum EER rating of 11.0. The 20 and 25 ton units shall have a minimum EER rating of 10.

They shall have built-in field convertible duct connections for down discharge supply/return or horizontal discharge supply/return, and be available with factory installed options or field installed accessories. The units shall be factory wired, piped, charged with R-410A refrigerant and factory tested prior to shipment. All unit wiring shall be both numbered and color coded. All units shall be manufactured in a facility certified to ISO 9001 standards and the cooling performance shall be rated in accordance with DOE and AHRI test procedures. Units shall be CSA listed, classified to ANSIZ21.47 standards, UL 1995/CAN/CSA No. 236-M90 conditions.

Unit Cabinet

Unit cabinet shall be constructed of galvanized steel, with exterior surfaces coated with a non-chalking, powdered paint finish, certified at 1000 hours salt spray test per ASTM-B117 standards. Indoor blower section shall be insulated with a minimum 1/2" thick insulation, coated on the airside. Aluminum foil faced insulation shall be used in the furnace compartment and be fastened with ridged fasteners to prevent insulation from entering the air stream. Cabinet panels shall be "large" size, easily removable for servicing and maintenance. Full perimeter base rails shall be provided to assure reliable transit of equipment, overhead rigging and proper sealing on roof curb applications. Disposable 2" filters shall be furnished and be accessible through a removable access door, sealed airtight. Units filter track shall be designed to accommodate either 2" or 4" filters. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating air by-pass of the coils. Condensate pan shall be internally sloped and conform to ASHRAE 62-89 self-draining standards. Condensate connection shall be a minimum of 1" I.D. female and be a ridged mount connection. Unit shall incorporate a fixed outdoor air damper with an outdoor air intake opening covered with a bird screen and a rain hood painted to match the exterior of the unit.

Indoor (Evaporator) Fan Assembly

Fan shall be a belt drive assembly and include an adjustable-pitch motor pulley. Job site selected (B.H.P.) brake horsepower shall not exceed the motors nameplate horsepower rating, plus the service factor. Units shall be designed not to operate above service factor. Fan wheel shall be double-inlet type with forward-curved blades, dynamically balanced to operate smoothly throughout the entire range of operation. Airflow design shall be constant air volume.

A variable air volume (VAV) option using a variable frequency drive (VFD) is available for applications requiring a constant supply duct static pressure. Units equipped for VAV shall be controlled by a duct pressure transducer with a 0 - 5” WC pressure range. The pressure transducer shall provide a 0 - 5 VDC output signal to a control board which, in turn shall provide a 2 - 10 VDC speed reference signal to the VFD. Units equipped with VFD’s shall have factory-installed manual bypass as an option.

Outdoor (Condenser) Fan Assembly

The outdoor fans shall be of the direct-driven propeller type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The 4 outdoor fan motors shall be totally enclosed with permanently lubricated bearings, internally protected against overload conditions and staged independently.

Refrigerant Components

Compressors:

a. Shall be Scroll compressors internally protected with internal high-pressure relief and over temperature protection.

b. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.

Coils:

a. Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option.

b. Evaporator and Condenser coils shall be of the direct expansion, draw-thru, design.

Refrigerant Circuit and Refrigerant Safety Components shall include:

a. Balance-port thermostatic expansion valve with independent circuit feed system.

b. Filter drier/strainer to eliminate any moisture or foreign matter.

c. Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.

d. The refrigeration system shall provide at least 15° F of sub-cooling at design conditions.

e. All models shall have four independent circuits.

f. Hot gas bypass option shall be factory-installed on compressor #1 discharge line to provide cooling in low-load applications. HGBP shall be a standard feature on VAV models and an optional feature on CV models.

Unit Controls

a. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.

b. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor.

c. Loss-of-charge/Low-pressure switch.

1. High-pressure switch.

2. Freeze condition sensor, evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.

d. Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.

e. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.

f. Unit control board shall have on-board diagnostics and fault message display.

g. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to 0 °F.

h. Control board shall monitor each refrigerant safety switch independently.

Gas Heating Section (ZJ/ZR/ZF*N Models)**

Shall be designed with induced draft combustion with post purge logic and energy saving direct spark ignition, redundant main gas valve. Ventor wheel shall be constructed of stainless steel for corrosion resistance. The heat exchanger shall be of the tubular type, constructed of T1-40 aluminized steel for corrosion resistance and allowing minimum mixed air entering temperature of 25 °F. Burners shall be of the in-shot type, constructed of aluminum coated steel and contain air mixture adjustments. All gas piping shall enter the unit cabinet at a single location through either the side or curb, without any field modifications. An integrated control board shall provide timed control of evaporator fan functioning and burner ignition. Heating section shall be provided with the following minimum protection:

a. Primary and auxiliary high-temperature limit switches.

b. Induced draft motor speed sensor.

c. Flame roll out switch (automatic reset).

d. Flame proving controls. Unit shall have two independent stages of capacity.

Electric Heating (ZJ/ZR/ZF*C00 Models) (Field Installed Electric Heat Accessory)**

Nickel chromium electric heating elements shall be provided as required by the application with 1 or 2 stage control, as required, from 13.5 KW to 72 KW capacities. The heating section shall have a primary limit control(s) and automatic reset to prevent the heating element system from operating at an excessive temperature. Units with Electric Heating shall be wired for a single point power supply with branch circuit fusing (where required).

Unit Operating Characteristics

Unit shall be capable of starting and running at 125° F outdoor temperature, exceeding maximum load criteria of AHRI Standard 340/360. The compressor, with standard controls, shall be capable of operation down to 25° F outdoor temperature. Accessory low ambient kit shall be available for operation to 0° F. Unit shall be provided with fan time delay to prevent cold air delivery before heat exchanger warms up (Gas heat only).

Electrical Requirements

All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry, to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.

Standard Limited Warranties

- Compressor 5 Years
- Heat Exchanger 10 Years
- Other Parts 1 Year

Optional Outdoor Air (Shall be made available by either/or):

- **Dry Bulb Economizer -** Outdoor and return air dampers that are interlocked and positioned by a fully-modulating, spring-return damper actuator. The maximum leakage rate for the outdoor air intake dampers shall be designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. During economizer operation, a mixed-air temperature control shall modulate the outdoor and return air damper assembly to prevent the supply air temperature from dropping below 55°F. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feeds input into the basic module. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit. Water eliminator/filters shall be provided.

  Simultaneous economizer/compressor operation is also possible. Dampers shall fully close on power loss.
- **Motorized Outdoor Air Dampers -** Outdoor and return air dampers that are interlocked and positioned by a 2-position, spring-return damper actuator. A unit-mounted potentiometer shall be provided to adjust the outdoor and return air damper assembly to take in the design CFM of outdoor air to meet the ventilation requirements of the conditioned space during normal operation. Whenever the indoor fan motor is energized, the dampers open up to one of two pre-selected positions - regardless of the outdoor air enthalpy. Dampers return to the fully closed position when the indoor fan motor is de-energized. Dampers shall fully close on power loss.

Other Factory Installed Options

- **Power Exhaust Option** - To work in conjunction with economizers.
- **Stainless Steel Heat Exchanger**
- **Stainless Steel Drain Pan**
- **E-Coat Epoxy Polymer Coated Condenser And Evaporator Coil**
- **Electronic Single Enthalpy Economizer**
- **Dirty Filter Switch**
- **Double Wall**
- **Phase Monitor**
- **Coil Guard**
- **Powered GFI Convenience Outlet**
- **Non-powered GFI Convenience Outlet**
- **BAS Controls** - Smart Equipment™ with BAS Communication (BACnet MS/TP, Modbus, and Johnson Controls N2) Option, CPC, HONEYWELL, NOVAR, Verasys, FDD
- **BAS Ready Economizer** (2-10 V.D.C. Actuator With Smart Equipment™ Controller)
- **Hinged Filter Door Access And Tool Free Access Panels**
- **Hinged Tool Free Blower, Blower Motor, Filter And Electrical Access Panels**
- **High Static Drive**
- **Low Static Drive (ZJ/ZR/ZF300 only)**
- **2" Pleated Filters, MERV 8**
- **4" Pleated Filters, MERV 13**
- **Disconnect Switch**
- **Supply Air Smoke Detector**
- **Return Air Smoke Detector**

Other Pre-engineered Accessories Available

- **Roof Curb -** 14" high, full perimeter curb with wood nailer (shipped knocked-down).
- **100% Barometric Relief Damper -** Contains a rain hood, air inlet screen, exhaust damper and mounting hardware. Used to relieve internal air pressure through the unit.
- **Propane Conversion Kit -** Contains new orifices and gas valve parts to convert from natural to L.P. gas. One per unit required.
- **High Altitude - Natural Gas -** Contains orifices required for applications between 2000 and 6000 feet altitude.
- **High Altitude - Propane Gas** - Contains orifices required for applications between 2000 and 6000 feet altitude. Must be used with propane conversion kit.
- **Burglar Bars -** Designed to work with above roof curbs, depending on unit model. Fits duct openings of curb supply and return air openings.
- **Side Duct Flange -** Supply and return air duct flanges for side duct applications. Do not use on units with power exhaust.
- **High Static Drive -** May include a belt, blower pulley, motor pulley or a motor change to enhance blower performance.
- **Wood Skid -** Allows unit to be handled with 90" forks.
- **Economizer/motorized Damper Rain Hood (ZJ/ZR/ZFN/C300 only) -** Contains all hood panels and the hardware for assembling.
- **Anti-Recycle Timer -** Assures 5-minute off time between compressor cycles.
- **Low Ambient Kit -** Provides unit cooling operation down to 0 °F.
- **Coil Guard Kit** - Guard for cooling coil.
- **Electric Heat Accessory -** (Field Installed Only)

Hot Gas Reheat

Setpoints and Related Data

Setpoints and related data includes:

- Hot Gas Reheat Alternate Operation Enabled (HGRAlt-En)
- Hot Gas Reheat Enabled for Operation (HGR-En)
- Hot Gas Reheat Alternate Operation Writable (HGRAltWrite)
- Hot Gas Reheat Humidity Setpoint (HGRHum-Sp)
- HGR Unoccupied Humidity Setpoint (HGRUnoccHum-Sp)
- HGR Enabled for Unoccupied Operation (HGRUnocc-En)

Inputs

Inputs include:

- Operational space humidity (OprSH)

Outputs

- Outputs include:
- 24 VAC from AUX-HGR to energize the hot gas reheat solenoid. 24 VAC from C1 or C2 to energize compressor contactors

Operation For ZR Units Only

Normal Occupied Operation Mode

If the return humidity is greater than or equal to the Hot Gas Reheat Humidity Setpoint, and no demand for cooling, C1 output energizes and the AUX-HGR output energizes.

If there is a demand for one stage of cooling and the return humidity is greater than or equal to the Hot Gas Reheat Humidity Setpoint, C1 output energizes but the AUX-HGR output de-energizes.

Any additional cooling demands energize compressor outputs, but do not change the status of the AUX-HGR output.

When the return humidity falls to 3% or more below the setpoint, the C1 and AUX-HGR outputs de-energize.

NOTE: If HGR Enabled for Unoccupied Operation is enabled, during unoccupied mode the control works the same as described above, except it uses the HGR Unoccupied Humidity Setpoint instead.

Alternate Mode

If the return humidity is greater than or equal to the Hot Gas Reheat Humidity Setpoint, and no demand for cooling, C1 and AUX-HGR outputs energize, and C2 energizes.

If there is a demand for one stage of cooling and the return humidity is greater than or equal to the Hot Gas Reheat Humidity Setpoint, C1 and AUX-HGR outputs energize, and C2 energizes.

If there is a demand for both first and second cooling stages and the return humidity is greater than or equal to the Hot Gas Reheat Humidity Setpoint, C1 and C2 outputs energize and AUX-HGR de-energizes.

When the return humidity falls to 3% or more below the setpoint, the C1, C2, and AUX-HGR outputs de-energize.

NOTE: If HGR Enabled for Unoccupied Operation is enabled, during unoccupied mode the control works the same as described above, except it uses the HGR Unoccupied Humidity Setpoint instead.

Dehumidification Sequence in Normal and Alternate Mode

Request	Normal Mode			Alternate Mode		
	HGR	C1	C2	HGR	C1	C2
Dehumidification	On	On	Off	On	On	Off
One Stage of Cooling (Y1)	Off	On	Off	On	On	On
Two Stages of Cooling (Y2)	Off	On	On	Off	On	On

Physical Data

ZJ180-300 Physical Data

Component	Models							
	ZJ180		ZJ210		ZJ240		ZJ300	
Nominal Tonnage	**15**		**17.5**		**20**		**25**	
AHRI COOLING PERFORMANCE								
Gross Capacity @ AHRI A point (K Btu)	181.4		208		255		290	
AHRI net capacity (K Btu)	172		202		242		280	
EER	12.2		12.1		11.0		10.6	
SEER	-		-		-		-	
IEER with Constant Volume	13.4		13.0		12.0		-	
IEER with Intellispeed	14.2[1]/14.0[2]		14.2[1]/14.0[2]		12.7[1]/12.5[2]		12.2[1]/12.0[2]	
IEER with VAV	13.4[1]/13.2[2]		13.4[1]/13.2[2]		12.15[1]/11.95[2]		11.9[1]/11.7[2]	
CFM	4500		5800		7000		7000	
System power (KW)	14.10		16.70		21.82		26.67	
Refrigerant type	R-410a		R-410a		R-410a		R-410a	
Refrigerant charge (lb-oz)								
System 1	12-0		14-0		12-0		12-4	
System 2	11-12		12-8		13-0		12-8	
System 3	12-4		12-8		12-0		12-8	
System 4	13-8		12-8		12-0		12-8	
AHRI HEATING PERFORMANCE								
Heating model	N30	N40	N30	N40	N30	N40	N30	N40
Heat input (K Btu)	300	400	300	400	300	400	300	400
Heat output (K Btu)	240	320	240	320	240	320	240	320
AFUE %	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80
No. burners	6	8	6	8	6	8	6	8
No. stages	2	2	2	2	2	2	2	2
Temperature Rise Range (ºF)	20-50	30-60	20-50	30-60	20-50	30-60	20-50	30-60
Gas Limit Setting (ºF)	195	195	195	195	195	195	195	195
Gas piping connection (in.)	1	1	1	1	1	1	1	1
DIMENSIONS (inches)								
Length	180-19/32							
Width	92							
Height	52-5/8							
OPERATING WT. (lbs.)	2609		2665		2697		2783	
COMPRESSORS								
Type	Scroll		Scroll		Scroll		Scroll	
Quantity	4		4		4		4	
Unit Capacity Steps (%)	25 / 50 / 75 / 100		25 / 50 / 75 / 100		25 / 50 / 75 / 100		25 / 50 / 75 / 100	
CONDENSER COIL DATA								
Face area (Sq. Ft.)	63.8		63.8		63.8		63.8	
Rows	2		2		2		2	
Fins per inch	20		20		20		20	
Tube diameter (in.)	3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face	
EVAPORATOR COIL DATA								
Face area (Sq. Ft.)	25		25		25		25	
Rows	4		4		4		4	
Fins per inch	13.5		13.5		13.5		13.5	
Tube diameter	3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face	
Refrigerant control	TXV		TXV		TXV		TXV	

ZJ180-300 Physical Data (Continued)

Component	Models								
	ZJ180		ZJ210		ZJ240		ZJ300		
Nominal Tonnage	**15**		**17.5**		**20**		**25**		
CONDENSER FAN DATA									
Quantity	4		4		4		4		
Fan diameter (Inch)	24		24		30		30		
Type	Prop		Prop		Prop		Prop		
Drive type	Direct		Direct		Direct		Direct		
No. speeds	1		1		1		1		
Number of motors	2		4		4		2		
Motor HP each	1/3		1/3		1/3		1/3		
RPM	850		850		870		870		
Total CFM	16000		16000		20000		20000		
BELT DRIVE EVAP FAN DATA									
Quantity	1		1		1		1		
Fan Size (Inch)	15 X 15		18 X 15		18 X 15		18 X 15		
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	1VP60	1VP60	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	BK110	BK090	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX83	BX81	BX78	BX75	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	5	5	7.5	5	7.5	7.5	10	15
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	184T	184T	184T	213T	184T	213T	213T	215T	254T
FILTERS									
Quantity - Size	12 - (12 x 24 x 2)[3,4]		12 - (12 x 24 x 2)[3,4]		12 - (12 x 24 x 2)[3,4]		12 - (12 x 24 x 2)[3,4]		
	2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[5]		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[5]		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[5]		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[5]		

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
4. 2 In. Pleated, Optional, MERV 8.
5. 4 In. Pleated, Optional, MERV 13.

ZR180-300 Physical Data

Component	Models					
	ZR180		ZR240		ZR300	
Nominal Tonnage	**15**		**20**		**25**	
AHRI COOLING PERFORMANCE						
Gross Capacity @ AHRI A point (K Btu)	189		243		303	
AHRI net capacity (K Btu)	180		228		288	
EER	11.2		11.0		10.0	
SEER	-		-		-	
IEER with Constant Volume	12.4[1]/12.2[2]		-		-	
IEER with Intellispeed	13.2[1]/13.0[2]		13.2[1]/13.0[2]		12.3[1]/12.1[2]	
CFM	5000		6000		7600	
System power (KW)	14.40		20.10		28.50	
Refrigerant type	R-410a		R-410a		R-410a	
Refrigerant charge (lb-oz)						
System 1	22		24		25	
System 2	22		24		24-8	
AHRI HEATING PERFORMANCE						
Heating model	N30	N40	N30	N40	N30	N40
Heat input (K Btu)	300	400	300	400	300	400
Heat output (K Btu)	240	320	240	320	240	320
AFUE %	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80
No. burners	6	8	6	8	6	8
No. stages	2	2	2	2	2	2
Temperature Rise Range (ºF)	20-50	30-60	20-50	30-60	20-50	30-60
Gas Limit Setting (ºF)	195	195	195	195	195	195
Gas piping connection (in.)	1	1	1	1	1	1
DIMENSIONS (inches)						
Length	180-19/32					
Width	92					
Height	52-5/8					
OPERATING WT. (lbs.)	2360		2660		2760	
COMPRESSORS						
Type	Scroll		Scroll		Scroll	
Quantity	2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA						
Face area (Sq. Ft.)	63.8		63.8		63.8	
Rows	2		2		2	
Fins per inch	20		20		20	
Tube diameter (in.)	3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face	
EVAPORATOR COIL DATA						
Face area (Sq. Ft.)	20		20		20.52	
Rows	3		4		4	
Fins per inch	13.5		13.5		13.5	
Tube diameter	3/8		3/8		3/8	
Circuitry Type	Intertwined		Intertwined		Intertwined	
Refrigerant control	TXV		TXV		TXV	
REHEAT COIL DATA						
Face area (Sq. Ft.)	17.2		17.2		17.2	
Rows	2		2		2	
Fins per inch	13		13		13	
Tube diameter	3/8		3/8		3/8	

ZR180-300 Physical Data (Continued)

Component	Models						
	ZR180		ZR240		ZR300		
Nominal Tonnage	**15**		**20**		**25**		
CONDENSER FAN DATA							
Quantity	4		4		4		
Fan diameter (Inch)	24		30		30		
Type	Prop		Prop		Prop		
Drive type	Direct		Direct		Direct		
No. speeds	1		1		1		
Number of motors	4		4		4		
Motor HP each	1/3		1/3		1/3		
RPM	850		850		850		
Total CFM	16000		18000		20000		
BELT DRIVE EVAP FAN DATA							
Quantity	1		1		1		
Fan Size (Inch)	15 X 15		18 X 15		18 X 15		
Type	Centrifugal		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX83	BX81	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	7.5	7.5	10	7.5	10	15
RPM	1725	1725	1725	1725	1725	1725	1725
Frame size	184T	213T	213T	215T	213T	215T	254T
FILTERS							
Quantity - Size	4 - (16 x 25 x 2), 4 - (16 x 20 x 2)[3,4]		4 - (16 x 25 x 2), 4 - (16 x 20 x 2)[3,4]		4 - (16 x 25 x 2), 4 - (16 x 20 x 2)[3,4]		
	4 - (16 x 25 x 4), 4 - (16 x 20 x 4)[5]		4 - (16 x 25 x 4), 4 - (16 x 20 x 4)[5]		4 - (16 x 25 x 4), 4 - (16 x 20 x 4)[5]		

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
4. 2 In. Pleated, Optional, MERV 8.
5. 4 In. Pleated, Optional, MERV 13.

ZF180-300 Physical Data

Component	Models							
	ZF180		ZF210		ZF240		ZF300	
Nominal Tonnage	**15**		**17.5**		**20**		**25**	
AHRI COOLING PERFORMANCE								
Gross Capacity @ AHRI A point (K Btu)	175		208		254.5		279	
AHRI net capacity (K Btu)	172		204		240		270	
EER	11.0[1]/10.8[2]		11.0[1]/10.8[2]		10.0[1]/9.8[2]		10.0[1]/9.8[2]	
SEER	-		-		-		-	
IEER with Constant Volume	12.4[1]/12.2[2]		-		-		-	
IEER with Intellispeed	13.2[1]/13.0[2]		13.1[1]/13.0[2]		12.5[1]/12.3[2]		11.6[1]/11.4[2]	
IEER with VAV	12.8[1]/12.6[2]		-		12.05[1]/11.85[2]		-	
CFM	4430		5300		6200		6750	
System power (KW)	15.0		18.5		24.7		27.0	
Refrigerant type	R-410a		R-410a		R-410a		R-410a	
Refrigerant charge (lb-oz)								
System 1	20-0		23-8		22		24-2	
System 2	20-0		23-8		23-8		24-4	
AHRI HEATING PERFORMANCE								
Heating model	N30	N40	N30	N40	N30	N40	N30	N40
Heat input (K Btu)	300	375	300	400	300	400	300	400
Heat output (K Btu)	240	300	240	320	240	320	240	320
AFUE%	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80
No. burners	6	8	6	8	6	8	6	8
No. stages	2	2	2	2	2	2	2	2
Temperature Rise Range (ºF)	20-50	35-65	20-50	30-60	20-50	30-60	20-50	30-60
Gas Limit Setting (ºF)	195	195	195	195	195	195	195	195
Gas piping connection (in.)	1	1	1	1	1	1	1	1
DIMENSIONS (inches)								
Length	125-1/4		136-1/4		136-1/4		136-1/4	
Width	92		92		92		92	
Height	48-5/8		52-5/8		52-5/8		52-5/8	
OPERATING WT. (lbs.)	1870		2006		2533		2597	
COMPRESSORS								
Type	Scroll		Scroll		Scroll		Scroll	
Quantity	2		2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA								
Face area (Sq. Ft.)	36.0		43.3		43.3		43.3	
Rows	3		3		3		3	
Fins per inch	18		15		15		15	
Tube diameter (in.)	3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face	
EVAPORATOR COIL DATA								
Face area (Sq. Ft.)	15.5		25		20		25	
Rows	4		4		4		4	
Fins per inch	14		13.5		13.5		13.5	
Tube diameter	3/8		3/8		3/8		3/8	
Circuitry Type	Intertwined		Split-face		Intertwined		Split-face	
Refrigerant control	TXV		TXV		TXV		TXV	

ZF180-300 Physical Data (Continued)

Component	Models								
	ZF180		ZF210		ZF240		ZF300		
Nominal Tonnage	15		17.5		20		25		
CONDENSER FAN DATA									
Quantity	2		2		2		2		
Fan diameter (Inch)	30		30		30		30		
Type	Prop		Prop		Prop		Prop		
Drive type	Direct		Direct		Direct		Direct		
No. speeds	1		1		1		1		
Number of motors	2		2		2		2		
Motor HP each	1.25		1.25		1.25		1.50		
RPM	1140		1140		1140		1140		
Total CFM	11530		14000		14000		15000		
BELT DRIVE EVAP FAN DATA									
Quantity	1		1		1		1		
Fan Size (Inch)	15 X 15		18 X 15		18 X 15		18 X 15		
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	1VP60	1VP60	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	BK110	BK090	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX75	BX70	BX78	BX75	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	5	5	7.5	5	7.5	7.5	10	15
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	184T	184T	184T	213T	184T	213T	213T	215T	254T
FILTERS									
Quantity - Size	5 - (18 x 24 x 2)[3,4]		12 - (12 x 24 x 2)[3,4]		4 - (16 x 25 x 2),		12 - (12 x 24 x 2)[3,4]		
	-		-		4 - (16 x 20 x 2)[3,4]		-		
	5 - (18 x 24 x 4)[5]		2 - (20 x 24 x 4),		4 - (16 x 25 x 4),		2 - (20 x 24 x 4),		
	-		4 - (24 x 24 x 4)[5]		4 - (16 x 20 x 4)[5]		4 - (24 x 24 x 4)[5]		

1. Cooling Only Unit or Cooling Unit with Electric Heat
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5. 4 In. Pleated, Optional, MERV 13.

ZJ/ZR/ZF180-300 Unit Limitations

Size (Tons)	Unit Voltage	Unit Limitations		
		Applied Voltage		Outdoor DB Temp
		Min	Max	Max (°F)
180 (15)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
210 (17.5)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
240 (20)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
300 (25)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125

Capacity Performance

ZJ180-300 Cooling Capacities

ZJ180 (15 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
3750	77	157.5	10.3	69.2	51.6	34.0	-	-	-	178.0	11.7	80.1	62.9	45.6	-	-	-
	72	175.9	10.2	112.5	94.9	77.3	59.7	-	-	180.7	11.6	114.6	97.4	80.1	62.9	-	-
	67	194.3	10.0	155.9	138.3	120.7	103.1	85.5	-	183.3	11.4	149.2	131.9	114.7	97.4	80.1	-
	62	177.4	9.7	177.4	173.1	149.4	131.8	114.2	96.6	169.1	11.3	169.1	166.5	141.9	124.6	107.4	90.1
4500	77	165.1	10.4	76.8	56.9	37.0	-	-	-	184.8	11.8	88.7	69.1	49.6	-	-	-
	72	184.0	10.2	124.0	104.1	84.2	64.3	-	-	187.6	11.6	126.2	106.7	87.1	67.6	-	-
	67	203.0	10.0	171.1	151.2	131.4	111.5	91.6	-	190.3	11.5	163.8	144.2	124.7	105.1	85.5	-
	62	185.4	9.8	185.4	182.5	162.6	142.8	122.9	103.0	175.5	11.4	175.5	173.8	154.3	134.7	115.2	95.6
	57	184.1	10.0	184.1	184.1	164.6	144.7	124.8	105.0	177.5	11.4	177.5	175.2	155.7	136.1	116.6	97.0
5250	77	172.6	10.4	84.4	62.2	40.1	-	-	-	191.6	11.8	97.3	75.4	53.6	-	-	-
	72	192.2	10.2	135.4	113.2	91.1	68.9	-	-	194.5	11.6	137.8	116.0	94.1	72.3	-	-
	67	211.8	10.0	186.3	164.2	142.0	119.9	97.8	-	197.3	11.5	178.4	156.5	134.7	112.8	91.0	-
	62	193.4	9.8	193.4	192.0	175.9	153.7	131.6	109.4	182.0	11.4	182.0	181.1	166.7	144.8	123.0	101.1
	57	192.1	10.0	192.1	192.1	178.0	155.8	133.7	111.5	184.0	11.4	184.0	182.9	168.2	146.3	124.5	102.6
6000	77	180.1	10.4	92.0	67.6	43.1	-	-	-	198.5	11.8	105.8	81.7	57.5	-	-	-
	72	200.3	10.2	146.8	122.3	97.9	73.5	-	-	201.4	11.7	149.4	125.2	101.1	77.0	-	-
	67	220.5	10.1	201.6	177.1	152.7	128.3	103.9	-	204.3	11.5	193.0	168.8	144.7	120.5	96.4	-
	62	201.4	9.8	201.4	201.4	189.1	164.7	140.2	115.8	188.5	11.4	188.5	188.5	179.0	154.9	130.7	106.6
	57	200.1	10.0	200.1	200.1	191.3	166.9	142.5	118.1	190.6	11.4	190.6	190.6	180.7	156.5	132.4	108.2
6750	72	201.8	10.3	155.2	129.2	103.1	77.0	-	-	203.6	11.7	158.2	132.5	106.8	81.1	-	-
	67	222.2	10.1	212.8	186.9	160.9	134.8	108.7	-	206.6	11.5	200.9	178.6	152.9	127.1	101.4	-
	62	203.0	9.9	203.0	203.0	196.8	170.8	144.7	118.6	190.6	11.4	190.6	190.6	185.8	160.1	134.4	108.7
	57	201.7	10.0	201.7	201.7	197.3	171.2	145.1	119.1	192.7	11.4	192.7	192.7	187.7	162.0	136.3	110.6
7500	72	203.3	10.3	163.7	136.0	108.3	80.5	-	-	205.9	11.7	167.1	139.8	112.5	85.3	-	-
	67	224.0	10.1	224.0	196.7	169.0	141.3	113.6	-	208.9	11.5	208.9	188.3	161.0	133.8	106.5	-
	62	204.6	9.9	204.6	204.6	204.6	176.9	149.2	121.4	192.6	11.4	192.6	192.6	192.6	165.4	138.1	110.8
	57	203.2	10.1	203.2	203.2	203.2	175.5	147.8	120.1	194.8	11.4	194.8	194.8	194.8	167.5	140.3	113.0
		95°F								105°F							
3750	77	198.6	13.2	91.0	74.1	57.2	-	-	-	186.8	14.9	81.5	68.5	51.8	-	-	-
	72	185.5	13.0	116.7	99.8	82.9	66.0	-	-	173.0	14.8	110.5	93.8	77.2	60.5	-	-
	67	172.4	12.9	142.4	125.5	108.6	91.7	74.8	-	159.2	14.7	139.5	119.2	102.5	85.8	69.2	-
	62	160.7	12.9	160.7	160.0	134.4	117.4	100.5	83.6	152.1	14.7	152.1	148.6	123.7	107.0	90.4	73.7
4500	77	204.6	13.2	100.6	81.3	62.1	-	-	-	191.2	14.9	94.2	75.2	56.3	-	-	-
	72	191.1	13.0	128.5	109.3	90.0	70.8	-	-	177.1	14.8	121.7	102.8	83.8	64.9	-	-
	67	177.6	12.9	156.4	137.2	117.9	98.7	79.5	-	163.0	14.7	149.2	130.3	111.4	92.4	73.5	-
	62	165.7	12.9	165.7	165.1	145.9	126.7	107.4	88.2	155.7	14.7	155.7	153.3	134.4	115.5	96.5	77.6
	57	170.9	12.8	170.9	166.0	146.8	127.5	108.3	89.1	159.0	14.6	159.0	154.0	135.1	116.2	97.2	78.3
5250	77	210.7	13.2	110.1	88.6	67.0	-	-	-	195.6	14.9	106.9	82.0	60.8	-	-	-
	72	196.8	13.0	140.3	118.7	97.1	75.6	-	-	181.2	14.8	132.9	111.7	90.5	69.3	-	-
	67	182.9	12.9	170.4	148.8	127.3	105.7	84.2	-	166.8	14.7	158.9	141.4	120.2	99.0	77.8	-
	62	170.6	12.9	170.6	170.3	157.5	135.9	114.3	92.8	159.2	14.7	159.2	158.1	145.1	123.9	102.7	81.5
	57	176.0	12.8	176.0	173.5	158.4	136.8	115.3	93.7	162.7	14.6	162.7	160.2	145.9	124.7	103.5	82.2
6000	77	216.8	13.2	119.7	95.8	71.9	-	-	-	200.0	14.9	119.6	88.8	65.3	-	-	-
	72	202.5	13.1	152.0	128.1	104.3	80.4	-	-	185.3	14.8	144.1	120.7	97.2	73.7	-	-
	67	188.2	12.9	184.4	160.5	136.6	112.7	88.9	-	170.5	14.7	168.6	152.6	129.1	105.6	82.1	-
	62	175.5	13.0	175.5	175.5	169.0	145.1	121.3	97.4	162.8	14.7	162.8	162.8	155.8	132.3	108.8	85.4
	57	181.0	12.8	181.0	181.0	170.0	146.1	122.3	98.4	166.3	14.6	166.3	166.3	156.6	133.1	109.7	86.2
6750	72	205.5	13.0	161.3	135.9	110.5	85.2	-	-	189.0	14.8	153.2	128.2	103.3	78.3	-	-
	67	191.0	12.9	189.0	170.2	144.8	119.5	94.1	-	174.0	14.7	173.0	161.5	137.2	112.2	87.3	-
	62	178.1	12.9	178.1	178.1	174.8	149.5	124.1	98.8	166.1	14.6	166.1	166.1	162.6	137.7	112.7	87.8
	57	183.7	12.8	183.7	183.7	178.2	152.9	127.5	102.1	169.7	14.6	169.7	169.7	164.9	139.9	114.9	90.0
7500	72	208.5	13.0	170.5	143.7	116.8	90.0	-	-	192.8	14.7	162.2	135.8	109.4	82.9	-	-
	67	193.7	12.9	193.7	179.9	153.1	126.2	99.4	-	177.5	14.6	177.5	170.5	145.3	118.8	92.4	-
	62	180.7	12.9	180.7	180.7	180.7	153.9	127.0	100.2	169.5	14.6	169.5	169.5	169.5	143.0	116.6	90.1
	57	186.4	12.8	186.4	186.4	186.4	159.6	132.7	105.9	173.1	14.5	173.1	173.1	173.1	146.7	120.2	93.8

ZJ180 (15 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
3750	77	175.1	16.6	71.9	62.9	46.5	-	-	-	163.4	18.3	63.0	56.6	41.1	-	-	-
	72	160.6	16.6	104.2	87.8	71.4	55.0	-	-	148.2	18.3	98.0	81.8	65.7	49.5	-	-
	67	146.1	16.5	136.6	112.8	96.4	79.9	63.5	-	133.0	18.3	133.0	106.4	90.2	74.1	57.9	-
	62	143.5	16.4	143.5	137.2	113.0	96.6	80.2	63.8	134.8	18.1	134.8	125.9	102.4	86.2	70.0	53.9
4500	77	177.8	16.6	87.8	69.2	50.5	-	-	-	164.4	18.4	82.5	63.1	44.7	-	-	-
	72	163.1	16.6	114.9	96.3	77.6	59.0	-	-	149.1	18.3	108.1	89.8	71.4	53.1	-	-
	67	148.4	16.5	142.0	123.4	104.8	86.1	67.5	-	133.8	18.3	133.8	116.5	98.2	79.8	61.5	-
	62	145.7	16.4	145.7	141.5	122.9	104.3	85.6	67.0	135.7	18.1	135.7	129.7	111.4	93.0	74.7	56.4
	57	147.1	16.5	147.1	142.1	123.4	104.8	86.2	67.5	135.2	18.3	135.2	130.1	111.8	93.4	75.1	56.8
5250	77	180.5	16.7	103.7	75.4	54.6	-	-	-	165.5	18.4	102.0	69.6	48.3	-	-	-
	72	165.6	16.6	125.6	104.7	83.9	63.0	-	-	150.0	18.4	118.2	97.7	77.2	56.7	-	-
	67	150.6	16.5	147.5	134.0	113.2	92.3	71.4	-	134.5	18.4	134.5	126.6	106.1	85.6	65.1	-
	62	147.9	16.4	147.9	145.8	132.7	111.9	91.0	70.2	136.5	18.2	136.5	133.6	120.4	99.9	79.4	58.9
	57	149.3	16.5	149.3	146.8	133.3	112.5	91.6	70.8	136.0	18.3	136.0	133.5	120.8	100.3	79.8	59.3
6000	77	183.3	16.7	119.6	81.7	58.6	-	-	-	166.5	18.4	121.5	76.1	52.0	-	-	-
	72	168.1	16.6	136.2	113.2	90.1	67.0	-	-	150.9	18.4	128.4	105.7	83.0	60.3	-	-
	67	152.9	16.6	152.9	144.6	121.6	98.5	75.4	-	135.3	18.4	135.3	135.3	114.0	91.3	68.7	-
	62	150.1	16.5	150.1	150.1	142.6	119.5	96.4	73.4	137.4	18.2	137.4	137.4	129.4	106.7	84.0	61.3
	57	151.6	16.5	151.6	151.6	143.2	120.2	97.1	74.0	136.8	18.3	136.8	136.8	129.9	107.2	84.5	61.8
6750	72	172.6	16.5	145.1	120.5	96.0	71.4	-	-	156.2	18.3	137.0	112.9	88.7	64.5	-	-
	67	157.0	16.5	157.0	152.9	129.5	105.0	80.4	-	140.1	18.2	140.1	140.1	121.9	97.7	73.5	-
	62	154.2	16.4	154.2	154.2	150.4	125.8	101.3	76.7	142.2	18.1	142.2	142.2	138.2	114.0	89.9	65.7
	57	155.7	16.4	155.7	155.7	151.5	126.9	102.4	77.8	141.6	18.2	141.6	141.6	138.2	114.0	89.8	65.7
7500	72	177.2	16.4	154.0	127.9	101.9	75.8	-	-	161.5	18.1	145.7	120.0	94.4	68.8	-	-
	67	161.2	16.4	161.2	161.2	137.5	111.4	85.4	-	144.9	18.1	144.9	144.9	129.7	104.0	78.4	-
	62	158.2	16.3	158.2	158.2	158.2	132.2	106.1	80.1	147.0	17.9	147.0	147.0	147.0	121.3	95.7	70.0
	57	159.8	16.3	159.8	159.8	159.8	133.7	107.7	81.7	146.4	18.1	146.4	146.4	146.4	120.8	95.2	69.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ210 (17.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
4375	77	271.8	12.4	121.1	101.3	82.1	-	-	-	251.8	13.7	111.3	92.2	73.2	-	-	-
	72	250.4	11.9	149.0	129.8	110.6	91.3	-	-	232.9	13.3	141.1	122.1	103.1	84.0	-	-
	67	229.0	11.5	176.9	158.3	139.1	119.8	100.6	-	214.0	13.0	171.0	152.0	133.0	113.9	94.9	-
	62	227.9	11.4	227.9	197.5	176.9	157.7	138.5	119.3	211.8	13.0	211.8	192.5	168.6	149.5	130.5	111.5
5250	77	276.3	12.3	132.4	110.1	87.7	-	-	-	256.2	13.6	122.7	100.5	78.4	-	-	-
	72	254.5	11.9	162.9	140.5	118.1	95.8	-	-	237.0	13.3	154.7	132.5	110.4	88.2	-	-
	67	232.8	11.4	193.3	170.9	148.6	126.2	103.9	-	217.7	13.0	186.7	164.6	142.4	120.2	98.1	-
	62	231.6	11.4	231.6	211.4	189.0	166.7	144.3	121.9	215.5	12.9	215.5	202.7	180.5	158.4	136.2	114.0
	57	223.9	11.5	223.9	215.9	193.5	171.2	148.8	126.5	211.0	13.0	211.0	203.9	181.7	159.6	137.4	115.3
6125	77	280.7	12.2	143.8	118.8	93.4	-	-	-	260.6	13.6	134.2	108.9	83.6	-	-	-
	72	258.6	11.8	176.7	151.2	125.7	100.2	-	-	241.0	13.3	168.3	143.0	117.7	92.4	-	-
	67	236.5	11.3	209.6	183.6	158.1	132.6	107.1	-	221.5	13.0	202.4	177.1	151.8	126.5	101.3	-
	62	235.3	11.3	235.3	225.2	201.1	175.6	150.1	124.6	219.2	12.9	219.2	212.8	192.5	167.2	141.9	116.6
	57	227.5	11.5	227.5	223.5	205.9	180.4	154.9	129.4	214.6	13.0	214.6	211.1	193.8	168.5	143.2	117.9
7000	77	285.2	12.2	155.2	127.6	99.0	-	-	-	265.0	13.6	145.6	117.2	88.8	-	-	-
	72	262.7	11.7	190.6	161.9	133.3	104.7	-	-	245.1	13.3	181.8	153.4	125.0	96.6	-	-
	67	240.2	11.3	226.0	196.2	167.6	139.0	110.3	-	225.2	12.9	218.1	189.7	161.3	132.8	104.4	-
	62	239.1	11.2	239.1	239.1	213.2	184.6	156.0	127.3	222.9	12.9	222.9	222.9	204.4	176.0	147.6	119.2
	57	231.1	11.4	231.1	231.1	218.3	189.7	161.1	132.4	218.3	12.9	218.3	218.3	205.8	177.4	149.0	120.6
7875	72	269.7	11.8	206.7	175.9	145.1	114.3	-	-	251.0	13.3	196.4	166.0	135.6	105.2	-	-
	67	246.7	11.4	239.5	213.3	182.5	151.7	120.9	-	230.6	13.0	227.1	205.3	174.9	144.5	114.1	-
	62	245.4	11.3	245.4	245.4	232.5	201.8	171.0	140.2	228.3	12.9	228.3	228.3	219.0	188.7	158.3	127.9
	57	237.3	11.5	237.3	237.3	230.9	200.1	169.4	138.6	223.5	13.0	223.5	223.5	217.3	186.9	156.5	126.1
8750	72	276.7	11.9	222.8	189.8	156.9	124.0	-	-	256.9	13.3	211.0	178.6	146.2	113.8	-	-
	67	253.1	11.4	253.1	230.3	197.4	164.5	131.6	-	236.1	13.0	236.1	221.0	188.6	156.2	123.9	-
	62	251.8	11.4	251.8	251.8	251.8	218.9	186.0	153.1	233.7	13.0	233.7	233.7	233.7	201.3	168.9	136.6
	57	243.5	11.6	243.5	243.5	243.5	210.6	177.6	144.7	228.8	13.0	228.8	228.8	228.8	196.4	164.0	131.7
		95°F								105°F							
4375	77	231.8	14.9	101.5	83.2	64.3	-	-	-	213.0	16.6	89.8	75.0	56.3	-	-	-
	72	215.4	14.7	133.3	114.4	95.6	76.7	-	-	198.0	16.5	124.6	105.9	87.2	68.5	-	-
	67	198.9	14.5	165.1	145.7	126.9	108.0	89.2	-	183.1	16.4	159.5	136.8	118.1	99.4	80.7	-
	62	195.7	14.5	195.7	187.6	160.2	141.3	122.5	103.7	180.2	16.3	180.2	172.1	144.9	126.2	107.5	88.7
5250	77	236.1	15.0	113.0	91.0	69.1	-	-	-	217.2	16.7	104.0	82.4	60.9	-	-	-
	72	219.4	14.8	146.6	124.6	102.6	80.7	-	-	202.0	16.5	137.5	115.9	94.4	72.9	-	-
	67	202.7	14.6	180.1	158.2	136.2	114.3	92.3	-	186.8	16.4	171.0	149.4	127.9	106.4	84.8	-
	62	199.4	14.5	199.4	194.0	172.0	150.0	128.1	106.1	183.8	16.4	183.8	178.4	156.8	135.3	113.8	92.2
	57	198.1	14.5	198.1	191.9	170.0	148.0	126.0	104.1	183.3	16.3	183.3	176.9	155.4	133.8	112.3	90.8
6125	77	240.5	15.0	124.5	98.9	73.8	-	-	-	221.4	16.7	118.2	89.9	65.5	-	-	-
	72	223.5	14.8	159.8	134.8	109.7	84.6	-	-	205.9	16.6	150.3	126.0	101.6	77.2	-	-
	67	206.5	14.6	195.2	170.6	145.6	120.5	95.4	-	190.4	16.4	182.5	162.0	137.7	113.3	88.9	-
	62	203.1	14.5	203.1	200.4	183.8	158.7	133.7	108.6	187.4	16.4	187.4	184.7	168.8	144.4	120.1	95.7
	57	201.8	14.5	201.8	198.7	181.6	156.6	131.5	106.4	186.8	16.4	186.8	183.7	167.2	142.9	118.5	94.1
7000	77	244.9	15.0	136.0	106.7	78.5	-	-	-	225.6	16.7	132.3	97.3	70.1	-	-	-
	72	227.6	14.8	173.1	144.9	116.7	88.5	-	-	209.8	16.6	163.2	136.0	108.8	81.6	-	-
	67	210.2	14.6	210.2	183.1	154.9	126.7	98.5	-	194.0	16.5	194.0	174.6	147.4	120.3	93.1	-
	62	206.8	14.5	206.8	206.8	195.6	167.4	139.3	111.1	191.0	16.4	191.0	191.0	180.7	153.6	126.4	99.2
	57	205.4	14.5	205.4	205.4	193.3	165.1	136.9	108.7	190.4	16.4	190.4	190.4	179.1	151.9	124.7	97.5
7875	72	232.3	14.8	186.1	156.1	126.1	96.1	-	-	213.0	16.5	175.8	146.6	117.5	88.3	-	-
	67	214.6	14.6	214.6	197.4	167.4	137.4	107.4	-	197.0	16.4	197.0	185.4	159.2	130.0	100.9	-
	62	211.2	14.5	211.2	211.2	205.6	175.6	145.5	115.5	193.8	16.4	193.8	193.8	188.7	159.6	130.4	101.2
	57	209.7	14.5	209.7	209.7	203.7	173.7	143.7	113.7	193.3	16.3	193.3	193.3	187.6	158.4	129.3	100.1
8750	72	237.1	14.7	199.1	167.3	135.5	103.7	-	-	216.2	16.5	188.4	157.3	126.2	95.0	-	-
	67	219.0	14.5	219.0	211.7	179.8	148.0	116.2	-	199.9	16.4	199.9	196.2	171.0	139.8	108.7	-
	62	215.5	14.5	215.5	215.5	215.5	183.7	151.8	120.0	196.7	16.3	196.7	196.7	196.7	165.6	134.4	103.3
	57	214.1	14.4	214.1	214.1	214.1	182.2	150.4	118.6	196.1	16.3	196.1	196.1	196.1	165.0	133.8	102.7

ZJ210 (17.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
4375	77	194.1	18.3	78.2	66.9	48.2	-	-	-	175.3	20.0	66.6	58.7	40.2	-	-	-
	72	180.7	18.3	116.0	97.4	78.8	60.2	-	-	163.4	20.1	107.4	88.9	70.4	51.9	-	-
	67	167.3	18.3	153.8	128.0	109.4	90.8	72.2	-	151.5	20.1	148.2	119.1	100.6	82.2	63.7	-
	62	164.7	18.2	164.7	156.7	129.6	111.0	92.4	73.8	149.3	20.0	149.3	141.2	114.3	95.8	77.3	58.9
5250	77	198.2	18.4	95.0	73.9	52.7	-	-	-	179.2	20.0	86.0	65.3	44.6	-	-	-
	72	184.5	18.3	128.4	107.3	86.2	65.0	-	-	167.1	20.1	119.4	98.6	77.9	57.2	-	-
	67	170.8	18.3	161.8	140.7	119.6	98.4	77.3	-	154.9	20.1	152.7	132.0	111.3	90.5	69.8	-
	62	168.2	18.2	168.2	162.8	141.7	120.6	99.4	78.3	152.6	20.1	152.6	147.2	126.5	105.8	85.1	64.4
	57	168.4	18.2	168.4	161.9	140.8	119.7	98.6	77.4	153.6	20.1	153.6	147.0	126.2	105.5	84.8	64.1
6125	77	202.3	18.4	111.8	80.9	57.2	-	-	-	183.2	20.1	105.4	71.9	49.0	-	-	-
	72	188.3	18.3	140.8	117.2	93.5	69.9	-	-	170.7	20.1	131.3	108.4	85.4	62.5	-	-
	67	174.3	18.3	169.8	153.4	129.8	106.1	82.5	-	158.3	20.2	157.2	144.8	121.9	98.9	76.0	-
	62	171.7	18.2	171.7	169.0	153.8	130.1	106.5	82.8	155.9	20.1	155.9	153.3	138.7	115.8	92.8	69.9
	57	171.9	18.2	171.9	168.6	152.8	129.2	105.5	81.9	156.9	20.1	156.9	153.6	138.4	115.5	92.5	69.6
7000	77	206.4	18.4	128.6	87.9	61.7	-	-	-	187.1	20.1	124.9	78.5	53.3	-	-	-
	72	192.1	18.4	153.2	127.0	100.9	74.7	-	-	174.4	20.1	143.3	118.1	92.9	67.7	-	-
	67	177.9	18.3	177.9	166.2	140.0	113.8	87.6	-	161.7	20.2	161.7	157.7	132.5	107.3	82.1	-
	62	175.1	18.3	175.1	175.1	165.8	139.7	113.5	87.3	159.3	20.1	159.3	159.3	150.9	125.8	100.6	75.4
	57	175.4	18.3	175.4	175.4	164.8	138.6	112.5	86.3	160.3	20.1	160.3	160.3	150.6	125.4	100.2	75.1
7875	72	193.7	18.3	165.5	137.1	108.8	80.5	-	-	174.3	20.1	155.1	127.7	100.2	72.7	-	-
	67	179.3	18.3	179.3	173.4	151.0	122.7	94.4	-	161.6	20.1	161.6	161.5	142.9	115.4	87.9	-
	62	176.5	18.2	176.5	176.5	171.9	143.6	115.3	86.9	159.2	20.0	159.2	159.2	155.1	127.6	100.1	72.7
	57	176.8	18.2	176.8	176.8	171.5	143.2	114.9	86.6	160.3	20.1	160.3	160.3	155.4	127.9	100.5	73.0
8750	72	195.2	18.2	177.7	147.3	116.8	86.4	-	-	174.3	20.0	167.0	137.2	107.5	77.7	-	-
	67	180.7	18.2	180.7	180.7	162.1	131.7	101.2	-	161.6	20.0	161.6	161.6	153.2	123.5	93.7	-
	62	178.0	18.1	178.0	178.0	178.0	147.5	117.0	86.6	159.2	20.0	159.2	159.2	159.2	129.4	99.6	69.9
	57	178.2	18.1	178.2	178.2	178.2	147.7	117.3	86.8	160.2	20.0	160.2	160.2	160.2	130.5	100.7	70.9

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ240 (20 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
5000	77	238.8	14.8	123.2	101.7	80.3	-	-	-	227.1	16.7	113.0	91.9	70.7	-	-	-
	72	247.3	14.4	166.1	144.6	123.2	101.7	-	-	235.2	16.4	155.7	134.6	113.4	92.3	-	-
	67	255.8	14.0	209.0	187.5	166.1	144.6	123.1	-	243.3	16.1	198.4	177.3	156.1	135.0	113.9	-
	62	247.0	13.8	247.0	235.5	206.5	185.1	163.6	142.1	226.8	15.9	226.8	221.1	192.5	171.4	150.3	129.1
6000	77	251.1	14.8	135.6	111.1	86.7	-	-	-	237.5	16.7	125.1	101.0	76.9	-	-	-
	72	260.0	14.5	181.8	157.4	132.9	108.4	-	-	246.0	16.5	171.6	147.4	123.3	99.2	-	-
	67	268.9	14.1	228.1	203.6	179.1	154.6	130.2	-	254.5	16.2	218.0	193.9	169.7	145.6	121.4	-
	62	259.6	13.9	259.6	251.9	222.8	198.3	173.9	149.4	237.2	15.9	237.2	233.4	209.3	185.1	161.0	136.8
	57	253.1	13.8	253.1	253.1	229.7	205.2	180.8	156.3	235.3	15.9	235.3	235.3	213.9	189.8	165.6	141.5
7000	77	263.3	14.9	148.0	120.6	93.1	-	-	-	247.9	16.8	137.3	110.2	83.0	-	-	-
	72	272.7	14.5	197.6	170.1	142.6	115.2	-	-	256.8	16.5	187.5	160.3	133.2	106.0	-	-
	67	282.0	14.2	247.1	219.7	192.2	164.7	137.3	-	265.7	16.2	237.6	210.4	183.3	156.2	129.0	-
	62	272.1	14.0	272.1	268.3	239.1	211.6	184.2	156.7	247.6	16.0	247.6	245.7	226.0	198.9	171.7	144.6
	57	265.4	13.8	265.4	265.4	246.5	219.0	191.6	164.1	245.7	16.0	245.7	245.7	231.0	203.9	176.7	149.6
8000	77	275.6	15.0	160.4	130.0	99.5	-	-	-	258.4	16.8	149.5	119.3	89.2	-	-	-
	72	285.4	14.6	213.3	182.8	152.4	121.9	-	-	267.6	16.6	203.3	173.2	143.0	112.9	-	-
	67	295.2	14.2	266.2	235.7	205.3	174.8	144.3	-	276.8	16.3	257.2	227.0	196.9	166.7	136.6	-
	62	284.7	14.0	284.7	284.7	255.4	224.9	194.5	164.0	258.1	16.0	258.1	258.1	242.8	212.6	182.4	152.3
	57	277.7	13.9	277.7	277.7	263.3	232.9	202.4	171.9	256.0	16.0	256.0	256.0	248.1	218.0	187.8	157.7
8700	72	294.0	14.6	223.0	190.9	158.8	126.7	-	-	275.6	16.6	212.6	180.8	149.0	117.3	-	-
	67	304.1	14.2	278.1	246.0	213.9	181.8	149.7	-	285.1	16.3	268.7	236.9	205.2	173.4	141.6	-
	62	293.4	14.0	293.4	293.4	268.4	236.3	204.2	172.1	265.8	16.1	265.8	265.8	253.0	221.2	189.4	157.6
	57	286.2	13.9	286.2	286.2	276.7	244.6	212.5	180.4	263.6	16.0	263.6	263.6	258.6	226.8	195.0	163.2
9400	72	302.7	14.6	232.7	199.0	165.2	131.5	-	-	283.6	16.6	221.9	188.5	155.1	121.6	-	-
	67	313.1	14.2	290.0	256.3	222.6	188.8	155.1	-	293.4	16.3	280.3	246.9	213.4	180.0	146.6	-
	62	302.0	14.0	302.0	302.0	281.3	247.6	213.9	180.2	273.5	16.1	273.5	273.5	263.2	229.8	196.3	162.9
	57	294.6	13.9	294.6	294.6	290.0	256.3	222.6	188.8	271.3	16.0	271.3	271.3	269.0	235.6	202.2	168.7
		95°F								105°F							
5000	77	215.3	18.6	102.7	82.0	61.2	-	-	-	201.4	20.9	94.7	76.5	55.7	-	-	-
	72	223.1	18.4	145.3	124.5	103.7	82.9	-	-	209.6	20.7	139.6	118.8	98.0	77.2	-	-
	67	230.8	18.2	187.8	167.0	146.2	125.4	104.7	-	217.7	20.6	184.6	161.1	140.3	119.5	98.7	-
	62	206.6	18.0	206.6	206.6	178.5	157.7	136.9	116.2	200.7	20.4	200.7	200.7	170.5	149.7	128.9	108.1
6000	77	223.9	18.6	114.7	90.9	67.1	-	-	-	207.9	21.0	108.4	84.6	60.9	-	-	-
	72	232.0	18.4	161.3	137.5	113.7	89.9	-	-	216.3	20.8	154.6	130.9	107.2	83.4	-	-
	67	240.0	18.2	207.9	184.1	160.3	136.5	112.7	-	224.7	20.6	200.9	177.2	153.4	129.7	106.0	-
	62	214.9	18.0	214.9	214.9	195.7	171.9	148.1	124.3	207.1	20.4	207.1	207.1	186.4	162.7	139.0	115.2
	57	217.5	18.1	217.5	217.5	198.1	174.3	150.5	126.7	207.3	20.4	207.3	207.3	186.7	163.0	139.2	115.5
7000	77	232.6	18.7	126.6	99.8	72.9	-	-	-	214.4	21.0	122.1	92.8	66.1	-	-	-
	72	240.9	18.5	177.3	150.5	123.7	96.9	-	-	223.1	20.9	169.6	143.0	116.3	89.7	-	-
	67	249.3	18.3	228.1	201.2	174.4	147.6	120.8	-	231.7	20.7	217.2	193.2	166.5	139.9	113.2	-
	62	223.2	18.0	223.2	223.2	212.9	186.1	159.3	132.4	213.5	20.5	213.5	213.5	202.4	175.7	149.0	122.4
	57	225.9	18.1	225.9	225.9	215.5	188.7	161.9	135.0	213.8	20.4	213.8	213.8	202.6	176.0	149.3	122.6
8000	77	241.2	18.7	138.5	108.7	78.8	-	-	-	220.9	21.1	135.8	100.9	71.3	-	-	-
	72	249.8	18.5	193.4	163.5	133.7	103.8	-	-	229.8	20.9	184.7	155.1	125.5	95.9	-	-
	67	258.5	18.3	248.2	218.3	188.5	158.7	128.8	-	238.7	20.7	233.5	209.2	179.6	150.0	120.4	-
	62	231.4	18.1	231.4	231.4	230.1	200.3	170.4	140.6	219.9	20.5	219.9	219.9	218.3	188.7	159.1	129.5
	57	234.2	18.1	234.2	234.2	232.9	203.1	173.2	143.4	220.2	20.5	220.2	220.2	218.6	189.0	159.4	129.8
8700	72	257.2	18.5	202.2	170.8	139.3	107.8	-	-	237.0	20.9	193.6	162.4	131.1	99.8	-	-
	67	266.1	18.3	259.4	227.9	196.4	164.9	133.5	-	246.2	20.7	242.8	219.0	187.7	156.4	125.2	-
	62	238.2	18.1	238.2	238.2	237.6	206.1	174.6	143.1	226.8	20.5	226.8	226.8	226.0	194.7	163.5	132.2
	57	241.1	18.1	241.1	241.1	240.4	209.0	177.5	146.0	227.1	20.5	227.1	227.1	226.3	195.0	163.8	132.5
9400	72	264.5	18.5	211.1	178.0	144.9	111.8	-	-	244.2	20.9	202.6	169.7	136.7	103.8	-	-
	67	273.7	18.3	270.5	237.4	204.3	171.2	138.1	-	253.7	20.7	252.1	228.7	195.8	162.8	129.9	-
	62	245.0	18.1	245.0	245.0	245.0	211.9	178.8	145.7	233.7	20.5	233.7	233.7	233.7	200.8	167.8	134.9
	57	248.0	18.1	248.0	248.0	248.0	214.9	181.8	148.7	234.0	20.5	234.0	234.0	234.0	201.1	168.2	135.2

ZJ240 (20 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
5000	77	187.6	23.2	86.6	71.0	50.2	-	-	-	173.7	25.6	75.9	65.6	44.8	-	-	-
	72	196.0	23.1	134.0	113.1	92.3	71.5	-	-	182.5	25.4	128.3	107.5	86.6	65.8	-	-
	67	204.5	22.9	181.3	155.2	134.4	113.6	92.8	-	191.4	25.3	178.1	149.3	128.5	107.7	86.9	-
	62	194.7	22.8	194.7	194.7	162.5	141.7	120.9	100.1	188.7	25.1	188.7	188.7	154.5	133.7	112.9	92.0
6000	77	191.9	23.3	102.1	78.4	54.8	-	-	-	175.9	25.7	95.8	72.2	48.6	-	-	-
	72	200.6	23.2	147.9	124.3	100.6	77.0	-	-	184.9	25.5	141.3	117.7	94.1	70.5	-	-
	67	209.3	23.0	193.8	170.2	146.5	122.9	99.2	-	193.9	25.4	186.8	163.2	139.6	116.1	92.5	-
	62	199.2	22.8	199.2	199.2	177.1	153.5	129.8	106.2	191.4	25.2	191.4	191.4	167.9	144.3	120.7	97.1
	57	197.1	22.7	197.1	197.1	175.3	151.6	128.0	104.3	187.0	25.0	187.0	187.0	163.9	140.3	116.7	93.1
7000	77	196.3	23.4	117.5	85.8	59.3	-	-	-	178.2	25.8	115.6	78.8	52.4	-	-	-
	72	205.2	23.2	161.9	135.5	109.0	82.5	-	-	187.3	25.6	154.3	127.9	101.6	75.3	-	-
	67	214.1	23.1	206.3	185.1	158.6	132.1	105.6	-	196.5	25.5	195.5	177.1	150.7	124.4	98.1	-
	62	203.8	22.9	203.8	203.8	191.8	165.3	138.8	112.3	194.1	25.3	194.1	194.1	181.2	154.9	128.5	102.2
	57	201.6	22.8	201.6	201.6	189.8	163.3	136.8	110.3	189.5	25.1	189.5	189.5	176.9	150.5	124.2	97.9
8000	77	200.7	23.5	133.0	93.1	63.8	-	-	-	180.4	25.9	135.4	85.4	56.3	-	-	-
	72	209.8	23.3	175.9	146.6	117.3	87.9	-	-	189.7	25.7	167.2	138.2	109.1	80.0	-	-
	67	218.9	23.2	218.9	200.1	170.7	141.4	112.1	-	199.0	25.6	199.0	190.9	161.9	132.8	103.7	-
	62	208.3	23.0	208.3	208.3	206.4	177.1	147.7	118.4	196.8	25.4	196.8	196.8	194.6	165.5	136.4	107.3
	57	206.1	22.9	206.1	206.1	204.2	174.9	145.6	116.2	192.1	25.2	192.1	192.1	189.9	160.8	131.7	102.6
8700	72	216.9	23.3	185.1	154.0	122.9	91.9	-	-	196.7	25.7	176.5	145.6	114.8	83.9	-	-
	67	226.3	23.2	226.3	210.1	179.0	147.9	116.9	-	206.4	25.6	206.4	201.1	170.3	139.4	108.6	-
	62	215.4	23.0	215.4	215.4	214.4	183.4	152.3	121.2	203.9	25.4	203.9	203.9	202.9	172.0	141.1	110.3
	57	213.1	22.9	213.1	213.1	212.2	181.1	150.0	119.0	199.1	25.2	199.1	199.1	198.0	167.2	136.3	105.5
9400	72	224.0	23.3	194.2	161.4	128.6	95.8	-	-	203.7	25.7	185.7	153.1	120.5	87.9	-	-
	67	233.7	23.2	233.7	220.0	187.3	154.5	121.7	-	213.7	25.6	213.7	211.3	178.7	146.1	113.5	-
	62	222.4	23.0	222.4	222.4	222.4	189.6	156.9	124.1	211.1	25.4	211.1	211.1	211.1	178.5	145.9	113.3
	57	220.1	22.8	220.1	220.1	220.1	187.3	154.5	121.8	206.2	25.2	206.2	206.2	206.2	173.5	140.9	108.3

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZJ300 (25 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
6250	77	389.1	20.4	142.8	116.5	90.2	-	-	-	365.0	22.0	147.7	121.4	95.1	-	-	-
	72	357.9	19.7	193.0	166.7	140.4	114.1	-	-	336.4	21.6	194.0	167.7	141.4	115.1	-	-
	67	326.6	18.9	243.2	216.9	190.6	164.3	138.0	-	307.7	21.1	240.3	214.0	187.8	161.5	135.2	-
	62	303.2	18.5	303.2	273.8	231.8	205.5	179.2	152.9	285.3	20.6	285.3	270.6	231.5	205.2	179.0	152.7
7500	77	399.6	20.6	160.8	131.0	101.1	-	-	-	374.4	22.3	163.0	133.5	104.1	-	-	-
	72	367.5	19.8	216.8	186.9	157.1	127.2	-	-	345.0	21.8	213.7	184.2	154.8	125.3	-	-
	67	335.4	19.0	272.7	242.9	213.0	183.2	153.3	-	315.6	21.3	264.4	234.9	205.5	176.0	146.6	-
	62	311.4	18.6	311.4	291.8	259.2	229.4	199.5	169.7	292.6	20.9	292.6	282.8	253.4	224.0	194.5	165.1
	57	315.1	18.5	315.1	294.6	263.1	233.2	203.4	173.5	296.1	20.7	296.1	285.8	256.4	226.9	197.5	168.0
8750	77	410.1	20.8	178.8	145.4	112.0	-	-	-	383.7	22.6	178.3	145.7	113.1	-	-	-
	72	377.2	20.0	240.6	207.2	173.7	140.3	-	-	353.6	22.1	233.4	200.7	168.1	135.5	-	-
	67	344.2	19.2	302.3	268.9	235.5	202.1	168.6	-	323.5	21.6	288.4	255.8	223.2	190.6	158.0	-
	62	319.6	18.7	319.6	309.8	286.6	253.2	219.8	186.4	300.0	21.1	300.0	295.1	275.3	242.7	210.1	177.5
	57	323.4	18.6	323.4	313.1	290.9	257.5	224.0	190.6	303.5	21.0	303.5	298.4	278.5	245.9	213.3	180.7
10000	77	420.6	20.9	196.9	159.9	122.9	-	-	-	393.1	22.8	193.6	157.8	122.0	-	-	-
	72	386.8	20.1	264.4	227.4	190.4	153.4	-	-	362.3	22.3	253.0	217.3	181.5	145.7	-	-
	67	353.0	19.3	331.8	294.9	257.9	220.9	183.9	-	331.4	21.8	312.5	276.7	241.0	205.2	169.4	-
	62	327.8	18.9	327.8	327.8	314.1	277.1	240.1	203.2	307.3	21.4	307.3	307.3	297.1	261.4	225.6	189.8
	57	331.7	18.8	331.7	331.7	318.7	281.7	244.7	207.8	310.9	21.2	310.9	310.9	300.6	264.9	229.1	193.3
11250	72	410.4	20.7	265.2	224.4	183.7	143.0	-	-	384.5	22.8	264.6	224.7	184.9	145.1	-	-
	67	374.5	19.8	330.8	290.1	249.4	208.7	168.0	-	351.8	22.3	325.2	285.3	245.5	205.6	165.8	-
	62	347.7	19.4	347.7	347.7	304.2	263.5	222.7	182.0	326.1	21.8	326.1	326.1	302.7	262.9	223.0	183.2
	57	351.8	19.3	351.8	351.8	308.2	267.5	226.8	186.1	330.0	21.7	330.0	330.0	306.3	266.4	226.6	186.7
12500	72	433.9	21.2	266.0	221.5	177.0	132.6	-	-	406.7	23.3	276.1	232.2	188.3	144.4	-	-
	67	396.0	20.4	329.8	285.4	240.9	196.5	152.0	-	372.1	22.8	337.8	293.9	250.0	206.1	162.2	-
	62	367.7	19.9	367.7	367.7	294.3	249.8	205.4	160.9	345.0	22.3	345.0	345.0	308.3	264.4	220.4	176.5
	57	372.0	19.8	372.0	372.0	297.8	253.3	208.9	164.4	349.0	22.2	349.0	349.0	311.9	268.0	224.1	180.1
		95°F								105°F							
6250	77	340.9	23.6	152.5	126.3	100.0	-	-	-	314.7	26.6	135.4	114.9	89.2	-	-	-
	72	314.9	23.5	195.0	168.7	142.4	116.2	-	-	292.2	26.3	183.4	157.6	131.8	106.1	-	-
	67	288.9	23.3	237.4	211.2	184.9	158.6	132.4	-	269.6	26.1	231.3	200.2	174.5	148.7	122.9	-
	62	267.4	22.8	267.4	267.4	231.3	205.0	178.7	152.5	254.2	25.5	254.2	250.8	211.9	186.2	160.4	134.6
7500	77	349.1	24.0	165.1	136.1	107.0	-	-	-	320.4	27.0	153.8	125.1	96.3	-	-	-
	72	322.5	23.8	210.6	181.5	152.5	123.5	-	-	297.4	26.8	200.0	171.2	142.5	113.8	-	-
	67	295.9	23.7	256.0	227.0	197.9	168.9	139.9	-	274.4	26.5	246.1	217.4	188.6	159.9	131.2	-
	62	273.9	23.1	273.9	273.9	247.6	218.6	189.5	160.5	258.7	25.9	258.7	256.4	229.1	200.3	171.6	142.9
	57	277.0	23.0	277.0	277.0	249.7	220.6	191.6	162.6	260.0	25.7	260.0	256.5	228.6	199.9	171.2	142.4
8750	77	357.4	24.4	177.7	145.9	114.1	-	-	-	326.0	27.5	172.3	135.2	103.5	-	-	-
	72	330.1	24.2	226.1	194.3	162.5	130.7	-	-	302.6	27.2	216.6	184.9	153.2	121.5	-	-
	67	302.9	24.0	274.6	242.8	211.0	179.2	147.4	-	279.2	27.0	260.9	234.5	202.8	171.1	139.4	-
	62	280.3	23.5	280.3	280.3	263.9	232.1	200.3	168.5	263.2	26.3	263.2	262.1	246.2	214.5	182.8	151.1
	57	283.6	23.3	283.6	283.6	266.1	234.3	202.5	170.7	264.5	26.2	264.5	262.8	245.7	214.0	182.3	150.6
10000	77	365.6	24.7	190.3	155.7	121.1	-	-	-	331.6	27.9	190.7	145.4	110.7	-	-	-
	72	337.7	24.6	241.7	207.1	172.6	138.0	-	-	307.8	27.6	233.2	198.5	163.8	129.2	-	-
	67	309.9	24.4	293.2	258.6	224.0	189.5	154.9	-	284.0	27.4	275.7	251.6	217.0	182.3	147.6	-
	62	286.8	23.9	286.8	286.8	280.2	245.6	211.1	176.5	267.7	26.7	267.7	267.7	263.3	228.7	194.0	159.3
	57	290.1	23.7	290.1	290.1	282.6	248.0	213.5	178.9	269.0	26.6	269.0	269.0	262.8	228.1	193.4	158.8
11250	72	358.6	25.0	264.0	225.0	186.1	147.1	-	-	328.4	28.1	250.8	211.8	172.7	133.7	-	-
	67	329.0	24.8	319.5	280.5	241.5	202.6	163.6	-	303.0	27.9	298.2	267.7	228.7	189.6	150.6	-
	62	304.5	24.3	304.5	304.5	301.2	262.3	223.3	184.3	285.7	27.2	285.7	285.7	277.3	238.3	199.3	160.2
	57	308.1	24.1	308.1	308.1	304.3	265.3	226.4	187.4	287.1	27.1	287.1	287.1	277.1	238.0	199.0	160.0
12500	72	379.5	25.5	286.3	242.9	199.5	156.2	-	-	349.0	28.6	268.4	225.0	181.7	138.3	-	-
	67	348.2	25.3	345.8	302.4	259.0	215.7	172.3	-	322.0	28.3	320.8	283.7	240.4	197.0	153.6	-
	62	322.3	24.7	322.3	322.3	322.3	278.9	235.5	192.2	303.6	27.7	303.6	303.6	291.3	247.9	204.6	161.2
	57	326.0	24.6	326.0	326.0	326.0	282.6	239.3	195.9	305.1	27.5	305.1	305.1	291.3	248.0	204.6	161.2

ZJ300 (25 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
6250	77	288.6	29.5	118.2	103.6	78.4	-	-	-	262.4	32.4	96.9	89.6	67.5	-	-	-
	72	269.4	29.2	171.7	146.5	121.2	95.9	-	-	246.7	32.0	160.1	135.3	110.6	85.8	-	-
	67	250.3	28.9	225.2	189.3	164.0	138.8	113.5	-	231.0	31.7	220.7	178.4	153.6	128.9	104.1	-
	62	241.1	28.1	241.1	234.1	192.6	167.3	142.1	116.8	227.9	30.8	227.9	217.5	173.3	148.5	123.8	99.0
7500	77	291.6	30.0	142.5	114.1	85.7	-	-	-	262.8	33.0	131.2	103.1	75.0	-	-	-
	72	272.3	29.7	189.4	160.9	132.5	104.1	-	-	247.1	32.6	178.8	150.6	122.5	94.4	-	-
	67	252.9	29.4	236.2	207.8	179.3	150.9	122.5	-	231.4	32.2	226.3	198.1	170.0	141.9	113.7	-
	62	243.6	28.6	243.6	239.0	210.5	182.1	153.7	125.2	228.5	31.4	228.5	221.5	192.0	163.9	135.8	107.6
	57	242.9	28.5	242.9	236.0	207.6	179.2	150.7	122.3	225.8	31.3	225.8	215.5	186.5	158.4	130.3	102.1
8750	77	294.6	30.5	166.8	124.6	93.0	-	-	-	263.2	33.6	165.5	116.6	82.4	-	-	-
	72	275.1	30.2	207.0	175.4	143.8	112.2	-	-	247.6	33.2	197.4	165.9	134.4	102.9	-	-
	67	255.5	29.9	247.2	226.2	194.6	163.0	131.4	-	231.9	32.8	231.9	217.9	186.4	154.9	123.4	-
	62	246.1	29.1	246.1	243.8	228.5	196.9	165.3	133.7	229.0	32.0	229.0	225.6	210.8	179.3	147.8	116.2
	57	245.4	29.0	245.4	242.0	225.3	193.7	162.1	130.5	226.3	31.8	226.3	221.2	204.9	173.3	141.8	110.3
10000	77	297.6	31.1	191.1	135.0	100.3	-	-	-	263.7	34.2	199.9	130.1	89.8	-	-	-
	72	277.9	30.7	224.6	189.9	155.1	120.3	-	-	248.0	33.8	216.1	181.2	146.3	111.4	-	-
	67	258.2	30.4	258.2	244.7	209.9	175.1	140.3	-	232.3	33.4	232.3	232.3	202.8	167.9	133.0	-
	62	248.7	29.6	248.7	248.7	246.4	211.7	176.9	142.1	229.6	32.5	229.6	229.6	229.5	194.7	159.8	124.9
	57	247.9	29.5	247.9	247.9	243.0	208.2	173.4	138.6	226.8	32.4	226.8	226.8	223.2	188.3	153.4	118.5
11250	72	298.2	31.2	237.6	198.5	159.4	120.4	-	-	268.0	34.4	224.4	185.2	146.1	107.0	-	-
	67	277.0	30.9	277.0	254.9	215.8	176.7	137.7	-	251.0	34.0	251.0	242.1	202.9	163.8	124.7	-
	62	266.8	30.1	266.8	266.8	253.4	214.3	175.2	136.1	248.0	33.0	248.0	248.0	229.4	190.3	151.2	112.1
	57	266.1	30.0	266.1	266.1	249.8	210.7	171.7	132.6	245.0	32.9	245.0	245.0	222.6	183.4	144.3	105.2
12500	72	318.5	31.8	250.5	207.2	163.8	120.4	-	-	288.0	34.9	232.6	189.3	145.9	102.6	-	-
	67	295.9	31.4	295.9	265.1	221.7	178.3	135.0	-	269.8	34.5	269.8	246.4	203.0	159.7	116.3	-
	62	285.0	30.6	285.0	285.0	260.3	216.9	173.6	130.2	266.4	33.6	266.4	266.4	229.3	186.0	142.6	99.2
	57	284.2	30.5	284.2	284.2	256.6	213.3	169.9	126.6	263.3	33.4	263.3	263.3	222.0	178.6	135.3	91.9

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR180-300 Cooling and Reheat Capacities

ZR180 (15 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
				Sensible Capacity (MBh)								Sensible Capacity (MBh)					
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
	77	243.6	12.1	109.3	87.9	66.5	-	-	-	234.2	13.1	110.4	89.0	67.6	-	-	-
	72	224.6	11.7	138.8	117.5	96.1	74.7	-	-	216.5	12.8	140.8	119.4	98.0	76.6	-	-
4500	67	205.7	11.2	168.4	147.0	125.6	104.2	82.8	-	198.8	12.5	171.2	149.8	128.4	107.0	85.6	-
	62	189.9	11.1	189.9	180.0	154.9	133.5	112.1	90.7	183.9	12.3	183.9	178.9	157.6	136.2	114.8	93.4
	57	187.0	10.9	187.0	187.0	161.2	139.8	118.4	97.0	181.3	12.2	181.3	181.3	163.1	141.7	120.4	99.0
	77	254.7	12.1	124.4	99.9	74.6	-	-	-	242.3	13.2	123.8	98.5	73.2	-	-	-
	72	235.0	11.7	158.3	133.0	107.8	82.5	-	-	224.0	12.8	156.7	131.4	106.2	80.9	-	-
5250	67	215.2	11.3	192.2	166.2	140.9	115.6	90.4	-	205.6	12.5	189.6	164.4	139.1	113.8	88.6	-
	62	198.7	11.1	198.7	193.7	173.7	148.4	123.1	97.9	190.3	12.3	190.3	187.8	170.7	145.4	120.2	94.9
	57	195.6	11.0	195.6	195.6	180.7	155.4	130.2	104.9	187.6	12.3	187.6	187.6	176.7	151.5	126.2	100.9
	77	265.9	12.2	139.6	111.8	82.7	-	-	-	250.4	13.2	137.2	108.0	78.9	-	-	-
	72	245.3	11.7	177.8	148.6	119.4	90.3	-	-	231.4	12.9	172.6	143.5	114.3	85.2	-	-
6000	67	224.7	11.3	216.0	185.4	156.2	127.0	97.9	-	212.5	12.6	208.1	179.0	149.8	120.6	91.5	-
	62	207.4	11.1	207.4	207.4	192.5	163.3	134.2	105.0	196.6	12.4	196.6	196.6	183.8	154.7	125.5	96.4
	57	204.2	11.0	204.2	204.2	200.2	171.0	141.9	112.7	193.8	12.3	193.8	193.8	190.3	161.2	132.0	102.8
	72	249.5	11.8	191.8	158.6	125.4	92.2	-	-	234.5	13.0	187.4	154.2	121.0	87.8	-	-
6750	67	228.5	11.4	224.1	197.1	163.9	130.7	97.5	-	215.3	12.6	213.2	191.8	158.6	125.4	92.2	-
	62	211.0	11.2	211.0	211.0	203.5	170.3	137.1	103.9	199.3	12.5	199.3	199.3	192.9	159.7	126.4	93.2
	57	207.7	11.1	207.7	207.7	205.7	172.5	139.3	106.1	196.4	12.4	196.4	196.4	194.7	161.5	128.3	95.0
	72	253.7	11.9	205.8	168.5	131.3	94.0	-	-	237.6	13.0	202.2	165.0	127.7	90.5	-	-
7500	67	232.3	11.5	232.3	208.9	171.7	134.4	97.2	-	218.2	12.7	218.2	204.6	167.3	130.1	92.8	-
	62	214.5	11.3	214.5	214.5	214.5	177.3	140.0	102.7	201.9	12.5	201.9	201.9	201.9	164.6	127.4	90.1
	57	211.2	11.2	211.2	211.2	211.2	174.0	136.7	99.4	199.0	12.4	199.0	199.0	199.0	161.8	124.5	87.2
		95°F								105°F							
	77	224.8	14.1	111.4	90.0	68.6	-	-	-	208.7	15.6	103.5	82.1	60.7	-	-	-
	72	208.3	13.9	142.7	121.3	99.9	78.5	-	-	192.4	15.5	133.9	112.5	91.1	69.7	-	-
4500	67	191.8	13.7	173.9	152.6	131.2	109.8	88.4	-	176.0	15.3	164.2	142.8	121.4	100.0	78.7	-
	62	177.9	13.5	177.9	177.9	160.3	138.9	117.5	96.1	163.9	15.1	163.9	163.9	149.1	127.8	106.4	85.0
	57	175.6	13.5	175.6	175.6	165.1	143.7	122.3	100.9	163.3	15.1	163.3	163.3	149.3	127.9	106.5	85.2
	77	229.8	14.2	123.1	97.1	71.8	-	-	-	214.4	15.7	120.4	90.0	64.7	-	-	-
	72	212.9	14.0	155.1	129.8	104.6	79.3	-	-	197.6	15.5	147.7	122.4	97.1	71.9	-	-
5250	67	196.0	13.8	187.1	162.6	137.3	112.0	86.7	-	180.8	15.4	174.9	154.8	129.5	104.3	79.0	-
	62	181.8	13.6	181.8	181.8	167.7	142.5	117.2	91.9	168.4	15.2	168.4	168.4	159.1	133.8	108.6	83.3
	57	179.5	13.6	179.5	179.5	172.8	147.5	122.2	96.9	167.8	15.2	167.8	167.8	159.2	133.9	108.6	83.4
	77	234.8	14.3	134.8	104.2	75.0	-	-	-	220.2	15.7	137.3	97.9	68.7	-	-	-
	72	217.5	14.1	167.5	138.4	109.2	80.0	-	-	202.9	15.6	161.5	132.3	103.2	74.0	-	-
6000	67	200.3	13.8	200.3	172.6	143.4	114.2	85.1	-	185.7	15.4	185.7	166.8	137.6	108.5	79.3	-
	62	185.8	13.6	185.8	185.8	175.2	146.0	116.9	87.7	172.9	15.2	172.9	172.9	169.1	139.9	110.8	81.6
	57	183.4	13.6	183.4	183.4	180.5	151.3	122.1	93.0	172.3	15.2	172.3	172.3	169.1	139.9	110.8	81.6
	72	219.6	14.1	183.1	149.9	116.7	83.5	-	-	204.8	15.6	176.9	143.7	110.5	77.2	-	-
6750	67	202.2	13.9	202.2	186.4	153.2	120.0	86.8	-	187.4	15.4	187.4	177.0	147.4	114.1	80.9	-
	62	187.5	13.7	187.5	187.5	182.2	149.0	115.8	82.6	174.5	15.2	174.5	174.5	172.6	139.4	106.2	73.0
	57	185.1	13.7	185.1	185.1	183.6	150.4	117.2	84.0	173.9	15.2	173.9	173.9	172.3	139.1	105.8	72.6
	72	221.6	14.1	198.7	161.4	124.1	86.9	-	-	206.6	15.6	192.3	155.0	117.7	80.5	-	-
7500	67	204.0	13.9	204.0	200.3	163.0	125.8	88.5	-	189.1	15.4	189.1	187.2	157.1	119.8	82.5	-
	62	189.3	13.7	189.3	189.3	189.3	152.0	114.7	77.5	176.1	15.2	176.1	176.1	176.1	138.8	101.6	64.3
	57	186.8	13.7	186.8	186.8	186.8	149.6	112.3	75.0	175.5	15.3	175.5	175.5	175.5	138.2	100.9	63.7

ZR180 (15 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
4500	77	192.6	17.1	95.7	74.3	52.9	-	-	-	176.4	18.6	87.8	66.4	45.0	-	-	-
	72	176.4	17.0	125.1	103.7	82.3	60.9	-	-	160.4	18.5	116.2	94.9	73.5	52.1	-	-
	67	160.2	16.9	154.5	133.1	111.7	90.3	68.9	-	144.5	18.5	144.5	123.3	101.9	80.6	59.2	-
	62	150.0	16.7	150.0	150.0	138.0	116.6	95.2	73.9	136.0	18.3	136.0	136.0	126.9	105.5	84.1	62.7
	57	151.0	16.7	151.0	151.0	133.5	112.2	90.8	69.4	138.8	18.3	138.8	138.8	117.8	96.4	75.0	53.6
5250	77	199.0	17.2	117.8	82.9	57.7	-	-	-	183.7	18.6	115.1	75.9	50.6	-	-	-
	72	182.3	17.0	140.3	115.0	89.7	64.5	-	-	167.1	18.6	132.9	107.6	82.3	57.0	-	-
	67	165.6	16.9	162.8	147.1	121.8	96.5	71.2	-	150.4	18.5	150.4	139.3	114.0	88.8	63.5	-
	62	155.0	16.7	155.0	155.0	150.5	125.2	99.9	74.7	141.6	18.3	141.6	141.6	141.6	116.6	91.3	66.1
	57	156.1	16.8	156.1	156.1	145.6	120.3	95.1	69.8	144.5	18.4	144.5	144.5	132.0	106.8	81.5	56.2
6000	77	205.5	17.2	139.9	91.6	62.4	-	-	-	190.9	18.7	142.5	85.3	56.2	-	-	-
	72	188.3	17.1	155.5	126.3	97.2	68.0	-	-	173.7	18.6	149.5	120.3	91.1	62.0	-	-
	67	171.0	17.0	171.0	161.0	131.9	102.7	73.6	-	156.4	18.5	156.4	155.3	126.1	97.0	67.8	-
	62	160.1	16.8	160.1	160.1	163.0	133.8	104.6	75.5	147.2	18.3	147.2	147.2	147.2	127.7	98.5	69.4
	57	161.2	16.8	161.2	161.2	157.7	128.5	99.4	70.2	150.2	18.4	150.2	150.2	146.3	117.1	88.0	58.8
6750	72	190.0	17.1	170.7	137.5	104.2	71.0	-	-	175.2	18.6	164.4	131.2	98.0	64.8	-	-
	67	172.6	17.0	172.6	167.6	141.5	108.3	75.1	-	157.8	18.5	157.8	157.8	135.6	102.4	69.2	-
	62	161.5	16.8	161.5	161.5	162.9	129.7	96.5	63.3	148.5	18.3	148.5	148.5	148.5	120.1	86.9	53.7
	57	162.7	16.8	162.7	162.7	160.9	127.7	94.5	61.3	151.4	18.4	151.4	151.4	149.5	116.3	83.1	49.9
7500	72	191.6	17.1	185.8	148.6	111.3	74.1	-	-	176.7	18.6	176.7	142.2	104.9	67.7	-	-
	67	174.1	17.0	174.1	174.1	151.1	113.8	76.6	-	159.1	18.5	159.1	159.1	145.1	107.9	70.6	-
	62	162.9	16.8	162.9	162.9	162.9	125.7	88.4	51.1	149.8	18.3	149.8	149.8	149.8	112.5	75.2	38.0
	57	164.1	16.8	164.1	164.1	164.1	126.8	89.6	52.3	152.7	18.4	152.7	152.7	152.7	115.5	78.2	41.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR180 (15 Ton) Alternate Reheat Mode

Air on Evaporator Coil		Temperature of Air on Condenser Coil														
CFM	WB (°F)	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65	Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F) 85	80	75	70	65
		35°F							45°F						
4500	72	134.0	9.8						125.8	10.4					
	67	120.5	9.0	50.1	28.8	7.4			113.0	9.7	46.0	24.6	3.2		
	62	104.5	8.1	87.0	85.0	64.0	60.0		98.6	8.9	95.0	75.0	53.0	45.0	
	57	100.8	8.0	100.8	85.0	76.0	35.0	10.0	95.7	8.8	95.7	80.0	75.0	30.0	5.0
5250	72	138.8	9.8						130.4	10.4					
	67	124.8	9.0	55.0	5.2				117.2	9.7	31.2	5.9			
	62	108.2	8.1	95.0	90.0	65.0	50.0		102.2	8.9	100.0	80.0	55.0	38.0	
	57	104.3	8.0	104.3	100.0	90.0	46.0	15.0	99.1	8.8	99.1	93.0	80.0	40.0	12.0
6000	72	143.6	9.7	24.7					135.1	10.4					
	67	129.0	9.0	45.0					121.4	9.7	48.5				
	62	111.8	8.1	98.0	95.0	70.0	45.0		105.8	8.9	105.0	85.0	60.0	35.0	
	57	107.8	8.0	107.8	105.0	126.7	69.9	23.0	102.6	8.8	102.6	102.0	110.4	60.5	19.2
6750	72	150.2	10.0						140.9	10.6					
	67	135.0	9.2	51.8	18.6				126.6	9.8	52.1	18.9			
	62	117.2	8.3	108.0	102.8	69.6	36.4		110.5	9.0	110.5	97.3	64.1	30.9	
	57	113.1	8.2	113.1	110.0	106.8	56.8	25.0	107.2	8.9	107.2	105.0	94.6	48.9	20.0
7500	72	156.9	10.2						146.7	10.8					
	67	141.0	9.4	92.8	55.6	18.3			131.8	10.0	87.8	50.6	13.3		
	62	122.5	8.5	112.9	110.0	85.0	65.0		115.1	9.2	107.4	130.0	75.0	50.0	
	57	118.3	8.4	118.3	118.3	81.1	78.0	45.0	111.8	9.1	111.8	111.8	74.5	25.8	35.0
		55°F							65°F						
4500	72	117.5	11.1						109.2	11.8					
	67	105.6	10.4	41.9	20.5				98.2	11.1	37.7	16.4			
	62	92.7	9.7	85.0	65.0	42.0	30.0		86.7	10.4	75.0	55.0	31.0	15.0	
	57	90.5	9.6	90.5	75.0	65.0	25.0		85.4	10.3	85.4	70.0	55.0	20.0	
5250	72	122.0	11.1						113.6	11.8					
	67	109.7	10.4	31.8	6.6				102.2	11.1	32.5	7.2			
	62	96.2	9.7	90.0	70.0	45.0	26.0		90.3	10.4	80.0	60.0	35.0	14.0	
	57	94.0	9.5	94.0	86.0	70.0	34.0	10.0	88.8	10.3	88.8	79.0	60.0	28.0	
6000	72	126.6	11.1	15.2					118.0	11.8	10.5				
	67	113.8	10.4	21.8					106.2	11.1	27.3	15.0			
	62	99.8	9.6	95.0	75.0	50.0	25.0		93.8	10.4	85.0	65.0	40.0	15.0	
	57	97.4	9.5	97.4	94.0	92.0	51.0	15.0	92.3	10.3	92.3	86.0	77.7	41.6	
6750	72	131.5	11.2						122.1	11.8					
	67	118.2	10.5	52.3	19.1				109.8	11.2	52.5	19.3			
	62	103.7	9.8	103.7	91.8	58.6	25.4		97.0	10.5	97.0	86.4	53.1	19.9	
	57	101.4	9.7	101.4	98.0	60.0	30.0	25.0	95.5	10.4	89.3	87.0	70.3	32.9	
7500	72	136.4	11.4						126.2	11.9					
	67	122.7	10.6	82.8	45.6	8.3			113.5	11.3	77.8	40.6	3.3		
	62	107.7	9.9	102.0	100.0	65.0	35.0		100.3	10.6	96.5	95.0	55.0	20.0	
	57	105.3	9.8	105.3	105.3	74.0	40.0	30.0	98.7	10.5	98.7	98.7	61.5	45.0	

ZR180 (15 Ton) Alternate Reheat Mode (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)				
				Return Dry Bulb (°F)							Return Dry Bulb (°F)				
CFM	WB (°F)			85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
4500	72	100.9	12.5						92.6	13.1					
	67	90.8	11.8	33.6	12.2				83.3	12.5	29.5	8.1			
	62	80.8	11.2	65.0	45.0	20.0			74.9	12.0	55.0	35.0	9.0		
	57	80.2	11.1	80.2	65.0	45.0	15.0		75.1	11.9	70.0	60.0	35.0	10.0	
5250	72	105.2	12.5						96.8	13.1					
	67	94.6	11.8	33.2	7.9				87.1	12.5	33.9	8.6			
	62	84.3	11.2	70.0	50.0	25.0	2.0		78.3	12.0	60.0	40.0	15.0		
	57	83.6	11.1	83.6	72.0	50.0	22.0		78.5	11.9	78.5	65.0	40.0	16.0	
6000	72	109.5	12.4	5.7					101.0	13.1	1.0				
	67	98.5	11.8	32.8	3.6				90.9	12.5	38.3	9.1			
	62	87.8	11.2	75.0	55.0	30.0	5.0		81.7	12.0	65.0	45.0	20.0		
	57	87.1	11.1	87.1	78.0	61.3	32.2		81.9	11.9	81.9	70.0	45.0	22.8	
6750	72	112.7	12.5						103.3	13.1					
	67	101.4	11.8	52.8	19.6				93.0	12.5	53.0	19.8			
	62	90.3	11.2	90.3	80.9	47.7	14.4		83.6	12.0	83.6	75.4	42.2	9.0	
	57	89.6	11.1	89.6	87.0	58.2	24.9		83.8	11.9	90.0	83.4	46.0	17.0	
7500	72	115.9	12.5						105.7	13.1					
	67	104.3	11.9	72.8	35.5				95.1	12.5	67.8	30.5			
	62	92.9	11.3	91.0	85.0	45.0	5.0		85.5	12.0	85.5	70.0	35.0		
	57	92.2	11.2	92.2	92.2	55.0	17.7		85.7	11.9	85.7	85.7	48.4	15.0	

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

No Sensible Cooling Capacity

ZR240 (20 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
6000	77	321.3	15.4	155.2	126.7	98.2	-	-	-	306.0	16.6	147.9	119.4	90.9	-	-	-
	72	295.4	14.9	191.2	162.7	134.2	105.7	-	-	281.6	16.3	185.5	157.0	128.5	100.0	-	-
	67	269.5	14.5	227.2	198.7	170.2	141.7	113.2	-	257.2	16.0	223.2	194.7	166.2	137.6	109.1	-
	62	244.8	14.4	244.8	240.1	211.6	183.1	154.6	126.1	236.6	15.8	236.6	233.5	205.0	176.5	148.0	119.5
	57	242.1	14.2	242.1	242.1	216.7	188.1	159.6	131.1	232.5	15.7	232.5	232.5	207.6	179.1	150.5	122.0
7000	77	334.5	15.4	169.8	140.9	107.2	-	-	-	316.5	16.7	166.4	132.7	99.0	-	-	-
	72	307.6	15.0	213.9	180.2	146.5	112.8	-	-	291.3	16.4	207.3	173.7	140.0	106.3	-	-
	67	280.6	14.6	258.0	219.5	185.8	152.1	118.4	-	266.0	16.1	248.3	214.6	180.9	147.2	113.5	-
	62	254.9	14.4	254.9	252.6	231.0	197.3	163.6	129.9	244.7	15.9	244.7	243.2	223.3	189.6	155.9	122.2
	57	252.1	14.3	252.1	252.1	236.5	202.8	169.2	135.5	240.5	15.7	240.5	240.5	226.0	192.3	158.6	124.9
8000	77	347.7	15.4	184.3	155.1	116.2	-	-	-	327.1	16.7	184.8	145.9	107.1	-	-	-
	72	319.7	15.0	236.6	197.7	158.8	120.0	-	-	301.0	16.4	229.1	190.3	151.4	112.5	-	-
	67	291.7	14.6	288.9	240.4	201.5	162.6	123.7	-	274.9	16.1	273.5	234.6	195.7	156.8	118.0	-
	62	265.0	14.4	265.0	265.0	250.5	211.6	172.7	133.8	252.9	15.9	252.9	252.9	241.5	202.6	163.7	124.9
	57	262.0	14.3	262.0	262.0	256.4	217.5	178.7	139.8	248.5	15.8	248.5	248.5	244.5	205.6	166.7	127.9
9000	72	325.0	15.1	250.5	206.2	161.9	117.6	-	-	305.0	16.5	243.3	199.0	154.7	110.5	-	-
	67	296.5	14.7	295.1	249.6	205.4	161.1	116.8	-	278.6	16.2	277.9	244.3	200.1	155.8	111.5	-
	62	269.5	14.5	269.5	269.5	255.3	211.0	166.7	122.5	256.3	16.0	256.3	256.3	246.8	202.6	158.3	114.0
	57	266.4	14.4	266.4	266.4	263.6	219.3	175.0	130.8	251.8	15.8	251.8	251.8	249.8	205.6	161.3	117.0
10000	72	330.3	15.1	264.3	214.7	165.0	115.3	-	-	309.1	16.5	257.5	207.8	158.1	-	-	-
	67	301.4	14.7	301.4	258.9	209.2	159.5	109.9	-	282.3	16.2	282.3	254.1	204.4	154.7	105.0	-
	62	273.9	14.6	273.9	273.9	260.1	210.4	160.8	111.1	259.7	16.0	259.7	259.7	252.2	202.5	152.8	103.2
	57	270.8	14.4	270.8	270.8	270.8	221.1	171.4	121.7	255.2	15.9	255.2	255.2	255.2	205.5	155.8	106.1
		95°F								105°F							
6000	77	290.7	17.9	140.6	112.1	83.6	-	-	-	269.2	19.8	129.8	101.2	72.7	-	-	-
	72	267.8	17.7	179.9	151.4	122.8	94.3	-	-	247.9	19.6	170.7	142.2	113.7	85.2	-	-
	67	244.9	17.5	219.1	190.6	162.1	133.6	105.1	-	226.7	19.4	211.7	183.2	154.7	126.1	97.6	-
	62	228.4	17.3	228.4	226.9	198.4	169.9	141.4	112.9	210.6	19.2	210.6	209.9	182.3	153.8	125.3	96.7
	57	222.9	17.2	222.9	222.9	198.5	170.0	141.5	112.9	209.2	19.1	209.2	203.5	177.1	148.6	120.1	91.5
7000	77	298.5	18.0	163.0	124.4	90.8	-	-	-	276.9	19.8	157.7	113.2	79.5	-	-	-
	72	275.0	17.8	200.8	167.1	133.4	99.7	-	-	255.0	19.6	191.7	158.0	124.3	90.6	-	-
	67	251.5	17.6	238.6	209.7	176.0	142.3	108.6	-	233.1	19.5	225.6	202.8	169.1	135.4	101.7	-
	62	234.5	17.4	234.5	233.8	215.5	181.8	148.1	114.4	216.6	19.2	216.6	216.3	199.2	165.5	131.8	98.1
	57	228.9	17.2	228.9	228.9	215.5	181.8	148.1	114.4	215.2	19.2	215.2	212.3	193.5	159.8	126.1	92.4
8000	77	306.4	18.0	185.3	136.8	97.9	59.0	-	-	284.5	19.8	185.7	125.1	86.2	47.3	-	-
	72	282.2	17.9	221.7	182.8	143.9	105.1	-	-	262.0	19.7	212.6	173.7	134.8	96.0	-	-
	67	258.1	17.7	258.1	228.8	190.0	151.1	112.2	-	239.6	19.5	239.6	222.4	183.5	144.6	105.7	-
	62	240.7	17.4	240.7	240.7	232.5	193.6	154.8	115.9	222.6	19.2	222.6	222.6	216.2	177.3	138.4	99.5
	57	234.9	17.3	234.9	234.9	232.6	193.7	154.8	115.9	221.1	19.2	221.1	221.1	209.9	171.0	132.1	93.3
9000	72	285.1	17.9	236.1	191.9	147.6	103.3	-	-	264.7	19.7	226.7	182.5	138.2	93.9	-	-
	67	260.7	17.7	260.7	239.0	194.8	150.5	106.2	-	242.0	19.5	242.0	229.9	188.0	143.7	99.5	-
	62	243.1	17.4	243.1	243.1	238.4	194.1	149.8	105.6	224.8	19.2	224.8	224.8	221.3	177.0	132.7	88.5
	57	237.3	17.3	237.3	237.3	236.1	191.8	147.5	103.3	223.4	19.2	223.4	223.4	213.9	169.6	125.4	81.1
10000	72	287.9	17.9	250.6	200.9	151.2	101.5	-	-	267.3	19.7	240.9	191.2	141.5	91.8	-	-
	67	263.3	17.7	263.3	249.2	199.6	149.9	100.2	-	244.4	19.5	244.4	237.3	192.5	142.9	93.2	-
	62	245.5	17.4	245.5	245.5	244.3	194.6	144.9	95.2	227.1	19.2	227.1	227.1	226.4	176.8	127.1	77.4
	57	239.6	17.3	239.6	239.6	239.6	189.9	140.3	90.6	225.6	19.2	225.6	225.6	217.9	168.2	118.6	68.9

ZR240 (20 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
				Return Dry Bulb (°F)								Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
6000	77	247.7	21.6	118.9	90.4	61.9	-	-	-	226.2	23.5	108.1	79.6	51.1	-	-	-
	72	228.1	21.5	161.6	133.1	104.5	76.0	-	-	208.3	23.3	152.4	123.9	95.4	66.9	-	-
	67	208.5	21.3	204.2	175.7	147.2	118.7	90.2	-	190.3	23.2	190.3	168.2	139.7	111.2	82.7	-
	62	192.9	21.0	192.9	192.9	166.1	137.6	109.1	80.6	175.2	22.9	175.2	175.2	150.0	121.5	93.0	64.4
	57	195.6	21.1	195.6	184.2	155.7	127.2	98.6	70.1	181.9	23.1	181.9	164.8	134.3	105.8	77.2	48.7
7000	77	255.2	21.6	152.5	101.9	68.2	-	-	-	233.5	23.5	147.2	90.6	56.9	-	-	-
	72	235.0	21.5	182.5	148.8	115.1	81.4	-	-	214.9	23.3	173.4	139.7	106.0	72.3	-	-
	67	214.8	21.3	212.6	195.8	162.1	128.4	94.7	-	196.4	23.2	196.4	188.8	155.2	121.5	87.8	-
	62	198.7	21.0	198.7	198.7	183.0	149.3	115.6	81.9	180.8	22.9	180.8	180.8	166.7	133.0	99.3	65.6
	57	201.5	21.1	201.5	195.8	171.5	137.8	104.1	70.4	187.7	23.1	187.7	179.2	149.4	115.7	82.0	48.3
8000	77	262.6	21.6	186.0	113.3	74.5	-	-	-	240.7	23.5	186.3	101.6	62.7	-	-	-
	72	241.8	21.5	203.5	164.6	125.7	86.9	-	-	221.6	23.3	194.4	155.5	116.6	77.8	-	-
	67	221.0	21.3	221.0	215.9	177.0	138.2	99.3	-	202.5	23.2	202.5	202.5	170.6	131.7	92.8	-
	62	204.5	21.0	204.5	204.5	199.8	160.9	122.1	83.2	186.4	22.8	186.4	186.4	183.5	144.6	105.7	66.8
	57	207.3	21.2	207.3	207.3	187.2	148.4	109.5	70.6	193.6	23.1	193.6	193.6	164.6	125.7	86.8	47.9
9000	72	244.2	21.5	217.3	173.0	128.8	84.5	-	-	223.8	23.3	207.9	163.6	119.4	75.1	-	-
	67	223.2	21.3	223.2	220.7	181.3	137.0	92.7	-	204.5	23.2	204.5	204.5	174.6	130.3	86.0	-
	62	206.6	21.1	206.6	206.6	204.2	159.9	115.7	71.4	188.3	22.9	188.3	188.3	187.1	142.8	98.6	54.3
	57	209.4	21.2	209.4	209.4	191.7	147.4	103.2	58.9	195.5	23.1	195.5	195.5	169.5	125.3	81.0	36.7
10000	72	246.7	21.5	231.1	181.5	131.8	82.1	-	-	226.0	23.3	221.4	171.7	122.1	72.4	-	-
	67	225.4	21.3	225.4	225.4	185.5	135.9	86.2	-	206.5	23.2	206.5	206.5	178.5	128.8	79.2	-
	62	208.6	21.1	208.6	208.6	208.6	158.9	109.3	59.6	190.2	22.9	190.2	190.2	190.2	141.1	91.4	41.7
	57	211.5	21.2	211.5	211.5	196.2	146.5	96.9	47.2	197.4	23.1	197.4	197.4	174.5	124.8	75.2	25.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR240 (20 Ton) Alternate Reheat Mode

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)				
CFM	WB (°F)			Return Dry Bulb (°F)							Return Dry Bulb (°F)				
				85	80	75	70	65			85	80	75	70	65
		35°F							45°F						
6000	72	115.8	9.8						119.0	11.3	1.1				
	67	102.1	9.0	60.3	31.8	3.3			105.6	10.5	55.9	27.4			
	62	119.8	8.5	98.0	97.6	69.1	40.6	12.0	117.3	9.9	95.0	84.6	56.1	27.6	
	57	105.3	8.5	105.3	100.0	90.2	61.7	33.2	104.4	11.3	104.4	102.5	74.0	45.5	17.0
7000	72	175.1	12.6	17.1					165.3	13.4	15.4				
	67	160.5	11.8	72.0	38.3	4.6			151.0	12.6	67.9	34.2	0.5		
	62	154.3	11.0	103.7	102.3	68.6	34.9	1.2	144.7	11.8	100.3	93.9	60.2	26.5	
	57	142.9	10.9	142.9	134.1	100.4	66.8	33.1	134.0	11.7	134.0	121.2	87.5	53.8	20.1
8000	72	185.0	12.7	36.5					174.5	13.5	29.6				
	67	169.6	11.9	83.7	44.8	5.9			159.5	12.7	79.9	41.0	2.1		
	62	163.1	11.1	125.0	107.0	68.2	29.3		152.8	11.9	110.0	103.2	64.3	25.4	
	57	151.0	11.0	151.0	149.6	110.7	71.8	32.9	141.5	11.8	141.5	139.9	101.0	62.1	23.2
9000	72	182.8	12.8	37.1					172.1	13.5	31.0				
	67	167.6	12.0	92.4	48.1	3.8			157.3	12.7	88.0	43.7			
	62	161.0	11.1	110.0	118.4	74.1	29.8		150.6	11.9	107.0	112.6	68.3	24.0	
	57	149.1	11.0	149.1	148.4	104.1	59.8	15.6	139.5	11.8	139.5	138.7	94.4	50.1	5.8
10000	72	180.6	12.8	37.7					169.7	13.5	32.4				
	67	165.5	12.0	124.4	51.4	1.7			155.0	12.8	114.8	46.5			
	62	159.0	11.1	138.0	129.7	80.0	30.3		148.5	11.9	125.0	122.0	72.3	22.6	
	57	147.2	11.0	147.2	147.2	97.5	115.0		137.5	11.8	137.5	135.0	87.8	95.0	
		55°F							65°F						
6000	72	122.2	12.7	4.5					125.4	14.2	7.9				
	67	109.1	12.0	51.5	22.9				112.5	13.5	47.0	18.5			
	62	114.7	11.4	100.2	71.7	43.2	14.7		112.2	12.9	87.3	58.8	30.2	1.7	
	57	103.4	11.3	103.4	86.4	57.9	29.4	0.8	102.5	13.2	102.5	70.2	41.7	13.2	
7000	72	155.4	14.2	13.6					145.6	14.9	11.9				
	67	141.5	13.4	63.7	30.0				132.0	14.2	59.6	25.9			
	62	135.1	12.7	96.9	85.5	51.8	18.1		125.5	13.5	93.4	77.1	43.4	9.7	
	57	125.1	12.6	125.1	108.3	74.6	40.9	7.2	116.2	13.4	116.2	95.3	61.6	27.9	
8000	72	164.0	14.2	22.8					153.6	15.0	15.9				
	67	149.4	13.5	76.0	37.2				139.2	14.2	72.2	33.3			
	62	142.5	12.7	110.0	99.3	60.4	21.5		132.3	13.5	95.0	85.0	56.5	17.6	
	57	132.0	12.6	132.0	130.1	91.3	52.4	13.5	122.5	13.4	122.5	120.4	81.5	42.7	3.8
9000	72	161.5	14.2	25.0					150.8	15.0	18.9				
	67	147.0	13.5	83.6	39.3				136.7	14.3	79.2	35.0			
	62	140.2	12.7	120.0	106.8	62.5	18.2		129.9	13.6	101.0	101.0	56.7	12.4	
	57	129.9	12.6	129.9	129.0	84.7	40.4		120.3	13.5	120.3	119.2	74.9	30.7	
10000	72	158.9	14.3	27.2					148.0	15.0	21.9				
	67	144.6	13.5	105.2	41.5				134.1	14.3	95.6	36.6			
	62	137.9	12.8	115.0	114.3	64.6	14.9		127.4	13.6	116.0	106.6	56.9	7.2	
	57	127.8	12.7	127.8	127.8	78.1	75.0		118.0	13.5	118.0	118.0	68.4	55.0	

ZR240 (20 Ton) Alternate Reheat Mode (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)				
				Return Dry Bulb (°F)							Return Dry Bulb (°F)				
CFM	WB (°F)			85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
6000	72	128.6	15.7	11.3					131.8	17.1	14.7				
	67	116.0	15.0	42.6	14.1				119.4	16.4	38.2	9.6			
	62	109.6	14.3	74.3	45.8	17.3			107.1	15.8	61.4	32.9	4.4		
	57	101.6	14.2	101.6	54.1	25.5			100.7	15.2	66.4	37.9	9.4		
7000	72	135.8	15.7	10.2					126.0	16.5	8.4				
	67	122.5	15.0	55.5	21.8				113.0	15.8	51.4	17.7			
	62	115.8	14.3	90.0	68.7	35.0	1.3		106.2	15.2	86.6	60.2	26.5		
	57	107.3	14.2	107.3	82.4	48.7	15.0		98.4	15.1	95.0	69.4	35.7	2.0	
8000	72	143.1	15.7	9.0					132.6	16.5	2.1				
	67	129.1	15.0	68.4	29.5				118.9	15.8	64.6	25.7			
	62	122.0	14.4	91.0	91.5	52.6	13.7		111.7	15.2	90.0	87.6	48.7	9.9	
	57	113.0	14.3	113.0	110.7	71.8	32.9		103.5	15.1	103.5	101.0	62.1	23.2	
9000	72	140.1	15.7	12.9					129.4	16.5	6.8				
	67	126.4	15.0	74.9	30.6				116.1	15.8	70.5	26.2			
	62	119.5	14.4	98.0	95.2	50.9	6.6		109.1	15.2	95.0	89.4	45.1	0.8	
	57	110.7	14.3	110.7	109.5	65.2	20.9		101.1	15.1	101.1	99.8	55.5	11.2	
10000	72	137.1	15.7	16.7					126.3	16.5	11.5				
	67	123.7	15.0	86.0	31.7				113.2	15.8	76.4	26.7			
	62	116.9	14.4	100.0	98.9	49.2			106.4	15.2	84.0	80.0	41.5		
	57	108.3	14.3	108.3	108.3	58.6	35.0		98.6	15.1	98.6	98.6	48.9	15.0	

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

No Sensible Cooling Capacity

ZR300 (25 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
7500	77	395.3	19.2	235.2	199.6	164.0	-	-	-	382.3	21.2	212.1	176.5	140.9	-	-	-
	72	367.6	19.1	261.5	225.9	190.2	154.6	-	-	352.6	21.2	246.0	210.3	174.7	139.1	-	-
	67	339.9	19.0	287.8	252.2	216.5	180.9	145.2	-	322.8	21.2	279.8	244.2	208.5	172.9	137.3	-
	62	309.6	18.4	309.6	295.9	260.2	224.6	189.0	153.3	297.0	20.5	297.0	285.0	249.4	213.7	178.1	142.4
	57	304.6	18.4	304.6	304.6	271.5	235.8	200.2	164.5	291.1	20.6	291.1	291.1	257.7	222.1	186.5	150.8
8750	77	406.1	19.5	253.6	216.9	174.8	-	-	-	391.6	21.5	235.1	193.0	150.9	-	-	-
	72	377.6	19.4	286.8	244.7	202.6	160.5	-	-	361.1	21.5	271.4	229.3	187.2	145.0	-	-
	67	349.1	19.3	320.1	272.5	230.4	188.3	146.2	-	330.6	21.5	307.6	265.5	223.4	181.3	139.2	-
	62	318.1	18.7	318.1	311.2	277.0	234.9	192.8	150.6	304.2	20.8	304.2	298.2	267.1	225.0	182.9	140.8
	57	312.9	18.7	312.9	312.9	289.0	246.9	204.7	162.6	298.1	20.8	298.1	298.1	276.1	234.0	191.9	149.7
10000	77	416.9	19.8	271.9	234.2	185.6	-	-	-	400.8	21.8	258.1	209.5	160.9	-	-	-
	72	387.6	19.7	312.2	263.6	215.0	166.4	-	-	369.6	21.8	296.8	248.2	199.6	151.0	-	-
	67	358.4	19.6	352.4	292.9	244.3	195.7	147.1	-	338.4	21.8	335.5	286.9	238.3	189.7	141.1	-
	62	326.5	19.0	326.5	326.5	293.7	245.1	196.5	147.9	311.4	21.1	311.4	311.4	284.9	236.3	187.7	139.1
	57	321.2	19.0	321.2	321.2	306.5	257.9	209.3	160.7	305.1	21.1	305.1	305.1	294.5	245.9	197.3	148.7
11250	72	394.3	20.5	329.3	273.9	218.6	163.2	-	-	374.6	22.4	313.0	257.7	202.3	147.0	-	-
	67	364.5	20.5	361.5	303.9	248.6	193.2	137.9	-	343.0	22.4	341.5	296.8	241.5	186.1	130.8	-
	62	332.1	19.8	332.1	332.1	298.8	243.5	188.1	132.8	315.6	21.7	315.6	315.6	288.8	233.4	178.1	122.7
	57	326.7	19.8	326.7	326.7	311.7	256.4	201.0	145.7	309.3	21.7	309.3	309.3	298.4	243.1	187.7	132.4
12500	72	400.9	21.4	346.4	284.3	222.2	160.1	-	-	379.6	23.0	329.2	267.1	205.0	142.9	-	-
	67	370.6	21.3	370.6	314.9	252.8	190.7	128.6	-	347.6	23.0	347.6	306.8	244.7	182.6	120.5	-
	62	337.7	20.6	337.7	337.7	303.9	241.8	179.7	117.6	319.8	22.3	319.8	319.8	292.6	230.5	168.4	106.3
	57	332.2	20.6	332.2	332.2	317.0	254.9	192.8	130.7	313.4	22.3	313.4	313.4	302.4	240.3	178.2	116.1
		95°F								105°F							
7500	77	369.4	23.3	189.1	153.4	117.8	-	-	-	342.9	26.5	167.4	131.8	96.1	-	-	-
	72	337.6	23.4	230.5	194.8	159.2	123.5	-	-	313.5	26.3	214.9	179.2	143.6	107.9	-	-
	67	305.8	23.5	271.9	236.2	200.6	164.9	129.3	-	284.0	26.1	262.3	226.7	191.0	155.4	119.8	-
	62	284.4	22.7	284.4	274.1	238.5	202.8	167.2	131.6	264.2	25.5	264.2	259.0	223.3	187.7	152.1	116.4
	57	277.5	22.7	277.5	277.5	244.0	208.4	172.7	137.1	257.8	25.5	257.8	257.8	225.5	189.9	154.2	118.6
8750	77	377.1	23.6	216.7	169.2	127.0	-	-	-	350.8	26.6	199.9	146.2	104.1	-	-	-
	72	344.6	23.7	256.0	213.8	171.7	129.6	-	-	320.7	26.5	239.8	197.7	155.6	113.5	-	-
	67	312.1	23.7	295.2	258.5	216.4	174.3	132.1	-	290.6	26.3	279.7	249.2	207.1	165.0	122.8	-
	62	290.3	23.0	290.3	285.2	257.3	215.2	173.0	130.9	270.3	25.7	270.3	267.7	242.1	199.9	157.8	115.7
	57	283.3	22.9	283.3	283.3	263.2	221.1	179.0	136.9	263.8	25.7	263.8	263.8	244.4	202.3	160.1	118.0
10000	77	384.8	23.8	244.4	184.9	136.3	-	-	-	358.7	26.8	232.4	160.7	112.1	-	-	-
	72	351.6	23.9	281.5	232.9	184.3	135.7	-	-	327.9	26.7	264.8	216.2	167.6	119.0	-	-
	67	318.5	24.0	318.5	280.8	232.2	183.6	135.0	-	297.2	26.5	297.2	271.7	223.1	174.5	125.9	-
	62	296.2	23.2	296.2	296.2	276.1	227.5	178.9	130.3	276.4	25.9	276.4	276.4	260.8	212.2	163.6	115.0
	57	289.1	23.2	289.1	289.1	282.4	233.8	185.2	136.6	269.7	25.8	269.7	269.7	263.3	214.7	166.1	117.5
11250	72	355.0	24.3	296.7	241.4	186.0	130.7	-	-	331.0	27.1	279.8	224.5	169.1	113.8	-	-
	67	321.5	24.4	321.5	289.7	234.4	179.0	123.7	-	299.9	26.9	299.9	280.5	225.2	169.8	114.5	-
	62	299.0	23.6	299.0	299.0	278.7	223.3	168.0	112.6	278.9	26.3	278.9	278.9	263.2	207.8	152.5	97.1
	57	291.8	23.6	291.8	291.8	285.1	229.8	174.4	119.1	272.2	26.3	272.2	272.2	265.7	210.4	155.0	99.7
12500	72	358.3	24.7	312.0	249.9	187.8	125.7	-	-	334.0	27.6	294.9	232.8	170.7	108.6	-	-
	67	324.6	24.8	324.6	298.7	236.6	174.5	112.4	-	302.7	27.4	302.7	289.3	227.2	165.1	103.0	-
	62	301.8	23.9	301.8	301.8	281.3	219.2	157.1	95.0	281.5	26.8	281.5	281.5	265.6	203.5	141.4	79.3
	57	294.6	23.9	294.6	294.6	287.8	225.7	163.6	101.5	274.7	26.7	274.7	274.7	268.2	206.1	144.0	81.9

ZR300 (25 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
7500	77	316.4	29.6	145.7	110.1	74.5	-	-	-	289.9	32.7	124.1	88.4	52.8	-	-	-
	72	289.3	29.1	199.3	163.6	128.0	92.3	-	-	265.2	32.0	183.7	148.0	112.4	76.7	-	-
	67	262.3	28.7	252.8	217.1	181.5	145.9	110.2	-	240.6	31.3	240.6	207.6	172.0	136.3	100.7	-
	62	243.9	28.3	243.9	243.8	208.2	172.5	136.9	101.3	223.7	31.1	223.7	223.7	193.0	157.4	121.7	86.1
	57	238.1	28.2	238.1	238.1	207.0	171.4	135.7	100.1	218.4	31.0	218.4	218.4	188.5	152.9	117.2	81.6
8750	77	324.6	29.7	183.1	123.2	81.1	-	-	-	298.3	32.8	166.2	100.3	58.2	-	-	-
	72	296.8	29.3	223.7	181.6	139.4	97.3	-	-	272.9	32.1	207.6	165.4	123.3	81.2	-	-
	67	269.1	28.8	264.3	239.9	197.8	155.7	113.5	-	247.5	31.4	247.5	230.6	188.5	146.3	104.2	-
	62	250.2	28.4	250.2	250.2	226.8	184.7	142.6	100.5	230.2	31.2	230.2	230.2	211.6	169.5	127.4	85.2
	57	244.2	28.4	244.2	244.2	225.5	183.4	141.3	99.2	224.7	31.1	224.7	224.7	206.7	164.6	122.5	80.4
10000	77	332.7	29.8	220.4	136.4	87.8	-	-	-	306.7	32.8	208.4	112.1	63.5	-	-	-
	72	304.3	29.4	248.1	199.5	150.9	102.3	-	-	280.6	32.1	231.4	182.8	134.2	85.6	-	-
	67	275.8	29.0	275.8	262.6	214.0	165.4	116.8	-	254.5	31.5	254.5	253.6	205.0	156.4	107.8	-
	62	256.5	28.6	256.5	256.5	245.5	196.9	148.3	99.7	236.7	31.3	236.7	236.7	230.2	181.6	133.0	84.4
	57	250.4	28.5	250.4	250.4	244.1	195.5	146.9	98.3	231.0	31.1	231.0	231.0	224.9	176.3	127.7	79.1
11250	72	307.0	29.9	263.0	207.6	152.3	96.9	-	-	283.0	32.7	246.1	190.8	135.4	80.1	-	-
	67	278.3	29.5	278.3	271.3	216.0	160.6	105.3	-	256.7	32.0	256.7	256.7	206.7	151.4	96.0	-
	62	258.8	29.1	258.8	258.8	247.7	192.3	137.0	81.6	238.7	31.8	238.7	238.7	232.2	176.8	121.5	66.1
	57	252.6	29.0	252.6	252.6	246.3	190.9	135.6	80.2	233.0	31.7	233.0	233.0	226.9	171.5	116.2	60.8
12500	72	309.7	30.4	277.8	215.7	153.6	91.5	-	-	285.5	33.3	260.8	198.7	136.6	74.5	-	-
	67	280.8	30.0	280.8	280.0	217.9	155.8	93.7	-	258.9	32.6	258.9	258.9	208.5	146.4	84.3	-
	62	261.1	29.6	261.1	261.1	249.9	187.8	125.7	63.6	240.8	32.4	240.8	240.8	234.2	172.1	110.0	47.9
	57	254.9	29.5	254.9	254.9	248.5	186.4	124.3	62.2	235.0	32.2	235.0	235.0	228.8	166.7	104.6	42.5

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZR300 (25 Ton) Alternate Reheat Mode

Air on Evaporator Coil		Temperature of Air on Condenser Coil														
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)				
CFM	WB (°F)			Return Dry Bulb (°F)							Return Dry Bulb (°F)				
				85	80	75	70	65			85	80	75	70	65
		35°F							45°F						
7500	72	203.3	15.3	51.6	16.0				190.6	16.6	47.9	12.3			
	67	180.0	14.8	61.9	26.2				170.0	16.1	58.2	22.5			
	62	170.1	13.9	62.1	50.0				159.6	15.2	71.4	50.0			
	57	167.8	13.0	150.0	87.2	51.6	15.9		156.7	15.0	135.0	89.6	53.9	18.3	
8750	72	206.6	15.7	51.4	45.0				194.0	17.0	49.0	41.0			
	67	182.7	15.2	63.5	58.0				172.9	16.4	60.9	54.0			
	62	172.9	14.3	102.0	58.0				162.4	15.5	104.0	66.0			
	57	170.5	14.0	157.0	124.9	82.4	40.2		159.6	15.0	140.0	121.2	78.7	36.6	
10000	72	209.8	16.1	51.2	2.6				197.5	17.3	50.1	1.5			
	67	185.4	15.6	65.3	19.7				175.9	16.8	63.7	17.5			
	62	175.6	14.7	130.0	125.0	90.0	17.2		165.3	15.8	119.0	115.0	75.0	11.0	
	57	173.3	14.0	147.0	100.0	62.0	49.2	3.6	162.4	15.0	143.0	100.0	59.0	42.6	
11250	72	204.7	17.1	79.2	23.8				194.1	18.3	73.8	18.4			
	67	180.2	16.5	85.9	30.5				172.4	17.7	81.7	26.4			
	62	171.2	15.5	135.0	130.9	57.3			162.5	16.7	122.0	116.0	52.9		
	57	169.4	15.0	157.0	147.5	88.9	25.3		159.9	16.0	150.0	141.8	83.9	21.9	
12500	72	199.6	18.0	65.6	55.0				190.8	19.2	64.2	52.0			
	67	175.0	17.4	99.8	85.0				169.0	18.6	94.4	80.0			
	62	166.9	16.4	137.0	135.0	53.8	27.2		159.7	17.6	126.0	104.0	50.3	16.6	
	57	165.4	16.0	165.0	148.0	93.0	16.9		157.4	17.0	157.4	146.0	87.0	14.9	
		55°F							65°F						
7500	72	177.9	17.9	44.2	8.6				165.2	19.2	40.5	4.8			
	67	160.0	17.4	54.5	25.0				150.1	18.7	50.7	15.1			
	62	149.0	16.5	80.6	30.0	4.1			138.4	17.8	89.8	37.4	15.1		
	57	145.6	16.0	145.6	91.9	56.3	20.6		134.5	17.0	134.5	94.2	58.6	22.9	
8750	72	181.5	18.2	46.6	37.0				169.0	19.4	44.2	33.0			
	67	163.2	17.6	58.3	50.0				153.5	18.8	55.6	46.0			
	62	152.0	16.8	106.0	74.0	3.2			141.6	18.0	108.0	82.0	14.1		
	57	148.6	16.0	148.6	117.4	75.1	33.0		137.6	18.0	137.6	113.7	71.4	29.3	
10000	72	185.1	18.5	49.0	0.4				172.8	19.6	47.9				
	67	166.4	17.9	62.1	15.3				156.9	19.0	60.6	13.2			
	62	155.1	17.0	118.0	105.0	60.0	4.8		144.8	18.2	117.0	95.0	45.0		
	57	151.6	17.0	137.0	115.0	56.0	36.1		140.7	18.0	131.0	100.0	53.0	29.5	
11250	72	183.6	19.5	68.4	13.0				173.0	20.7	62.9	7.6			
	67	164.7	18.9	77.5	22.2				157.0	20.0	73.3	18.0			
	62	153.7	17.9	120.0	114.9	48.6			145.0	19.2	116.0	107.0	44.3		
	57	150.4	17.0	150.4	136.2	78.9	18.6		141.0	19.0	141.0	130.6	74.0	15.3	
12500	72	182.0	20.5	62.8	49.0				173.2	21.7	61.4	46.0			
	67	163.0	19.9	88.9	75.0				157.0	21.1	83.5	70.0			
	62	152.4	18.9	122.0	102.7	46.9	6.1		145.2	20.1	118.0	101.3	43.4		
	57	149.3	18.0	149.3	140.0	81.0	12.9		141.2	20.0	141.2	134.0	75.0	11.0	

ZR300 (25 Ton) Alternate Reheat Mode (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil													
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)				
CFM	WB (°F)			Return Dry Bulb (°F)							Return Dry Bulb (°F)				
				85	80	75	70	65			85	80	75	70	65
		75°F							85°F						
7500	72	152.5	20.6	36.8	1.1				139.7	21.9	33.1				
	67	140.1	19.9	47.0	11.4				130.2	21.2	43.3	7.7			
	62	127.9	19.1	99.0	55.0	26.0			117.3	20.5	108.2	72.6	36.9	1.3	
	57	123.4	16.5	123.4	96.6	60.9	25.3		112.3	20.1	112.3	98.9	63.3	27.6	
8750	72	156.4	20.7	41.8	29.0				143.9	21.9	39.4	25.0			
	67	143.8	20.0	53.0	42.0				134.1	21.2	50.4	38.0			
	62	131.2	19.2	110.0	90.0	25.0			120.8	20.5	112.0	98.0	35.9		
	57	126.6	17.0	126.6	110.0	67.8	25.7		115.7	20.2	115.7	106.3	64.2	22.0	
10000	72	160.4	20.8	46.7					148.1	21.9	45.6				
	67	147.4	20.1	59.0	11.0				137.9	21.2	57.4	8.8			
	62	134.6	19.3	116.0	85.0	30.0			124.3	20.5	115.0	75.0	15.0		
	57	129.9	17.7	125.0	100.0	50.0	23.0		119.0	20.2	119.0	100.0	47.0	16.5	
11250	72	162.4	21.9	57.5	2.2				151.9	23.1	52.1				
	67	149.2	21.2	69.2	13.8				141.5	22.4	65.0	9.6			
	62	136.2	20.4	120.0	99.0	40.0			127.5	21.6	120.0	91.0	35.7		
	57	131.5	18.6	131.5	125.0	69.0	12.0		122.1	21.2	122.1	119.4	64.0	8.7	
12500	72	164.4	23.0	60.0	43.0				155.7	24.2	58.6	40.0			
	67	151.0	22.3	78.0	65.0				145.0	23.5	72.5	60.0			
	62	137.9	21.4	114.0	100.0	40.0			130.7	22.7	110.0	98.7	36.6		
	57	133.2	19.6	133.2	128.0	69.0	9.0		125.1	22.3	125.1	122.0	63.0	7.0	

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

No Sensible Cooling Capacity

ZF180-300 Cooling Capacities

ZF180 (15 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
3750	77	219.1	11.4	101.6	85.2	68.7	-	-	-	207.3	12.5	93.4	77.4	61.4	-	-	-
	72	204.6	11.0	126.7	110.3	93.8	77.3	-	-	192.6	12.2	118.6	102.6	86.6	70.7	-	-
	67	190.1	10.7	151.8	135.4	118.9	102.4	86.0	-	177.9	12.0	143.7	127.8	111.8	95.9	79.9	-
	62	173.8	10.4	173.8	173.8	152.3	135.9	119.4	102.9	165.1	11.8	165.1	165.1	141.2	125.2	109.3	93.3
4500	77	225.7	11.5	110.6	92.2	73.8	-	-	-	212.9	12.6	102.4	84.4	66.4	-	-	-
	72	210.7	11.1	137.5	119.1	100.7	82.2	-	-	197.8	12.3	129.6	111.6	93.7	75.7	-	-
	67	195.8	10.8	164.4	146.0	127.6	109.2	90.7	-	182.7	12.0	156.9	138.9	120.9	103.0	85.0	-
	62	179.1	10.5	179.1	179.1	163.5	145.1	126.6	108.2	169.5	11.8	169.5	169.5	152.7	134.7	116.8	98.8
	57	177.5	10.5	177.5	177.5	162.4	144.0	125.6	107.2	168.4	11.8	168.4	168.4	151.4	133.4	115.4	97.5
5250	77	232.3	11.6	119.6	99.2	78.8	-	-	-	218.4	12.6	111.4	91.4	71.4	-	-	-
	72	216.9	11.2	148.3	127.9	107.5	87.2	-	-	202.9	12.4	140.7	120.7	100.7	80.8	-	-
	67	201.5	10.9	177.0	156.6	136.2	115.9	95.5	-	187.4	12.1	170.0	150.0	130.0	110.1	90.1	-
	62	184.4	10.6	184.4	184.4	174.6	154.2	133.9	113.5	174.0	11.9	174.0	174.0	164.2	144.2	124.2	104.3
	57	182.7	10.6	182.7	182.7	173.5	153.1	132.8	112.4	172.8	11.9	172.8	172.8	162.8	142.8	122.8	102.9
6000	77	238.9	11.7	128.5	106.2	83.9	-	-	-	224.0	12.7	120.4	98.4	76.4	-	-	-
	72	223.1	11.3	159.0	136.7	114.4	92.1	-	-	208.1	12.5	151.7	129.8	107.8	85.8	-	-
	67	207.2	11.0	189.6	167.2	144.9	122.6	100.3	-	192.2	12.2	183.1	161.1	139.1	117.2	95.2	-
	62	189.6	10.8	189.6	189.6	185.8	163.4	141.1	118.8	178.4	12.0	178.4	178.4	175.7	153.7	131.7	109.8
	57	187.9	10.8	187.9	187.9	184.6	162.3	139.9	117.6	177.2	12.0	177.2	177.2	174.2	152.2	130.2	108.2
6750	72	224.2	11.5	168.1	144.2	120.2	96.3	-	-	209.5	12.6	160.9	137.4	113.8	90.2	-	-
	67	208.2	11.1	199.4	176.2	152.3	128.3	104.4	-	193.5	12.3	188.9	170.5	146.9	123.3	99.8	-
	62	190.5	10.9	190.5	190.5	188.6	164.7	140.7	116.8	179.6	12.1	179.6	179.6	178.2	154.7	131.1	107.5
	57	188.8	10.9	188.8	188.8	187.2	163.2	139.3	115.4	178.4	12.1	178.4	178.4	176.9	153.3	129.8	106.2
7500	72	225.2	11.6	177.1	151.6	126.1	100.5	-	-	210.9	12.7	170.1	145.0	119.8	94.7	-	-
	67	209.2	11.2	209.2	185.2	159.6	134.1	108.6	-	194.8	12.4	194.8	179.8	154.7	129.5	104.4	-
	62	191.4	11.0	191.4	191.4	191.4	165.9	140.4	114.8	180.8	12.2	180.8	180.8	180.8	155.6	130.5	105.3
	57	189.7	11.0	189.7	189.7	189.7	164.2	138.7	113.1	179.6	12.1	179.6	179.6	179.6	154.4	129.3	104.1
		95°F								105°F							
3750	77	195.6	13.6	85.1	69.6	54.2	-	-	-	182.2	15.1	75.9	64.3	49.2	-	-	-
	72	180.7	13.4	110.4	94.9	79.4	64.0	-	-	168.0	14.9	104.2	89.2	74.1	59.0	-	-
	67	165.8	13.3	135.7	120.2	104.7	89.3	73.8	-	153.8	14.7	132.6	114.0	98.9	83.8	68.7	-
	62	156.4	13.1	156.4	155.6	130.1	114.6	99.1	83.7	146.8	14.6	146.8	144.4	119.6	104.5	89.4	74.3
4500	77	200.1	13.6	94.1	76.6	59.1	-	-	-	185.6	15.2	88.1	71.0	53.9	-	-	-
	72	184.8	13.5	121.7	104.2	86.7	69.2	-	-	171.1	15.0	115.3	98.2	81.0	63.9	-	-
	67	169.6	13.3	149.3	131.8	114.3	96.8	79.2	-	156.6	14.8	142.4	125.3	108.2	91.1	74.0	-
	62	160.0	13.1	160.0	159.4	141.9	124.4	106.9	89.3	149.5	14.7	149.5	147.9	130.8	113.7	96.6	79.5
	57	159.3	13.1	159.3	157.8	140.3	122.8	105.3	87.8	149.2	14.6	149.2	146.5	129.4	112.3	95.2	78.1
5250	77	204.6	13.7	103.2	83.6	64.0	-	-	-	188.9	15.3	100.4	77.7	58.5	-	-	-
	72	188.9	13.5	133.1	113.5	93.9	74.3	-	-	174.2	15.1	126.3	107.2	88.0	68.9	-	-
	67	173.3	13.4	163.0	143.4	123.8	104.2	84.7	-	159.5	14.8	152.2	136.7	117.5	98.4	79.3	-
	62	163.6	13.2	163.6	163.3	153.8	134.2	114.6	95.0	152.2	14.7	152.2	151.4	142.1	122.9	103.8	84.7
	57	162.9	13.1	162.9	162.1	152.0	132.5	112.9	93.3	151.9	14.7	151.9	150.6	140.5	121.4	102.3	83.1
6000	77	209.0	13.8	112.2	90.6	69.0	-	-	-	192.3	15.3	112.6	84.3	63.2	-	-	-
	72	193.1	13.6	144.4	122.8	101.2	79.5	-	-	177.3	15.1	137.3	116.2	95.0	73.8	-	-
	67	177.1	13.5	176.6	155.0	133.4	111.7	90.1	-	162.3	14.9	162.1	148.0	126.9	105.7	84.5	-
	62	167.1	13.3	167.1	167.1	165.6	144.0	122.3	100.7	154.9	14.8	154.9	154.9	153.3	132.2	111.0	89.9
	57	166.4	13.2	166.4	166.4	163.8	142.1	120.5	98.9	154.6	14.7	154.6	154.6	151.7	130.5	109.3	88.2
6750	72	194.8	13.6	153.8	130.6	107.4	84.2	-	-	178.7	15.2	146.5	123.8	101.0	78.3	-	-
	67	178.7	13.5	178.5	164.7	141.5	118.3	95.1	-	163.6	15.0	163.5	155.0	134.9	112.1	89.4	-
	62	168.6	13.3	168.6	168.6	167.9	144.7	121.5	98.3	156.2	14.8	156.2	156.2	155.4	132.6	109.9	87.1
	57	167.9	13.2	167.9	167.9	166.6	143.4	120.2	97.0	155.9	14.8	155.9	155.9	154.4	131.6	108.9	86.1
7500	72	196.6	13.7	163.1	138.3	113.6	88.8	-	-	180.2	15.2	155.8	131.4	107.0	82.7	-	-
	67	180.4	13.5	180.4	174.5	149.7	124.9	100.1	-	164.9	15.0	164.9	162.0	142.9	118.6	94.2	-
	62	170.2	13.3	170.2	170.2	170.2	145.4	120.6	95.8	157.4	14.9	157.4	157.4	157.4	133.1	108.7	84.3
	57	169.5	13.3	169.5	169.5	169.5	144.7	119.9	95.1	157.1	14.9	157.1	157.1	157.1	132.8	108.4	84.0

ZF180 (15 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
3750	77	168.8	16.7	66.6	59.0	44.3	-	-	-	155.4	18.3	57.3	53.1	39.4	-	-	-
	72	155.3	16.4	98.1	83.4	68.7	54.0	-	-	142.6	18.0	92.0	77.6	63.3	49.0	-	-
	67	141.8	16.2	129.6	107.8	93.0	78.3	63.6	-	129.7	17.6	126.5	101.5	87.2	72.9	58.5	-
	62	137.2	16.1	137.2	133.2	109.0	94.3	79.6	64.9	127.6	17.7	127.6	122.1	98.5	84.2	69.9	55.6
4500	77	171.1	16.8	82.1	65.4	48.7	-	-	-	156.5	18.4	76.0	59.8	43.5	-	-	-
	72	157.4	16.5	108.8	92.1	75.4	58.7	-	-	143.6	18.0	102.4	86.1	69.8	53.5	-	-
	67	143.7	16.2	135.5	118.8	102.1	85.4	68.7	-	130.7	17.7	128.7	112.4	96.1	79.8	63.5	-
	62	139.1	16.2	139.1	136.4	119.7	103.0	86.3	69.6	128.6	17.7	128.6	124.9	108.6	92.3	76.0	59.8
	57	139.1	16.2	139.1	135.2	118.5	101.8	85.1	68.4	129.1	17.7	129.1	123.8	107.5	91.2	74.9	58.7
5250	77	173.3	16.8	97.5	71.7	53.0	-	-	-	157.7	18.4	94.8	66.4	47.5	-	-	-
	72	159.5	16.6	119.5	100.8	82.1	63.4	-	-	144.7	18.1	112.7	94.5	76.2	58.0	-	-
	67	145.6	16.3	141.5	129.9	111.2	92.6	73.9	-	131.7	17.7	130.8	123.2	105.0	86.7	68.5	-
	62	140.9	16.3	140.9	139.6	130.4	111.7	93.0	74.3	129.6	17.8	129.6	127.7	118.7	100.4	82.2	63.9
	57	141.0	16.2	141.0	139.0	129.0	110.3	91.6	72.9	130.1	17.8	130.1	127.4	117.5	99.2	81.0	62.7
6000	77	175.6	16.9	113.0	78.0	57.4	-	-	-	158.9	18.5	113.6	73.1	51.5	-	-	-
	72	161.5	16.6	130.2	109.5	88.9	68.2	-	-	145.8	18.1	123.1	102.9	82.7	62.5	-	-
	67	147.5	16.4	147.5	141.0	120.4	99.7	79.0	-	132.7	17.8	132.7	132.7	113.8	93.6	73.4	-
	62	142.8	16.3	142.8	142.8	141.0	120.4	99.7	79.0	130.6	17.8	130.6	130.6	128.8	108.6	88.3	68.1
	57	142.8	16.3	142.8	142.8	139.6	118.9	98.2	77.5	131.1	17.9	131.1	131.1	127.5	107.3	87.0	66.8
6750	72	162.6	16.7	139.3	117.0	94.7	72.4	-	-	146.5	18.2	132.1	110.2	88.4	66.5	-	-
	67	148.5	16.4	148.5	145.3	128.3	105.9	83.6	-	133.3	17.9	133.3	133.3	121.6	99.8	77.9	-
	62	143.7	16.4	143.7	143.7	142.9	120.5	98.2	75.9	131.3	17.9	131.3	131.3	130.3	108.5	86.6	64.8
	57	143.8	16.4	143.8	143.8	142.2	119.8	97.5	75.2	131.7	17.9	131.7	131.7	129.9	108.1	86.2	64.3
7500	72	163.7	16.8	148.4	124.5	100.5	76.6	-	-	147.3	18.3	141.0	117.5	94.0	70.5	-	-
	67	149.5	16.5	149.5	149.5	136.2	112.2	88.3	-	134.0	18.0	134.0	134.0	129.4	105.9	82.4	-
	62	144.7	16.5	144.7	144.7	144.7	120.7	96.8	72.9	131.9	18.0	131.9	131.9	131.9	108.4	84.9	61.4
	57	144.8	16.4	144.8	144.8	144.8	120.8	96.9	73.0	132.4	18.0	132.4	132.4	132.4	108.9	85.4	61.9

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZF210 (17.5 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
4375	77	266.4	14.9	105.7	87.4	69.1	-	-	-	252.5	16.1	104.8	86.2	67.5	-	-	-
	72	246.6	14.5	139.2	120.9	102.6	84.2	-	-	233.7	15.7	137.6	118.9	100.2	81.6	-	-
	67	226.7	14.0	172.7	154.4	136.0	117.7	99.4	-	215.0	15.4	170.3	151.6	133.0	114.3	95.6	-
	62	209.7	14.0	209.7	194.9	165.5	147.2	128.9	110.5	198.6	15.2	198.6	191.2	163.3	144.6	126.0	107.3
5250	77	276.8	14.8	119.5	97.9	76.4	-	-	-	261.8	16.1	117.3	95.7	74.2	-	-	-
	72	256.2	14.4	156.5	135.0	113.4	91.9	-	-	242.4	15.7	153.3	131.7	110.1	88.5	-	-
	67	235.5	14.0	193.5	172.0	150.5	129.0	107.4	-	223.0	15.4	189.3	167.7	146.1	124.5	102.9	-
	62	217.8	13.9	217.8	207.9	183.1	161.5	140.0	118.5	205.9	15.2	205.9	201.0	179.4	157.8	136.2	114.6
	57	219.1	13.8	219.1	216.4	189.4	167.9	146.3	124.8	205.8	15.1	205.8	204.4	182.8	161.2	139.6	118.0
6125	77	287.1	14.8	133.2	108.5	83.7	-	-	-	271.2	16.1	129.9	105.3	80.8	-	-	-
	72	265.7	14.4	173.8	149.1	124.3	99.6	-	-	251.1	15.7	169.1	144.5	120.0	95.5	-	-
	67	244.3	14.0	214.4	189.7	164.9	140.2	115.4	-	231.0	15.4	208.3	183.7	159.2	134.7	110.2	-
	62	225.9	13.9	225.9	221.0	200.7	175.9	151.2	126.4	213.3	15.2	213.3	210.9	195.5	171.0	146.5	122.0
	57	227.3	13.8	227.3	225.9	207.6	182.8	158.1	133.3	213.1	15.2	213.1	212.5	199.2	174.7	150.2	125.7
7000	77	297.5	14.7	147.0	119.0	91.1	-	-	-	280.6	16.1	142.4	114.9	87.5	-	-	-
	72	275.3	14.3	191.1	163.2	135.2	107.2	-	-	259.8	15.7	184.8	157.4	129.9	102.5	-	-
	67	253.1	13.9	235.3	207.3	179.4	151.4	123.4	-	239.0	15.4	227.2	199.8	172.3	144.9	117.4	-
	62	234.1	13.9	234.1	234.1	218.3	190.3	162.3	134.4	220.7	15.2	220.7	220.7	211.7	184.2	156.8	129.3
	57	235.4	13.8	235.4	235.4	225.7	197.8	169.8	141.8	220.5	15.2	220.5	220.5	215.7	188.2	160.8	133.3
7875	72	278.8	14.5	203.0	173.1	143.2	113.3	-	-	262.4	15.8	195.7	166.4	137.2	107.9	-	-
	67	256.4	14.1	247.5	219.9	190.0	160.1	130.2	-	241.4	15.5	235.5	211.2	182.0	152.7	123.4	-
	62	237.1	14.0	237.1	237.1	229.2	199.3	169.4	139.5	222.9	15.3	222.9	222.9	218.4	189.1	159.8	130.6
	57	238.5	13.9	238.5	238.5	233.6	203.7	173.8	143.9	222.7	15.3	222.7	222.7	220.3	191.0	161.7	132.5
8750	72	282.4	14.6	214.9	183.1	151.3	119.4	-	-	264.9	15.9	206.6	175.5	144.4	113.3	-	-
	67	259.6	14.2	259.6	232.5	200.7	168.8	137.0	-	243.7	15.6	243.7	222.6	191.6	160.5	129.4	-
	62	240.1	14.1	240.1	240.1	240.1	208.2	176.4	144.6	225.0	15.4	225.0	225.0	225.0	194.0	162.9	131.8
	57	241.5	14.0	241.5	241.5	241.5	209.6	177.8	146.0	224.9	15.3	224.9	224.9	224.9	193.8	162.7	131.6
		95°F								105°F							
4375	77	238.5	17.2	104.0	84.9	65.9	-	-	-	222.3	19.0	92.0	77.9	59.4	-	-	-
	72	220.9	17.0	135.9	116.9	97.9	78.9	-	-	205.9	18.7	128.5	110.0	91.5	73.0	-	-
	67	203.4	16.7	167.9	148.9	129.9	110.9	91.9	-	189.4	18.4	165.0	142.1	123.6	105.1	86.6	-
	62	187.5	16.4	187.5	187.5	161.1	142.1	123.1	104.1	177.4	18.2	177.4	176.9	148.8	130.3	111.8	93.3
5250	77	246.9	17.3	115.2	93.6	71.9	-	-	-	230.2	19.0	108.4	86.8	65.3	-	-	-
	72	228.7	17.0	150.1	128.5	106.8	85.1	-	-	213.2	18.7	143.7	122.1	100.6	79.0	-	-
	67	210.5	16.7	185.0	163.4	141.7	120.0	98.4	-	196.2	18.4	179.0	157.4	135.9	114.3	92.7	-
	62	194.1	16.5	194.1	194.1	175.8	154.1	132.4	110.8	183.7	18.2	183.7	183.4	163.5	141.9	120.4	98.8
	57	192.5	16.5	192.5	192.5	176.2	154.6	132.9	111.3	182.2	18.2	182.2	182.2	164.7	143.1	121.6	100.0
6125	77	255.3	17.3	126.5	102.2	77.9	-	-	-	238.2	19.0	124.7	95.7	71.1	-	-	-
	72	236.5	17.1	164.3	140.0	115.7	91.4	-	-	220.6	18.7	158.8	134.2	109.6	85.0	-	-
	67	217.7	16.8	202.1	177.8	153.5	129.2	104.9	-	203.0	18.4	192.9	172.7	148.1	123.5	98.9	-
	62	200.7	16.5	200.7	200.7	190.4	166.1	141.8	117.5	190.1	18.2	190.1	189.9	178.2	153.6	129.0	104.4
	57	199.0	16.5	199.0	199.0	190.9	166.6	142.3	118.0	188.5	18.2	188.5	188.5	179.5	154.9	130.3	105.7
7000	77	263.7	17.4	137.8	110.8	83.9	-	-	-	246.1	19.1	141.1	104.6	77.0	-	-	-
	72	244.3	17.1	178.5	151.5	124.6	97.7	-	-	227.9	18.7	174.0	146.3	118.7	91.0	-	-
	67	224.9	16.8	219.2	192.2	165.3	138.4	111.4	-	209.7	18.4	206.9	188.0	160.4	132.7	105.1	-
	62	207.3	16.6	207.3	207.3	205.1	178.1	151.2	124.2	196.4	18.2	196.4	196.4	192.9	165.3	137.6	110.0
	57	205.6	16.6	205.6	205.6	205.6	178.7	151.7	124.8	194.8	18.2	194.8	194.8	194.3	166.7	139.0	111.4
7875	72	245.9	17.2	188.3	159.7	131.1	102.4	-	-	229.0	18.8	182.2	153.3	124.5	95.6	-	-
	67	226.4	16.9	223.5	202.5	173.9	145.3	116.6	-	210.7	18.5	209.3	196.1	168.2	139.3	110.4	-
	62	208.7	16.6	208.7	208.7	207.5	178.9	150.3	121.7	197.3	18.3	197.3	197.3	195.6	166.7	137.8	108.9
	57	206.9	16.6	206.9	206.9	206.9	178.3	149.7	121.0	195.7	18.3	195.7	195.7	195.5	166.6	137.7	108.8
8750	72	247.5	17.2	198.2	167.9	137.5	107.2	-	-	230.1	18.9	190.5	160.4	130.3	100.2	-	-
	67	227.8	16.9	227.8	212.8	182.5	152.2	121.8	-	211.7	18.6	211.7	204.2	176.0	145.9	115.8	-
	62	210.0	16.7	210.0	210.0	210.0	179.7	149.4	119.1	198.2	18.4	198.2	198.2	198.2	168.1	138.0	107.9
	57	208.2	16.7	208.2	208.2	208.2	177.9	147.6	117.3	196.6	18.4	196.6	196.6	196.6	166.5	136.4	106.3

ZF210 (17.5 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
4375	77	206.1	20.8	80.0	70.9	52.9	-	-	-	190.0	22.6	66.6	63.7	46.3	-	-	-
	72	190.8	20.5	121.1	103.1	85.1	67.1	-	-	175.7	22.2	113.6	96.1	78.7	61.2	-	-
	67	175.5	20.2	162.1	135.3	117.3	99.3	81.3	-	161.5	21.9	160.3	128.5	111.0	93.5	76.0	-
	62	167.3	20.0	167.3	166.3	136.4	118.4	100.5	82.5	157.2	21.8	157.2	155.7	124.1	106.6	89.1	71.6
5250	77	213.6	20.8	101.5	80.1	58.6	-	-	-	196.9	22.5	94.7	73.3	51.9	-	-	-
	72	197.7	20.5	137.2	115.8	94.3	72.8	-	-	182.2	22.2	130.8	109.4	88.0	66.7	-	-
	67	181.8	20.1	172.9	151.5	130.0	108.5	87.1	-	167.5	21.8	166.9	145.5	124.2	102.8	81.4	-
	62	173.3	20.0	173.3	172.7	151.2	129.8	108.3	86.9	163.0	21.7	163.0	162.0	139.0	117.6	96.3	74.9
	57	172.0	20.0	172.0	172.0	153.1	131.7	110.2	88.7	161.7	21.8	161.7	161.7	141.6	120.2	98.8	77.5
6125	77	221.1	20.7	123.0	89.2	64.3	-	-	-	203.9	22.4	122.7	82.9	57.5	-	-	-
	72	204.6	20.4	153.4	128.4	103.5	78.6	-	-	188.7	22.1	147.9	122.7	97.4	72.2	-	-
	67	188.2	20.1	183.7	167.6	142.7	117.8	92.9	-	173.4	21.8	173.4	162.6	137.3	112.1	86.9	-
	62	179.4	19.9	179.4	179.1	166.0	141.1	116.2	91.3	168.7	21.6	168.7	168.3	153.8	128.6	103.4	78.2
	57	178.0	20.0	178.0	178.0	168.1	143.2	118.3	93.3	167.5	21.7	167.5	167.5	156.7	131.5	106.2	81.0
7000	77	228.5	20.7	144.5	98.4	70.1	-	-	-	210.9	22.4	150.7	92.5	63.1	-	-	-
	72	211.5	20.4	169.5	141.1	112.7	84.4	-	-	195.1	22.0	165.0	135.9	106.8	77.7	-	-
	67	194.5	20.1	194.5	183.8	155.4	127.1	98.7	-	179.4	21.7	179.4	179.4	150.5	121.4	92.3	-
	62	185.5	19.9	185.5	185.5	180.8	152.4	124.1	95.7	174.5	21.6	174.5	174.5	168.7	139.6	110.5	81.4
	57	184.0	19.9	184.0	184.0	183.1	154.7	126.3	97.9	173.2	21.6	173.2	173.2	171.8	142.7	113.6	84.5
7875	72	212.1	20.5	176.1	147.0	117.9	88.7	-	-	195.2	22.1	170.0	140.6	111.3	81.9	-	-
	67	195.0	20.1	195.0	189.7	162.5	133.4	104.2	-	179.4	21.7	179.4	179.4	156.8	127.4	98.0	-
	62	185.9	20.0	185.9	185.9	183.6	154.5	125.4	96.2	174.6	21.6	174.6	174.6	171.7	142.3	112.9	83.5
	57	184.5	20.0	184.5	184.5	184.0	154.9	125.8	96.6	173.3	21.7	173.3	173.3	172.6	143.2	113.8	84.4
8750	72	212.6	20.5	182.7	152.9	123.0	93.1	-	-	195.2	22.2	175.0	145.4	115.7	86.0	-	-
	67	195.6	20.2	195.6	195.6	169.6	139.7	109.8	-	179.4	21.8	179.4	179.4	163.1	133.4	103.8	-
	62	186.4	20.0	186.4	186.4	186.4	156.6	126.7	96.8	174.7	21.7	174.7	174.7	174.7	145.0	115.3	85.7
	57	185.0	20.1	185.0	185.0	185.0	155.1	125.2	95.3	173.3	21.7	173.3	173.3	173.3	143.7	114.0	84.3

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZF240 (20 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
5000	77	307.7	17.9	145.7	125.9	106.2	-	-	-	303.2	20.6	133.1	113.2	93.4	-	-	-
	72	291.0	17.8	178.9	159.2	139.4	119.6	-	-	282.6	20.3	168.1	148.2	128.4	108.5	-	-
	67	274.4	17.6	212.2	192.4	172.7	152.9	133.1	-	261.9	20.0	203.1	183.2	163.3	143.5	123.6	-
	62	257.5	17.5	257.5	240.0	219.4	199.7	179.9	160.1	244.0	19.7	244.0	226.9	202.9	183.0	163.2	143.3
6000	77	319.5	18.3	157.8	135.3	112.8	-	-	-	311.3	20.8	144.5	122.1	99.8	-	-	-
	72	302.1	18.1	193.0	170.5	148.0	125.5	-	-	290.1	20.5	181.8	159.5	137.1	114.8	-	-
	67	284.7	18.0	228.2	205.7	183.2	160.7	138.2	-	268.9	20.2	219.2	196.9	174.5	152.2	129.8	-
	62	267.1	17.9	267.1	255.5	233.0	210.5	188.0	165.5	250.5	19.9	250.5	239.1	216.8	194.4	172.1	149.7
	57	265.0	17.2	265.0	263.6	241.1	218.6	196.1	173.6	249.9	19.6	249.9	243.5	221.2	198.8	176.5	154.1
7000	77	331.2	18.6	169.9	144.6	119.4	-	-	-	319.3	21.0	155.8	131.0	106.1	-	-	-
	72	313.1	18.5	207.1	181.8	156.6	131.4	-	-	297.6	20.7	195.6	170.7	145.9	121.1	-	-
	67	294.9	18.3	244.3	219.0	193.8	168.6	143.3	-	275.8	20.4	235.4	210.5	185.7	160.8	136.0	-
	62	276.8	18.2	276.8	270.9	246.5	221.2	196.0	170.8	257.0	20.1	257.0	251.3	230.6	205.8	180.9	156.1
	57	274.6	17.6	274.6	273.9	255.2	229.9	204.7	179.4	256.4	19.8	256.4	253.2	235.3	210.5	185.6	160.8
8000	77	343.0	19.0	181.9	154.0	126.0	-	-	-	327.4	21.3	167.2	139.9	112.5	-	-	-
	72	324.1	18.9	221.1	193.2	165.2	137.2	-	-	305.1	20.9	209.4	182.0	154.7	127.3	-	-
	67	305.2	18.7	260.3	232.3	204.4	176.4	148.4	-	282.8	20.6	251.5	224.2	196.8	169.5	142.1	-
	62	286.4	18.6	286.4	286.4	260.0	232.0	204.0	176.1	263.5	20.4	263.5	263.5	244.5	217.1	189.8	162.5
	57	284.2	17.9	284.2	284.2	269.2	241.2	213.2	185.3	262.8	20.1	262.8	262.8	249.4	222.1	194.8	167.4
9000	72	329.1	18.6	240.3	209.7	179.1	148.5	-	-	311.4	20.9	226.2	196.3	166.4	136.4	-	-
	67	310.0	18.5	284.6	252.3	221.7	191.1	160.6	-	288.7	20.6	271.6	241.6	211.7	181.7	151.8	-
	62	290.9	18.3	290.9	290.9	277.7	247.1	216.5	186.0	269.0	20.3	269.0	269.0	259.5	229.5	199.6	169.6
	57	288.6	17.7	288.6	288.6	281.1	250.6	220.0	189.4	268.3	20.0	268.3	268.3	261.6	231.7	201.7	171.8
10000	72	334.2	18.4	259.4	226.2	193.1	159.9	-	-	317.8	20.8	243.1	210.6	178.0	145.5	-	-
	67	314.8	18.3	308.9	272.3	239.1	205.9	172.7	-	294.6	20.5	291.7	259.1	226.6	194.0	161.4	-
	62	295.4	18.1	295.4	295.4	295.4	262.2	229.1	195.9	274.5	20.2	274.5	274.5	274.5	241.9	209.4	176.8
	57	293.1	17.5	293.1	293.1	293.1	259.9	226.7	193.6	273.8	19.9	273.8	273.8	273.8	241.3	208.7	176.2
		95°F								105°F							
5000	77	298.7	23.2	120.5	100.5	80.6	-	-	-	268.4	25.6	111.2	93.6	74.1	-	-	-
	72	274.1	22.8	157.2	137.3	117.3	97.4	-	-	247.8	25.2	149.0	129.5	110.0	90.5	-	-
	67	249.5	22.3	193.9	174.0	154.0	134.1	114.2	-	227.1	24.8	186.8	165.4	145.9	126.4	106.9	-
	62	230.5	21.9	230.5	213.9	186.4	166.4	146.5	126.5	213.5	24.5	213.5	201.2	173.3	153.8	134.3	114.9
6000	77	303.0	23.3	131.1	108.9	86.8	-	-	-	273.2	25.7	123.7	101.9	80.1	-	-	-
	72	278.1	22.9	170.7	148.5	126.3	104.1	-	-	252.2	25.3	162.5	140.7	118.9	97.1	-	-
	67	253.1	22.4	210.2	188.0	165.8	143.6	121.4	-	231.2	24.9	201.3	179.5	157.7	135.9	114.1	-
	62	233.8	22.0	233.8	222.8	200.6	178.4	156.2	134.0	217.4	24.6	217.4	209.1	187.3	165.5	143.7	121.9
	57	234.8	22.0	234.8	223.4	201.2	179.0	156.8	134.6	219.3	24.6	219.3	208.3	186.4	164.6	142.8	121.0
7000	77	307.4	23.4	141.8	117.4	92.9	-	-	-	278.0	25.8	136.2	110.2	86.0	-	-	-
	72	282.1	22.9	184.1	159.7	135.2	110.8	-	-	256.6	25.4	176.1	151.9	127.8	103.6	-	-
	67	256.7	22.5	226.4	202.0	177.5	153.1	128.6	-	235.3	25.0	215.9	193.7	169.5	145.4	121.2	-
	62	237.2	22.1	237.2	231.7	214.8	190.3	165.9	141.4	221.2	24.7	221.2	217.1	201.3	177.2	153.0	128.9
	57	238.2	22.1	238.2	232.5	215.4	191.0	166.5	142.1	223.1	24.7	223.1	217.6	200.4	176.2	152.1	127.9
8000	77	311.7	23.5	152.5	125.8	99.0	-	-	-	282.8	25.9	148.7	118.5	92.0	-	-	-
	72	286.0	23.0	197.6	170.9	144.2	117.5	-	-	261.1	25.5	189.6	163.1	136.7	110.2	-	-
	67	260.4	22.6	242.7	216.0	189.3	162.6	135.9	-	239.3	25.1	230.5	207.8	181.3	154.8	128.3	-
	62	240.5	22.2	240.5	240.5	229.0	202.3	175.6	148.9	225.1	24.8	225.1	225.1	215.3	188.8	162.3	135.9
	57	241.5	22.2	241.5	241.5	229.7	203.0	176.3	149.6	227.0	24.8	227.0	227.0	214.3	187.8	161.3	134.8
9000	72	293.7	23.1	212.2	182.9	153.6	124.3	-	-	267.7	25.5	203.8	174.8	145.9	116.9	-	-
	67	267.4	22.6	258.5	231.0	201.7	172.3	143.0	-	245.4	25.1	240.9	222.5	193.5	164.6	135.6	-
	62	247.0	22.2	247.0	247.0	241.3	211.9	182.6	153.3	230.7	24.8	230.7	230.7	225.8	196.9	167.9	139.0
	57	248.1	22.3	248.1	248.1	242.1	212.8	183.5	154.2	232.7	24.8	232.7	232.7	226.4	197.4	168.5	139.5
10000	72	301.5	23.1	226.9	194.9	163.0	131.1	-	-	274.2	25.6	217.9	186.5	155.1	123.7	-	-
	67	274.4	22.7	274.4	246.0	214.0	182.1	150.2	-	251.4	25.2	251.4	237.2	205.8	174.4	143.0	-
	62	253.5	22.3	253.5	253.5	253.5	221.6	189.7	157.7	236.4	24.9	236.4	236.4	236.4	205.0	173.5	142.1
	57	254.6	22.3	254.6	254.6	254.6	222.6	190.7	158.8	238.4	24.9	238.4	238.4	238.4	207.0	175.6	144.2

ZF240 (20 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh)					
CFM	WB (°F)			Return Dry Bulb (°F)								Return Dry Bulb (°F)					
				90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
5000	77	238.2	28.0	101.8	86.6	67.5	-	-	-	207.9	30.4	88.1	79.6	61.0	-	-	-
	72	221.5	27.7	140.7	121.7	102.7	83.6	-	-	195.2	30.1	132.5	113.9	95.4	76.8	-	-
	67	204.8	27.3	179.6	156.8	137.8	118.8	99.7	-	182.4	29.8	175.0	148.3	129.7	111.1	92.5	-
	62	196.6	27.1	196.6	188.5	160.3	141.3	122.2	103.2	179.7	29.7	179.7	175.7	147.2	128.7	110.1	91.5
6000	77	243.4	28.1	116.2	94.8	73.4	-	-	-	213.6	30.5	108.8	87.7	66.7	-	-	-
	72	226.4	27.7	154.4	132.9	111.5	90.1	-	-	200.5	30.2	146.2	125.2	104.1	83.1	-	-
	67	209.3	27.4	192.5	171.1	149.6	128.2	106.8	-	187.4	29.9	183.7	162.6	141.6	120.5	99.5	-
	62	200.9	27.2	200.9	195.5	174.1	152.6	131.2	109.7	184.5	29.8	184.5	181.9	160.8	139.7	118.7	97.6
	57	203.7	27.2	203.7	193.1	171.7	150.3	128.8	107.4	188.2	29.8	188.2	178.0	157.0	135.9	114.8	93.8
7000	77	248.7	28.2	130.6	103.0	79.2	-	-	-	219.3	30.6	129.5	95.8	72.3	-	-	-
	72	231.2	27.8	168.0	144.2	120.3	96.5	-	-	205.8	30.3	160.0	136.4	112.9	89.3	-	-
	67	213.8	27.5	205.4	185.3	161.5	137.6	113.8	-	192.3	30.0	192.3	177.0	153.5	129.9	106.4	-
	62	205.3	27.3	205.3	202.5	187.8	164.0	140.1	116.3	189.3	29.9	189.3	188.0	174.4	150.8	127.3	103.7
	57	208.1	27.3	208.1	202.8	185.3	161.4	137.6	113.7	193.0	29.8	193.0	188.0	170.2	146.7	123.1	99.6
8000	77	253.9	28.3	145.0	111.2	85.0	-	-	-	225.0	30.7	150.1	104.0	77.9	-	-	-
	72	236.1	27.9	181.7	155.4	129.1	102.9	-	-	211.1	30.4	173.7	147.7	121.6	95.6	-	-
	67	218.3	27.6	218.3	199.6	173.3	147.1	120.8	-	197.3	30.1	197.3	191.4	165.4	139.3	113.3	-
	62	209.6	27.4	209.6	209.6	201.6	175.4	149.1	122.8	194.1	29.9	194.1	194.1	187.9	161.9	135.9	109.8
	57	212.5	27.4	212.5	212.5	198.9	172.6	146.4	120.1	197.9	29.9	197.9	197.9	183.5	157.4	131.4	105.4
9000	72	241.6	28.0	195.3	166.8	138.2	109.6	-	-	215.5	30.4	186.9	158.7	130.5	102.3	-	-
	67	223.3	27.6	223.3	214.0	185.4	156.9	128.3	-	201.3	30.1	201.3	201.3	177.3	149.1	120.9	-
	62	214.4	27.4	214.4	214.4	210.4	181.9	153.3	124.7	198.1	30.0	198.1	198.1	195.0	166.8	138.6	110.4
	57	217.4	27.4	217.4	217.4	210.6	182.0	153.4	124.8	202.0	30.0	202.0	202.0	194.8	166.6	138.4	110.2
10000	72	247.0	28.0	209.0	178.1	147.2	116.3	-	-	219.8	30.5	200.1	169.7	139.3	108.9	-	-
	67	228.4	27.7	228.4	228.4	197.5	166.6	135.7	-	205.4	30.2	205.4	205.4	189.3	158.9	128.5	-
	62	219.3	27.4	219.3	219.3	219.3	188.3	157.4	126.5	202.1	30.0	202.1	202.1	202.1	171.7	141.3	110.9
	57	222.3	27.4	222.3	222.3	222.3	191.4	160.5	129.6	206.1	30.0	206.1	206.1	206.1	175.8	145.4	115.0

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

ZF300 (25 Ton)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		75°F								85°F							
6250	77	417.2	14.6	174.9	147.8	120.7	-	-	-	367.0	20.0	156.3	130.1	103.9	-	-	-
	72	388.4	14.2	228.9	201.8	174.8	147.7	-	-	341.8	19.5	206.0	179.8	153.5	127.3	-	-
	67	359.6	13.8	283.0	255.9	228.8	201.7	174.7	-	316.6	18.9	255.6	229.4	203.2	177.0	150.8	-
	62	332.4	13.4	332.4	312.5	282.3	255.2	228.1	201.1	292.9	18.5	292.9	282.9	251.9	225.7	199.5	173.3
7500	77	409.9	16.7	179.8	150.4	121.1	-	-	-	370.5	21.0	164.8	136.1	107.4	-	-	-
	72	381.6	16.2	233.7	204.4	175.0	145.6	-	-	345.0	20.5	216.1	187.4	158.7	130.0	-	-
	67	353.3	15.7	287.7	258.3	228.9	199.6	170.2	-	319.6	19.9	267.4	238.7	210.0	181.3	152.5	-
	62	326.5	15.3	326.5	313.3	282.4	253.0	223.6	194.3	295.6	19.4	295.6	289.0	260.3	231.6	202.9	174.1
	57	320.4	15.2	320.4	320.4	307.9	278.6	249.2	219.8	291.6	19.4	291.6	291.6	279.1	250.4	221.6	192.9
8750	77	402.6	18.7	184.7	153.1	121.4	-	-	-	374.0	22.0	173.3	142.1	110.8	-	-	-
	72	374.8	18.2	238.6	206.9	175.2	143.6	-	-	348.3	21.5	226.3	195.0	163.8	132.6	-	-
	67	346.9	17.6	292.4	260.7	229.1	197.4	165.8	-	322.6	20.9	279.2	248.0	216.8	185.5	154.3	-
	62	320.7	17.2	320.7	314.1	282.4	250.8	219.1	187.4	298.4	20.4	298.4	295.1	268.7	237.5	206.2	175.0
	57	314.6	17.1	314.6	314.6	308.4	276.7	245.1	213.4	294.4	20.3	294.4	294.4	288.1	256.9	225.6	194.4
10000	77	395.3	20.8	189.7	155.7	121.8	-	-	-	377.5	23.0	181.8	148.0	114.3	-	-	-
	72	368.0	20.2	243.4	209.4	175.5	141.5	-	-	351.6	22.4	236.4	202.7	168.9	135.2	-	-
	67	340.6	19.6	297.1	263.1	229.2	195.3	161.3	-	325.6	21.8	291.0	257.3	223.5	189.8	156.1	-
	62	314.8	19.1	314.8	314.8	282.5	248.5	214.6	180.6	301.2	21.3	301.2	301.2	277.1	243.4	209.6	175.9
	57	308.8	19.0	308.8	308.8	308.8	274.8	240.9	207.0	297.1	21.2	297.1	297.1	297.1	263.4	229.6	195.9
11250	72	375.4	20.3	259.8	222.7	185.5	148.4	-	-	357.9	22.6	252.5	215.6	178.7	141.8	-	-
	67	347.5	19.7	317.9	279.4	242.3	205.2	168.0	-	331.5	21.9	310.3	273.4	236.5	199.6	162.7	-
	62	321.1	19.2	321.1	321.1	302.2	265.0	227.9	190.7	306.6	21.4	306.6	306.6	293.2	256.3	219.4	182.5
	57	315.0	19.1	315.0	315.0	315.0	277.8	240.7	203.6	302.4	21.3	302.4	302.4	302.4	265.5	228.6	191.7
12500	72	382.7	20.4	276.2	235.9	195.6	155.2	-	-	364.1	22.7	268.6	228.5	188.5	148.4	-	-
	67	354.3	19.8	338.8	295.8	255.4	215.1	174.8	-	337.3	22.1	329.5	289.5	249.4	209.4	169.3	-
	62	327.5	19.4	327.5	327.5	321.9	281.5	241.2	200.9	312.0	21.6	312.0	312.0	309.2	269.2	229.1	189.0
	57	321.2	19.2	321.2	321.2	321.2	280.8	240.5	200.2	307.7	21.5	307.7	307.7	307.7	267.7	227.6	187.6
		95°F								105°F							
6250	77	316.8	25.4	137.7	112.4	87.1	-	-	-	289.4	27.9	132.4	106.9	81.3	-	-	-
	72	295.2	24.7	183.0	157.7	132.3	107.0	-	-	270.0	27.3	175.6	150.1	124.5	99.0	-	-
	67	273.6	24.1	228.2	202.9	177.6	152.2	126.9	-	250.6	26.7	218.8	193.2	167.7	142.2	116.6	-
	62	253.3	23.6	253.3	253.3	221.5	196.2	170.8	145.5	232.1	26.2	232.1	232.1	209.9	184.3	158.8	133.2
7500	77	331.1	25.4	149.8	121.7	93.7	-	-	-	306.3	27.9	144.5	116.4	88.3	-	-	-
	72	308.5	24.7	198.5	170.4	142.3	114.3	-	-	285.7	27.3	191.4	163.3	135.2	107.1	-	-
	67	286.0	24.1	247.2	219.1	191.0	162.9	134.9	-	265.2	26.7	238.4	210.3	182.2	154.1	126.0	-
	62	264.8	23.6	264.8	264.8	238.2	210.2	182.1	154.0	245.6	26.1	245.6	245.6	228.0	199.9	171.8	143.7
	57	262.8	23.5	262.8	262.8	250.2	222.2	194.1	166.0	245.6	26.2	245.6	245.6	235.4	207.3	179.2	151.1
8750	77	345.4	25.3	161.9	131.1	100.2	-	-	-	323.2	27.8	156.7	126.0	95.3	-	-	-
	72	321.8	24.7	214.0	183.2	152.4	121.5	-	-	301.5	27.2	207.3	176.6	146.0	115.3	-	-
	67	298.3	24.1	266.1	235.3	204.5	173.6	142.8	-	279.8	26.6	257.9	227.3	196.6	166.0	135.3	-
	62	276.2	23.5	276.2	276.2	255.0	224.2	193.4	162.6	259.2	26.1	259.2	259.2	246.1	215.4	184.8	154.1
	57	274.1	23.5	274.1	274.1	267.8	237.0	206.2	175.4	259.2	26.1	259.2	259.2	254.1	223.4	192.8	162.1
10000	77	359.6	25.3	173.9	140.4	106.8	-	-	-	340.1	27.8	168.8	135.6	102.3	-	-	-
	72	335.1	24.7	229.5	195.9	162.4	128.8	-	-	317.3	27.2	223.1	189.9	156.7	123.5	-	-
	67	310.6	24.1	285.0	251.4	217.9	184.4	150.8	-	294.4	26.6	277.5	244.3	211.1	177.9	144.6	-
	62	287.6	23.5	287.6	287.6	271.8	238.2	204.7	171.1	272.7	26.1	272.7	272.7	264.2	231.0	197.8	164.5
	57	285.4	23.5	285.4	285.4	285.4	251.9	218.3	184.8	272.7	26.1	272.7	272.7	272.7	239.5	206.3	173.1
11250	72	340.3	24.8	245.2	208.5	171.9	135.2	-	-	321.8	27.3	239.0	202.6	166.2	129.9	-	-
	67	315.5	24.2	302.6	267.3	230.7	194.0	157.3	-	298.7	26.7	290.2	260.3	223.9	187.5	151.2	-
	62	292.1	23.6	292.1	292.1	284.2	247.5	210.8	174.2	276.7	26.2	276.7	276.7	272.4	236.0	199.7	163.3
	57	289.9	23.6	289.9	289.9	289.9	253.2	216.6	179.9	276.7	26.2	276.7	276.7	276.7	240.3	204.0	167.6
12500	72	345.6	24.9	260.9	221.2	181.4	141.6	-	-	326.4	27.4	254.8	215.3	175.8	136.3	-	-
	67	320.3	24.3	320.3	283.2	243.4	203.6	163.9	-	302.9	26.8	302.9	276.2	236.7	197.2	157.7	-
	62	296.6	23.8	296.6	296.6	296.6	256.8	217.0	177.2	280.6	26.3	280.6	280.6	280.6	241.1	201.6	162.1
	57	294.3	23.7	294.3	294.3	294.3	254.6	214.8	175.0	280.6	26.3	280.6	280.6	280.6	241.1	201.6	162.1

ZF300 (25 Ton) (Continued)

Air on Evaporator Coil		Temperature of Air on Condenser Coil															
		Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)						Total Capacity[1] (MBh)	Total Input (kW)[2]	Sensible Capacity (MBh) Return Dry Bulb (°F)					
CFM	WB (°F)			90	85	80	75	70	65			90	85	80	75	70	65
		115°F								125°F							
6250	77	262.1	30.5	127.1	101.4	75.6	-	-	-	234.7	33.0	121.6	95.8	69.9	-	-	-
	72	244.8	29.9	168.2	142.5	116.7	91.0	-	-	219.6	32.5	160.8	134.9	108.9	82.9	-	-
	67	227.5	29.4	209.3	183.6	157.8	132.1	106.3	-	204.4	32.0	199.8	173.9	147.9	122.0	96.0	-
	62	210.8	28.8	210.8	210.8	198.3	172.5	146.8	121.0	189.6	31.4	189.6	189.6	189.6	160.7	134.7	108.8
7500	77	281.6	30.4	139.3	111.2	83.0	-	-	-	256.8	32.9	134.0	105.9	77.7	-	-	-
	72	263.0	29.8	184.4	156.3	128.2	100.0	-	-	240.2	32.4	177.4	149.2	121.1	92.9	-	-
	67	244.4	29.3	229.6	201.4	173.3	145.2	117.0	-	223.6	31.9	220.7	192.6	164.4	136.3	108.1	-
	62	226.5	28.7	226.5	226.5	217.7	189.6	161.4	133.3	207.4	31.3	207.4	207.4	207.4	179.3	151.1	123.0
	57	228.4	28.8	228.4	228.4	220.6	192.5	164.4	136.2	211.2	31.5	211.2	211.2	205.9	177.7	149.5	121.4
8750	77	301.1	30.3	151.5	121.0	90.4	-	-	-	278.9	32.8	146.5	115.9	85.5	-	-	-
	72	281.2	29.7	200.6	170.1	139.6	109.1	-	-	260.9	32.2	194.0	163.6	133.2	102.9	-	-
	67	261.3	29.2	249.8	219.3	188.8	158.3	127.7	-	242.9	31.7	241.6	211.3	180.9	150.6	120.2	-
	62	242.2	28.7	242.2	242.2	237.2	206.6	176.1	145.6	225.2	31.2	225.2	225.2	225.2	197.9	167.5	137.1
	57	244.2	28.7	244.2	244.2	240.3	209.8	179.3	148.8	229.3	31.3	229.3	229.3	226.6	196.2	165.9	135.5
10000	77	320.6	30.2	163.6	130.8	97.9	-	-	-	301.0	32.6	159.0	125.9	93.4	-	-	-
	72	299.4	29.7	216.8	183.9	151.1	118.2	-	-	281.6	32.1	210.5	178.0	145.4	112.8	-	-
	67	278.3	29.1	270.0	237.1	204.2	171.4	138.5	-	262.1	31.6	262.1	230.0	197.4	164.9	132.3	-
	62	257.9	28.6	257.9	257.9	256.6	223.7	190.8	157.9	243.0	31.1	243.0	243.0	243.0	216.4	183.9	151.3
	57	260.1	28.6	260.1	260.1	260.1	227.2	194.3	161.4	247.4	31.2	247.4	247.4	247.4	214.8	182.2	149.7
11250	72	303.4	29.8	232.7	196.6	160.6	124.5	-	-	284.9	32.2	226.5	190.7	154.9	119.2	-	-
	67	281.9	29.2	277.8	253.2	217.1	181.1	145.0	-	265.2	31.7	265.2	246.1	210.4	174.6	138.9	-
	62	261.3	28.7	261.3	261.3	260.6	224.6	188.5	152.5	245.9	31.2	245.9	245.9	245.9	213.1	177.4	141.6
	57	263.5	28.8	263.5	263.5	263.5	227.4	191.4	155.3	250.3	31.3	250.3	250.3	250.3	214.5	178.8	143.0
12500	72	307.3	29.9	248.6	209.4	170.1	130.9	-	-	288.2	32.4	242.4	203.4	164.5	125.6	-	-
	67	285.6	29.3	285.6	269.3	230.0	190.8	151.6	-	268.2	31.9	268.2	262.3	223.3	184.4	145.5	-
	62	264.7	28.8	264.7	264.7	264.7	225.5	186.2	147.0	248.7	31.3	248.7	248.7	248.7	209.8	170.8	131.9
	57	266.9	28.9	266.9	266.9	266.9	227.7	188.5	149.2	253.2	31.5	253.2	253.2	253.2	214.2	175.3	136.3

1. These capacities are gross ratings. For net capacity, deduct air blower motor, MBh = 3.415 x kW. Refer to the appropriate Blower Performance Table for the kW of the supply air blower motor.
2. These ratings include the condenser fan motors (total 1 kW) and the compressor motors but not the supply air blower motor.

Airflow Performance

ZJ180-300 Side Duct Application

ZJ180 (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 5 HP & Drive									
4000	727	1.14	765	1.47	806	1.77	848	2.04	891	2.29	934	2.52	977	2.73	1020	2.93	1061	3.12	1101	3.30	1138	3.48	1174	3.67
4400	753	1.51	792	1.84	832	2.14	874	2.41	917	2.66	960	2.88	1004	3.09	1046	3.29	1087	3.48	1127	3.67	1165	3.85	1200	4.03
4800	781	1.92	820	2.25	861	2.55	903	2.82	946	3.06	989	3.29	1032	3.50	1074	3.70	1116	3.89	1155	4.08	1193	4.26	1228	4.44
5200	812	2.37	850	2.70	891	3.00	933	3.27	976	3.52	1019	3.74	1062	3.95	1105	4.15	1146	4.34	1186	4.53	1223	4.71	1259	4.89
5600	844	2.86	882	3.19	923	3.49	965	3.76	1008	4.01	1051	4.23	1094	4.45	1137	4.64	1178	4.83	1218	5.02	1255	5.20	1291	5.39
6000	877	3.39	916	3.72	957	4.02	999	4.29	1042	4.54	1085	4.76	1128	4.98	1170	5.17	1212	5.36	1251	5.55	1289	5.73	-	-
6400	912	3.96	951	4.29	992	4.59	1034	4.86	1077	5.10	1120	5.33	1163	5.54	1205	5.74	-	-	-	-	-	-	-	-
6800	949	4.56	988	4.89	1028	5.19	1070	5.46	1113	5.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	986	5.20	1025	5.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZJ210 (17.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive										High Static 7.5 HP & Drive							
4400	636	0.65	672	1.14	709	1.60	745	2.03	780	2.43	815	2.78	849	3.09	882	3.35	914	3.55	944	3.70	973	3.78	999	3.79
4800	649	0.99	685	1.48	721	1.94	757	2.37	793	2.77	828	3.12	862	3.43	895	3.69	927	3.89	957	4.04	985	4.12	1012	4.13
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ240 (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive										High Static 7.5 HP & Drive									
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
9200	905	6.85	941	7.33	977	7.79	1014	8.22	1049	8.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	936	7.65	973	8.13	1009	8.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	969	8.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ300 (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	760	2.51	793	3.11	824	3.68	856	4.23	887	4.74	919	5.23	950	5.70	983	6.15
7000	775	2.99	808	3.60	839	4.17	871	4.71	902	5.22	934	5.72	966	6.19	998	6.64
7400	792	3.51	824	4.11	856	4.69	887	5.23	918	5.74	950	6.24	982	6.70	1014	7.16
7800	809	4.07	841	4.67	873	5.24	904	5.78	935	6.30	967	6.79	999	7.26	1031	7.71
8200	826	4.66	859	5.27	890	5.84	922	6.38	953	6.89	985	7.39	1016	7.86	1049	8.31
8600	845	5.30	877	5.90	909	6.47	940	7.01	972	7.53	1003	8.02	1035	8.49	1067	8.94
9000	864	5.97	896	6.57	928	7.14	960	7.69	991	8.20	1022	8.69	1054	9.16	1087	9.61
9400	884	6.68	916	7.28	948	7.86	980	8.40	1011	8.91	1042	9.41	1074	9.88	1107	10.33
9800	905	7.43	937	8.04	969	8.61	1000	9.15	1032	9.67	1063	10.16	1095	10.63	1127	11.08
10200	926	8.22	958	8.83	990	9.40	1021	9.94	1053	10.46	1084	10.95	1116	11.42	1148	11.87
10600	948	9.05	980	9.66	1012	10.23	1043	10.77	1075	11.29	1106	11.78	1138	12.25	1170	12.70
11000	970	9.92	1003	10.52	1034	11.09	1066	11.64	1097	12.15	1128	12.64	1160	13.11	1193	13.56
11400	993	10.82	1025	11.43	1057	12.00	1089	12.54	1120	13.06	1151	13.55	1183	14.02	1216	14.47
11800	1017	11.76	1049	12.37	1081	12.94	1112	13.48	1143	14.00	1175	14.49	1207	14.96	1239	15.41
12200	1040	12.74	1073	13.34	1104	13.91	1136	14.46	1167	14.97	1199	15.46	1231	15.93	1263	16.38
12600	1065	13.75	1097	14.35	1129	14.92	1160	15.47	1192	15.98	1223	16.47	1255	16.94	-	-
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1016	6.59	1050	7.00	1086	7.41	1123	7.81	1161	8.19	1202	8.58	1244	8.95	1289	9.33
7000	1031	7.07	1065	7.49	1101	7.89	1138	8.29	1176	8.68	1217	9.06	1259	9.44	1304	9.82
7400	1047	7.59	1081	8.01	1117	8.41	1154	8.81	1192	9.20	1233	9.58	1275	9.96	1320	10.34
7800	1064	8.14	1098	8.56	1134	8.97	1171	9.36	1209	9.75	1250	10.13	1292	10.51	1337	10.89
8200	1082	8.74	1116	9.16	1152	9.56	1189	9.96	1227	10.35	1268	10.73	1310	11.11	1355	11.49
8600	1101	9.37	1135	9.79	1170	10.20	1207	10.59	1246	10.98	1286	11.36	1329	11.74	1374	12.12
9000	1120	10.05	1154	10.46	1189	10.87	1226	11.27	1265	11.65	1305	12.04	1348	12.41	1393	12.79
9400	1140	10.76	1174	11.18	1209	11.58	1246	11.98	1285	12.37	1325	12.75	1368	13.13	1413	13.51
9800	1160	11.51	1195	11.93	1230	12.33	1267	12.73	1306	13.12	1346	13.50	1389	13.88	1434	14.26
10200	1182	12.30	1216	12.72	1251	13.12	1288	13.52	1327	13.91	1367	14.29	1410	14.67	1455	15.05
10600	1204	13.13	1238	13.55	1273	13.95	1310	14.35	1349	14.74	1389	15.12	1432	15.50	1477	15.88
11000	1226	14.00	1260	14.41	1296	14.82	1332	15.22	1371	15.60	1412	15.99	1454	16.36	1499	16.74
11400	1249	14.90	1283	15.32	1318	15.72	1355	16.12	1394	16.51	1434	16.89	-	-	-	-
11800	1272	15.84	1306	16.26	1342	16.66	1379	17.06	-	-	-	-	-	-	-	-
12200	1296	16.82	1330	17.23	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

ZJ180-300 Bottom Duct Application

ZJ180 (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive								High Static 5 HP & Drive											
4000	768	1.24	806	1.55	846	1.83	888	2.09	930	2.32	972	2.53	1015	2.73	1056	2.91	1097	3.09	1136	3.27	1173	3.44	1208	3.61
4400	797	1.65	835	1.96	875	2.24	916	2.49	959	2.72	1001	2.93	1043	3.13	1085	3.32	1126	3.50	1165	3.67	1202	3.84	1237	4.02
4800	828	2.09	866	2.40	906	2.68	947	2.93	989	3.16	1032	3.38	1074	3.58	1116	3.76	1157	3.94	1196	4.11	1233	4.28	1267	4.46
5200	860	2.57	898	2.88	938	3.16	980	3.41	1022	3.65	1064	3.86	1107	4.06	1148	4.24	1189	4.42	1228	4.59	1265	4.77	1300	4.94
5600	894	3.09	932	3.40	972	3.68	1014	3.93	1056	4.16	1098	4.38	1141	4.57	1182	4.76	1223	4.94	1262	5.11	1299	5.28	1334	5.46
6000	930	3.64	968	3.95	1008	4.23	1049	4.48	1091	4.71	1134	4.93	1176	5.12	1218	5.31	1259	5.49	1298	5.66	-	-	-	-
6400	966	4.22	1005	4.53	1045	4.81	1086	5.06	1128	5.30	1171	5.51	1213	5.71	-	-	-	-	-	-	-	-	-	-
6800	1005	4.84	1043	5.14	1083	5.42	1124	5.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	1044	5.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																	5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZJ210 (17.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive												High Static 7.5 HP & Drive							
4400	661	0.74	697	1.19	733	1.62	768	2.03	803	2.40	838	2.73	871	3.02	904	3.26	935	3.45	964	3.59	992	3.66	1018	3.67
4800	677	1.07	712	1.53	748	1.96	784	2.36	819	2.73	853	3.06	887	3.35	919	3.59	950	3.79	980	3.92	1008	4.00	1034	4.01
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
																	7.5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ240 (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive												High Static 7.5 HP & Drive									
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
9200	955	7.23	991	7.68	1026	8.11	1062	8.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	988	8.05	1024	8.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
															7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ300 (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6			
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP		
	Low Static 7.5 HP & Field Supplied Drive		Low Static 7.5 HP & Drive													
6600	787	2.67	819	3.23	850	3.76	881	4.27	912	4.75	943	5.21	974	5.65		
7000	804	3.18	835	3.74	867	4.27	898	4.78	928	5.26	959	5.72	991	6.16		
7400	821	3.72	853	4.28	884	4.82	915	5.32	946	5.80	977	6.26	1008	6.70		
7800	839	4.30	871	4.86	902	5.40	933	5.90	964	6.39	995	6.85	1026	7.28		
8200	858	4.92	890	5.48	921	6.02	952	6.52	983	7.01	1013	7.47	1045	7.90		
8600	877	5.58	909	6.14	940	6.68	971	7.18	1002	7.66	1033	8.12	1064	8.56		
9000	898	6.28	929	6.84	960	7.37	991	7.88	1022	8.36	1053	8.82	1084	9.26		
9400	918	7.01	950	7.57	981	8.10	1012	8.61	1043	9.09	1074	9.55	1105	9.99		
9800	940	7.78	972	8.34	1003	8.87	1034	9.38	1064	9.86	1095	10.32	1127	10.76		
10200	962	8.58	994	9.14	1025	9.68	1056	10.18	1086	10.67	1117	11.13	1149	11.56		
10600	984	9.42	1016	9.98	1047	10.52	1078	11.02	1109	11.51	1140	11.96	1171	12.40		
11000	1007	10.30	1039	10.86	1070	11.39	1101	11.90	1132	12.38	1163	12.84	1194	13.28		
11400	1031	11.20	1063	11.76	1094	12.30	1125	12.80	1156	13.29	1187	13.75	1218	14.18		
11800	1055	12.14	1087	12.70	1118	13.24	1149	13.74	1180	14.23	1211	14.69	1242	15.12		
12200	1080	13.11	1111	13.68	1142	14.21	1173	14.72	1204	15.20	1235	15.66	1266	16.10		
12600	1104	14.12	1136	14.68	1167	15.21	1198	15.72	1229	16.20	1260	16.66	1291	17.10		
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	1.8		2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive							
6600	1006	6.07	1039	6.48	1072	6.87	1107	7.25	1144	7.62	1182	7.98	1221	8.33	1263	8.68	1307	9.04
7000	1023	6.58	1055	6.98	1089	7.37	1124	7.75	1160	8.12	1198	8.48	1238	8.84	1280	9.19	1324	9.54
7400	1040	7.12	1072	7.53	1106	7.92	1141	8.30	1177	8.67	1215	9.03	1255	9.38	1297	9.74	1341	10.09
7800	1058	7.71	1090	8.11	1124	8.50	1159	8.88	1195	9.25	1233	9.61	1273	9.97	1315	10.32	1359	10.67
8200	1077	8.33	1109	8.73	1143	9.12	1178	9.50	1214	9.87	1252	10.23	1292	10.59	1334	10.94	1378	11.29
8600	1096	8.98	1129	9.39	1162	9.78	1197	10.16	1234	10.53	1272	10.89	1311	11.24	1353	11.60	1397	11.95
9000	1116	9.68	1149	10.08	1183	10.47	1218	10.85	1254	11.22	1292	11.58	1332	11.94	1373	12.29	1418	12.64
9400	1137	10.41	1170	10.82	1203	11.21	1238	11.59	1275	11.95	1313	12.32	1352	12.67	1394	13.02	1438	13.37
9800	1159	11.18	1191	11.59	1225	11.98	1260	12.35	1296	12.72	1334	13.09	1374	13.44	1416	13.79	1460	14.14
10200	1181	11.99	1213	12.39	1247	12.78	1282	13.16	1318	13.53	1356	13.89	1396	14.25	1438	14.60	1482	14.95
10600	1203	12.82	1236	13.23	1269	13.62	1304	14.00	1341	14.37	1379	14.73	1418	15.08	1460	15.44	1504	15.79
11000	1226	13.70	1259	14.10	1293	14.49	1327	14.87	1364	15.24	1402	15.60	1441	15.96	1483	16.31	1528	16.66
11400	1250	14.61	1282	15.01	1316	15.40	1351	15.78	1387	16.15	1425	16.51	1465	16.87	1507	17.22	-	-
11800	1274	15.55	1307	15.95	1340	16.34	1375	16.72	1411	17.09	-	-	-	-	-	-	-	-
12200	1298	16.52	1331	16.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

ZR180-300 Side Duct Application

ZR180 (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 7.5 HP & Drive									
4000	696	0.94	735	1.23	776	1.49	818	1.73	861	1.95	904	2.15	947	2.34	990	2.52	1031	2.68	1071	2.84	1109	3.01	1144	3.17
4400	724	1.27	763	1.56	804	1.83	846	2.07	889	2.29	932	2.49	976	2.68	1018	2.85	1060	3.02	1100	3.18	1137	3.34	1173	3.50
4800	756	1.66	795	1.95	835	2.21	878	2.45	921	2.67	964	2.87	1007	3.06	1050	3.24	1091	3.40	1131	3.56	1169	3.72	1204	3.89
5200	790	2.09	829	2.38	870	2.65	912	2.89	955	3.11	998	3.31	1041	3.49	1084	3.67	1125	3.84	1165	4.00	1203	4.16	1238	4.32
5600	826	2.57	865	2.87	906	3.13	948	3.37	991	3.59	1035	3.79	1078	3.98	1120	4.15	1162	4.32	1202	4.48	1239	4.64	1275	4.81
6000	865	3.11	904	3.40	945	3.66	987	3.90	1030	4.12	1073	4.32	1117	4.51	1159	4.69	1201	4.85	1241	5.01	1278	5.18	1314	5.34
6400	906	3.69	945	3.98	986	4.24	1028	4.48	1071	4.70	1114	4.90	1158	5.09	1200	5.27	1242	5.43	1282	5.59	1319	5.76	1355	5.92
6800	949	4.31	988	4.60	1029	4.87	1071	5.11	1114	5.33	1157	5.53	1201	5.72	1243	5.89	1285	6.06	1324	6.22	1362	6.38	1398	6.54
7200	994	4.98	1033	5.27	1074	5.54	1116	5.78	1159	6.00	1202	6.20	1245	6.39	1288	6.56	1329	6.73	1369	6.89	1407	7.05	1442	7.21
7600	1040	5.70	1079	5.99	1120	6.25	1162	6.49	1205	6.71	1249	6.91	1292	7.10	1334	7.27	1376	7.44	1416	7.60	1453	7.76	1489	7.93
											7.5 HP & Field Supplied Drive													

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZR240 (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 7.5 HP & Field Supplied Drive		Standard 7.5 HP & Drive												High Static 10 HP & Drive									
5200	693	1.36	730	1.83	766	2.27	802	2.68	838	3.06	873	3.40	907	3.69	940	3.94	971	4.14	1002	4.28	1030	4.35	1057	4.37
5600	714	1.77	750	2.24	786	2.68	822	3.09	858	3.47	893	3.81	927	4.11	960	4.36	992	4.55	1022	4.69	1050	4.77	1077	4.78
6000	736	2.23	772	2.70	809	3.14	845	3.55	880	3.93	915	4.27	949	4.56	982	4.81	1014	5.01	1044	5.15	1073	5.23	1099	5.24
6400	760	2.73	796	3.20	832	3.64	869	4.05	904	4.43	939	4.77	973	5.06	1006	5.31	1038	5.51	1068	5.65	1096	5.72	1123	5.74
6800	785	3.28	821	3.74	858	4.18	894	4.60	930	4.97	965	5.31	999	5.61	1032	5.86	1063	6.05	1094	6.19	1122	6.27	1148	6.28
7200	812	3.87	848	4.33	885	4.78	921	5.19	957	5.57	992	5.91	1026	6.20	1059	6.45	1090	6.65	1120	6.79	1149	6.86	1175	6.88
7600	840	4.51	877	4.98	913	5.42	949	5.83	985	6.21	1020	6.55	1054	6.84	1087	7.09	1119	7.29	1149	7.43	1177	7.50	1204	7.52
8000	870	5.20	907	5.66	943	6.10	979	6.52	1015	6.89	1050	7.23	1084	7.53	1117	7.78	1148	7.98	1179	8.11	1207	8.19	1233	8.20
8400	901	5.93	938	6.40	974	6.84	1010	7.25	1046	7.63	1081	7.97	1115	8.27	1148	8.51	1179	8.71	1210	8.85	1238	8.93	1265	8.94
8800	933	6.71	970	7.18	1006	7.62	1042	8.03	1078	8.41	1113	8.75	1147	9.05	1180	9.30	1212	9.49	1242	9.63	1270	9.71	1297	9.72
9200	967	7.54	1003	8.01	1040	8.45	1076	8.86	1111	9.24	1146	9.58	1180	9.87	1213	10.12	1245	10.32	1275	10.46	1304	10.54	1330	10.55
9600	1001	8.41	1038	8.88	1074	9.32	1110	9.73	1146	10.11	1181	10.45	1215	10.74	1248	10.99	1280	11.19	1310	11.33	1338	11.41	1365	11.42
10000	1037	9.33	1073	9.79	1110	10.23	1146	10.65	1182	11.02	1217	11.36	-	-	-	-	-	-	-	-	-	-	-	-
							10 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZR300 (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	758	3.03	790	3.47	822	3.88	854	4.27	885	4.65	916	5.00	948	5.34	981	5.66
7000	781	3.56	813	4.00	845	4.42	876	4.81	908	5.18	939	5.53	971	5.87	1003	6.20
7400	806	4.14	838	4.58	870	5.00	901	5.39	933	5.76	964	6.12	996	6.45	1028	6.78
7800	833	4.78	865	5.22	897	5.63	928	6.03	959	6.40	991	6.75	1023	7.09	1055	7.41
8200	861	5.47	893	5.91	925	6.33	956	6.72	988	7.09	1019	7.45	1051	7.78	1083	8.11
8600	891	6.23	923	6.67	955	7.08	986	7.47	1018	7.85	1049	8.20	1081	8.54	1113	8.86
9000	922	7.05	955	7.48	986	7.90	1018	8.29	1049	8.66	1080	9.02	1112	9.36	1145	9.68
9400	955	7.93	987	8.37	1019	8.78	1050	9.17	1082	9.54	1113	9.90	1145	10.24	1177	10.56
9800	989	8.87	1021	9.31	1053	9.73	1084	10.12	1115	10.49	1147	10.84	1179	11.18	1211	11.51
10200	1024	9.88	1056	10.32	1088	10.74	1119	11.13	1150	11.50	1182	11.86	1214	12.19	1246	12.52
10600	1060	10.96	1092	11.40	1124	11.81	1155	12.20	1186	12.58	1218	12.93	1250	13.27	1282	13.59
11000	1096	12.10	1129	12.54	1160	12.95	1192	13.34	1223	13.72	1255	14.07	1286	14.41	1319	14.73
11400	1134	13.30	1166	13.74	1198	14.16	1230	14.55	1261	14.92	1292	15.27	1324	15.61	1357	15.94
11800	1173	14.57	1205	15.01	1237	15.42	1268	15.82	1299	16.19	1331	16.54	1363	16.88	1395	17.20
12200	1212	15.90	1244	16.34	1276	16.75	1308	17.14	-	-	-	-	-	-	-	-
	High Static 15 HP & Drive														15 HP & Field Supplied Drive	

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1014	5.98	1048	6.28	1083	6.57	1120	6.86	1159	7.15	1199	7.44	1242	7.72	1287	8.01
7000	1037	6.51	1071	6.81	1106	7.11	1143	7.40	1182	7.68	1222	7.97	1265	8.26	1310	8.54
7400	1061	7.09	1096	7.39	1131	7.69	1168	7.98	1207	8.27	1247	8.55	1290	8.84	1335	9.13
7800	1088	7.73	1122	8.03	1158	8.33	1195	8.62	1233	8.90	1274	9.19	1316	9.47	1361	9.76
8200	1117	8.42	1151	8.72	1186	9.02	1223	9.31	1262	9.60	1302	9.88	1345	10.17	1390	10.45
8600	1146	9.18	1181	9.48	1216	9.77	1253	10.06	1292	10.35	1332	10.63	1375	10.92	1420	11.21
9000	1178	9.99	1212	10.30	1247	10.59	1284	10.88	1323	11.17	1363	11.45	1406	11.74	1451	12.03
9400	1210	10.87	1245	11.18	1280	11.47	1317	11.76	1356	12.05	1396	12.33	1439	12.62	1484	12.91
9800	1244	11.82	1279	12.12	1314	12.42	1351	12.71	1389	12.99	1430	13.28	1473	13.57	1517	13.85
10200	1279	12.83	1313	13.13	1349	13.43	1386	13.72	1424	14.01	1465	14.29	1507	14.58	1552	14.87
10600	1315	13.91	1349	14.21	1385	14.50	1422	14.79	1460	15.08	1501	15.37	1543	15.65	1588	15.94
11000	1352	15.05	1386	15.35	1422	15.64	1459	15.93	1497	16.22	1538	16.51	1580	16.79	1625	17.08
11400	1390	16.25	1424	16.55	1459	16.85	1496	17.14	-	-	-	-	-	-	-	-
11800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

ZR180-300 Bottom Duct Application

ZR180 (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 7.5 HP & Drive									
4000	735	1.20	773	1.46	813	1.70	855	1.92	897	2.12	939	2.30	982	2.47	1023	2.63	1064	2.78	1103	2.93	1140	3.07	1175	3.22
4400	767	1.56	805	1.83	845	2.07	886	2.28	929	2.48	971	2.66	1013	2.83	1055	2.99	1096	3.14	1135	3.29	1172	3.44	1207	3.58
4800	802	1.98	840	2.24	880	2.48	921	2.70	963	2.89	1006	3.08	1048	3.25	1090	3.40	1131	3.56	1170	3.70	1207	3.85	1242	3.99
5200	839	2.44	877	2.70	917	2.94	959	3.16	1001	3.35	1043	3.54	1086	3.70	1127	3.86	1168	4.01	1207	4.16	1244	4.31	1279	4.45
5600	879	2.94	917	3.21	957	3.44	998	3.66	1041	3.86	1083	4.04	1125	4.21	1167	4.37	1208	4.52	1247	4.67	1284	4.81	1319	4.96
6000	921	3.49	959	3.76	999	4.00	1040	4.21	1082	4.41	1125	4.59	1167	4.76	1209	4.92	1250	5.07	1289	5.22	1326	5.36	1361	5.51
6400	965	4.09	1003	4.35	1043	4.59	1084	4.81	1126	5.01	1169	5.19	1211	5.36	1253	5.51	1294	5.67	1333	5.81	1370	5.96	1405	6.11
6800	1010	4.72	1049	4.99	1089	5.23	1130	5.44	1172	5.64	1215	5.82	1257	5.99	1299	6.15	1339	6.30	1379	6.45	1416	6.59	1450	6.74
7200	1058	5.40	1096	5.66	1136	5.90	1177	6.12	1220	6.32	1262	6.50	1304	6.67	1346	6.82	1387	6.98	1426	7.12	1463	7.27	1498	7.42
7600	1107	6.11	1145	6.37	1185	6.61	1226	6.83	1269	7.03	1311	7.21	1353	7.38	1395	7.54	1436	7.69	1475	7.84	1512	7.98	1547	8.13
													7.5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZR240 (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 7.5 HP & Drive												High Static 10 HP & Drive											
5200	727	1.51	763	1.95	799	2.36	835	2.75	870	3.10	904	3.42	938	3.70	970	3.93	1001	4.11	1031	4.24	1059	4.32	1085	4.33
5600	750	1.96	786	2.39	822	2.81	857	3.19	892	3.55	927	3.86	960	4.14	993	4.37	1024	4.56	1054	4.69	1082	4.76	1108	4.77
6000	774	2.45	810	2.88	846	3.30	882	3.68	917	4.04	951	4.35	985	4.63	1017	4.86	1048	5.05	1078	5.18	1106	5.25	1132	5.26
6400	800	2.98	836	3.42	872	3.83	908	4.22	943	4.57	977	4.89	1011	5.16	1043	5.40	1074	5.58	1104	5.71	1132	5.78	1158	5.79
6800	828	3.56	864	4.00	899	4.41	935	4.80	970	5.15	1004	5.47	1038	5.74	1070	5.98	1102	6.16	1131	6.29	1159	6.36	1185	6.37
7200	857	4.19	892	4.62	928	5.03	964	5.42	999	5.77	1033	6.09	1067	6.37	1099	6.60	1130	6.79	1160	6.92	1188	6.99	1214	7.00
7600	887	4.86	923	5.29	958	5.71	994	6.09	1029	6.44	1063	6.76	1097	7.04	1129	7.27	1160	7.46	1190	7.59	1218	7.66	1244	7.67
8000	918	5.57	954	6.01	990	6.42	1025	6.81	1060	7.16	1095	7.48	1128	7.75	1161	7.99	1192	8.17	1222	8.30	1249	8.37	1276	8.38
8400	951	6.33	987	6.77	1022	7.18	1058	7.56	1093	7.92	1127	8.23	1161	8.51	1193	8.74	1224	8.93	1254	9.06	1282	9.13	1308	9.14
8800	984	7.13	1020	7.57	1056	7.98	1092	8.36	1127	8.72	1161	9.04	1195	9.31	1227	9.55	1258	9.73	1288	9.86	1316	9.93	1342	9.94
9200	1019	7.97	1055	8.41	1091	8.82	1126	9.21	1162	9.56	1196	9.88	1229	10.15	1262	10.39	1293	10.57	1323	10.70	1351	10.77	1377	10.79
9600	1055	8.85	1091	9.29	1127	9.70	1162	10.09	1197	10.44	1232	10.76	1265	11.04	1298	11.27	1329	11.45	-	-	-	-	-	-
10000	1092	9.78	1128	10.21	1164	10.62	1199	11.01	1234	11.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
													10 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZR300 (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Drive														Standard 10 HP & Drive							
6600	796	3.24	827	3.65	859	4.04	890	4.40	920	4.75	951	5.08	983	5.40	1014	5.70	1047	6.00	1081	6.28	1116	6.55	1152	6.82
7000	821	3.81	853	4.22	884	4.61	915	4.97	946	5.32	977	5.65	1008	5.97	1040	6.27	1073	6.57	1106	6.85	1141	7.12	1177	7.39
7400	848	4.43	880	4.84	911	5.23	942	5.60	973	5.95	1004	6.28	1035	6.59	1067	6.90	1100	7.19	1134	7.47	1168	7.75	1205	8.02
7800	877	5.12	909	5.53	940	5.91	971	6.28	1002	6.63	1033	6.96	1064	7.28	1096	7.58	1129	7.87	1162	8.16	1197	8.43	1234	8.70
8200	908	5.86	940	6.27	971	6.65	1002	7.02	1032	7.37	1063	7.70	1095	8.02	1127	8.32	1159	8.61	1193	8.90	1228	9.17	1264	9.44
8600	940	6.66	971	7.07	1002	7.46	1033	7.82	1064	8.17	1095	8.50	1126	8.82	1158	9.12	1191	9.42	1225	9.70	1259	9.97	1296	10.24
9000	973	7.52	1004	7.93	1035	8.32	1066	8.69	1097	9.04	1128	9.37	1159	9.68	1191	9.99	1224	10.28	1258	10.56	1292	10.84	1329	11.11
9400	1007	8.45	1038	8.86	1070	9.24	1101	9.61	1131	9.96	1162	10.29	1194	10.61	1225	10.91	1258	11.20	1292	11.49	1327	11.76	1363	12.03
9800	1042	9.43	1074	9.84	1105	10.23	1136	10.60	1167	10.95	1198	11.28	1229	11.59	1261	11.90	1293	12.19	1327	12.47	1362	12.75	1398	13.02
10200	1078	10.48	1110	10.89	1141	11.28	1172	11.64	1203	11.99	1234	12.32	1265	12.64	1297	12.94	1330	13.24	1363	13.52	1398	13.79	1434	14.06
10600	1115	11.59	1147	12.00	1178	12.38	1209	12.75	1240	13.10	1271	13.43	1302	13.75	1334	14.05	1367	14.34	1400	14.62	1435	14.90	1472	15.17
11000	1153	12.75	1185	13.16	1216	13.55	1247	13.91	1278	14.26	1309	14.59	1340	14.91	1372	15.21	1405	15.51	1438	15.79	1473	16.06	1510	16.34
11400	1192	13.97	1224	14.38	1255	14.77	1286	15.14	1317	15.49	1348	15.82	1379	16.13	1411	16.44	1444	16.73	1477	17.01	-	-	-	-
11800	1232	15.25	1264	15.66	1295	16.05	1326	16.42	1356	16.77	1387	17.10	-	-	-	-	-	-	-	-	-	-	-	-
12200	1272	16.59	1304	17.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	High Static 15 HP & Drive										15 HP & Field Supplied Drive													

Air Flow (CFM)	Available External Static Pressure - IWG[1]							
	2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	High Static 15 HP & Drive							
6600	1190	7.09	1230	7.36	1272	7.62	1316	7.89
7000	1215	7.66	1255	7.93	1297	8.19	1341	8.46
7400	1243	8.29	1282	8.55	1324	8.82	1369	9.08
7800	1272	8.97	1311	9.23	1353	9.50	1397	9.77
8200	1302	9.71	1342	9.97	1384	10.24	1428	10.51
8600	1334	10.51	1374	10.78	1415	11.04	1460	11.31
9000	1367	11.37	1407	11.64	1448	11.90	1493	12.17
9400	1401	12.30	1441	12.56	1483	12.83	1527	13.10
9800	1436	13.28	1476	13.55	1518	13.82	1562	14.08
10200	1472	14.33	1512	14.60	1554	14.86	1598	15.13
10600	1510	15.44	1549	15.70	1591	15.97	1635	16.23
11000	1548	16.60	1587	16.87	1629	17.13	-	-
11400	-	-	-	-	-	-	-	-
11800	-	-	-	-	-	-	-	-
12200	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

ZF180-300 Side Duct Application

ZF180 (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive						High Static 5 HP & Drive													
4400	760	1.56	798	1.90	835	2.20	878	2.47	950	2.81	1014	3.11	1069	3.38	1115	3.61	1154	3.81	1184	3.97	1205	4.09	1218	4.18
4800	786	1.93	824	2.27	861	2.57	904	2.84	976	3.18	1040	3.48	1095	3.75	1142	3.98	1180	4.18	1210	4.34	1231	4.46	1244	4.55
5200	815	2.34	853	2.68	890	2.98	933	3.25	1005	3.59	1068	3.89	1123	4.16	1170	4.39	1208	4.59	1238	4.75	1260	4.87	1273	4.96
5600	845	2.79	883	3.13	920	3.43	963	3.70	1035	4.04	1099	4.34	1154	4.61	1200	4.84	1239	5.04	1269	5.20	1290	5.32	1303	5.41
6000	877	3.28	915	3.62	952	3.92	995	4.19	1067	4.53	1131	4.83	1186	5.10	1232	5.33	1271	5.53	1301	-	-	-	-	-
6400	911	3.81	949	4.15	986	4.45	1029	4.72	1101	5.06	1164	5.36	1219	5.63	-	-	-	-	-	-	-	-	-	-
6800	946	4.38	984	4.72	1021	5.02	1064	5.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	982	4.98	1020	5.32	1057	5.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
											5 HP & Field Supplied Drive													

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF210 (17.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive										High Static 7.5 HP & Drive							
4400	636	0.65	672	1.14	709	1.60	745	2.03	780	2.43	815	2.78	849	3.09	882	3.35	914	3.55	944	3.70	973	3.78	999	3.79
4800	649	0.99	685	1.48	721	1.94	757	2.37	793	2.77	828	3.12	862	3.43	895	3.69	927	3.89	957	4.04	985	4.12	1012	4.13
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
																			High Static 7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF240 (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive										High Static 7.5 HP & Drive									
5200	678	1.35	715	1.83	751	2.28	787	2.70	823	3.09	858	3.43	892	3.74	925	3.99	957	4.19	987	4.33	1015	4.41	1042	4.42
5600	697	1.74	733	2.22	770	2.67	806	3.09	842	3.48	876	3.82	911	4.13	944	4.38	975	4.58	1005	4.72	1034	4.80	1060	4.82
6000	717	2.17	754	2.65	790	3.10	826	3.52	862	3.90	897	4.25	931	4.55	964	4.81	996	5.01	1026	5.15	1054	5.23	1081	5.24
6400	740	2.64	776	3.11	812	3.57	848	3.99	884	4.37	919	4.72	953	5.02	986	5.28	1018	5.48	1048	5.62	1076	5.70	1103	5.71
6800	763	3.15	800	3.63	836	4.08	872	4.50	908	4.88	943	5.23	977	5.53	1010	5.79	1042	5.99	1072	6.13	1100	6.21	1127	6.22
7200	789	3.71	825	4.18	861	4.63	898	5.05	933	5.44	968	5.79	1002	6.09	1035	6.34	1067	6.55	1097	6.69	1126	6.77	1152	6.78
7600	815	4.31	852	4.79	888	5.24	924	5.66	960	6.04	995	6.39	1029	6.69	1062	6.95	1094	7.15	1124	7.29	1152	7.37	1179	7.38
8000	844	4.96	880	5.44	916	5.89	952	6.31	988	6.70	1023	7.04	1057	7.34	1090	7.60	1122	7.80	1152	7.94	1180	8.02	1207	8.03
8400	873	5.66	909	6.13	946	6.59	982	7.01	1018	7.39	1053	7.74	1087	8.04	1120	8.30	1151	8.50	1182	8.64	1210	8.72	1236	8.73
8800	904	6.40	940	6.88	977	7.33	1013	7.75	1048	8.14	1083	8.48	1117	8.79	-	-	-	-	-	-	-	-	-	-
9200	936	7.19	972	7.67	1009	8.12	1045	8.54	1080	8.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	969	8.03	1005	8.50	1042	8.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	1003	8.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
													High Static 7.5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF300 (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	760	2.51	793	3.11	824	3.68	856	4.23	887	4.74	919	5.23	950	5.70	983	6.15
7000	775	2.99	808	3.60	839	4.17	871	4.71	902	5.22	934	5.72	966	6.19	998	6.64
7400	792	3.51	824	4.11	856	4.69	887	5.23	918	5.74	950	6.24	982	6.70	1014	7.16
7800	809	4.07	841	4.67	873	5.24	904	5.78	935	6.30	967	6.79	999	7.26	1031	7.71
8200	826	4.66	859	5.27	890	5.84	922	6.38	953	6.89	985	7.39	1016	7.86	1049	8.31
8600	845	5.30	877	5.90	909	6.47	940	7.01	972	7.53	1003	8.02	1035	8.49	1067	8.94
9000	864	5.97	896	6.57	928	7.14	960	7.69	991	8.20	1022	8.69	1054	9.16	1087	9.61
9400	884	6.68	916	7.28	948	7.86	980	8.40	1011	8.91	1042	9.41	1074	9.88	1107	10.33
9800	905	7.43	937	8.04	969	8.61	1000	9.15	1032	9.67	1063	10.16	1095	10.63	1127	11.08
10200	926	8.22	958	8.83	990	9.40	1021	9.94	1053	10.46	1084	10.95	1116	11.42	1148	11.87
10600	948	9.05	980	9.66	1012	10.23	1043	10.77	1075	11.29	1106	11.78	1138	12.25	1170	12.70
11000	970	9.92	1003	10.52	1034	11.09	1066	11.64	1097	12.15	1128	12.64	1160	13.11	1193	13.56
11400	993	10.82	1025	11.43	1057	12.00	1089	12.54	1120	13.06	1151	13.55	1183	14.02	1216	14.47
11800	1017	11.76	1049	12.37	1081	12.94	1112	13.48	1143	14.00	1175	14.49	1207	14.96	1239	15.41
12200	1040	12.74	1073	13.34	1104	13.91	1136	14.46	1167	14.97	1199	15.46	1231	15.93	1263	16.38
12600	1065	13.75	1097	14.35	1129	14.92	1160	15.47	1192	15.98	1223	16.47	1255	16.94	-	-
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1016	6.59	1050	7.00	1086	7.41	1123	7.81	1161	8.19	1202	8.58	1244	8.95	1289	9.33
7000	1031	7.07	1065	7.49	1101	7.89	1138	8.29	1176	8.68	1217	9.06	1259	9.44	1304	9.82
7400	1047	7.59	1081	8.01	1117	8.41	1154	8.81	1192	9.20	1233	9.58	1275	9.96	1320	10.34
7800	1064	8.14	1098	8.56	1134	8.97	1171	9.36	1209	9.75	1250	10.13	1292	10.51	1337	10.89
8200	1082	8.74	1116	9.16	1152	9.56	1189	9.96	1227	10.35	1268	10.73	1310	11.11	1355	11.49
8600	1101	9.37	1135	9.79	1170	10.20	1207	10.59	1246	10.98	1286	11.36	1329	11.74	1374	12.12
9000	1120	10.05	1154	10.46	1189	10.87	1226	11.27	1265	11.65	1305	12.04	1348	12.41	1393	12.79
9400	1140	10.76	1174	11.18	1209	11.58	1246	11.98	1285	12.37	1325	12.75	1368	13.13	1413	13.51
9800	1160	11.51	1195	11.93	1230	12.33	1267	12.73	1306	13.12	1346	13.50	1389	13.88	1434	14.26
10200	1182	12.30	1216	12.72	1251	13.12	1288	13.52	1327	13.91	1367	14.29	1410	14.67	1455	15.05
10600	1204	13.13	1238	13.55	1273	13.95	1310	14.35	1349	14.74	1389	15.12	1432	15.50	1477	15.88
11000	1226	14.00	1260	14.41	1296	14.82	1332	15.22	1371	15.60	1412	15.99	1454	16.36	1499	16.74
11400	1249	14.90	1283	15.32	1318	15.72	1355	16.12	1394	16.51	1434	16.89	-	-	-	-
11800	1272	15.84	1306	16.26	1342	16.66	1379	17.06	-	-	-	-	-	-	-	-
12200	1296	16.82	1330	17.23	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	High Static 15 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

ZF180-300 Bottom Duct Application

ZF180 (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive						High Static 5 HP & Drive															
4400	803	1.70	841	2.00	877	2.28	919	2.52	991	2.84	1055	3.13	1110	3.38	1155	3.59	1193	3.78	1221	3.93	1242	4.04	1253	4.12
4800	832	2.11	870	2.42	906	2.69	948	2.93	1020	3.25	1084	3.54	1139	3.79	1185	4.01	1222	4.19	1250	4.34	1271	4.45	1282	4.53
5200	863	2.55	900	2.86	936	3.14	979	3.38	1051	3.70	1115	3.99	1169	4.24	1215	4.46	1253	4.64	1281	4.79	1301	4.90	1313	4.98
5600	896	3.03	933	3.34	969	3.62	1011	3.86	1084	4.19	1147	4.47	1202	4.73	1248	4.94	1285	5.13	1314	5.27	1334	5.39	1345	5.47
6000	930	3.54	967	3.86	1003	4.13	1045	4.38	1118	4.70	1181	4.99	1236	5.24	1282	5.46	-	-	-	-	-	-	-	-
6400	965	4.09	1002	4.41	1038	4.68	1081	4.93	1153	5.25	1217	5.54	-	-	-	-	-	-	-	-	-	-	-	-
6800	1002	4.67	1039	4.99	1075	5.27	1117	5.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	1040	5.28	1077	5.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
													5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF210 (17.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive												High Static 7.5 HP & Drive							
4400	661	0.74	697	1.19	733	1.62	768	2.03	803	2.40	838	2.73	871	3.02	904	3.26	935	3.45	964	3.59	992	3.66	1018	3.67
4800	677	1.07	712	1.53	748	1.96	784	2.36	819	2.73	853	3.06	887	3.35	919	3.59	950	3.79	980	3.92	1008	4.00	1034	4.01
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
															High Static 7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF240 (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive										High Static 7.5 HP & Drive											
5200	711	1.47	747	1.92	782	2.34	818	2.73	853	3.09	887	3.42	921	3.70	953	3.94	985	4.13	1014	4.26	1042	4.34	1068	4.35
5600	732	1.89	768	2.33	803	2.76	839	3.15	874	3.51	908	3.84	942	4.12	974	4.36	1005	4.54	1035	4.68	1063	4.75	1089	4.76
6000	754	2.35	790	2.79	826	3.21	862	3.61	897	3.97	931	4.29	965	4.58	997	4.81	1028	5.00	1058	5.14	1086	5.21	1112	5.22
6400	779	2.85	814	3.29	850	3.71	886	4.11	921	4.47	955	4.79	989	5.08	1021	5.31	1052	5.50	1082	5.64	1110	5.71	1136	5.72
6800	804	3.39	840	3.84	876	4.26	912	4.65	947	5.01	981	5.34	1015	5.62	1047	5.86	1078	6.05	1108	6.18	1136	6.26	1162	6.27
7200	832	3.98	868	4.43	903	4.85	939	5.24	974	5.60	1008	5.93	1042	6.21	1074	6.45	1105	6.64	1135	6.77	1163	6.85	1189	6.86
7600	860	4.62	896	5.06	932	5.49	967	5.88	1002	6.24	1037	6.56	1070	6.85	1103	7.09	1134	7.27	1164	7.41	1192	7.48	1218	7.49
8000	890	5.30	926	5.74	962	6.17	997	6.56	1032	6.92	1067	7.24	1100	7.53	1133	7.77	1164	7.95	1194	8.09	1222	8.16	1248	8.17
8400	921	6.02	957	6.47	993	6.89	1028	7.28	1064	7.64	1098	7.97	1131	8.25	1164	8.49	1195	8.68	1225	8.81	-	-	-	-
8800	954	6.79	989	7.24	1025	7.66	1061	8.05	1096	8.41	1130	8.74	-	-	-	-	-	-	-	-	-	-	-	-
9200	987	7.60	1023	8.05	1059	8.47	1094	8.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	1021	8.45	1057	8.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	546	4.89	564	5.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
													High Static 7.5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZF300 (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6			
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP		
	Low Static 7.5 HP & Field Supplied Drive		Low Static 7.5 HP & Drive													
6600	787	2.67	819	3.23	850	3.76	881	4.27	912	4.75	943	5.21	974	5.65		
7000	804	3.18	835	3.74	867	4.27	898	4.78	928	5.26	959	5.72	991	6.16		
7400	821	3.72	853	4.28	884	4.82	915	5.32	946	5.80	977	6.26	1008	6.70		
7800	839	4.30	871	4.86	902	5.40	933	5.90	964	6.39	995	6.85	1026	7.28		
8200	858	4.92	890	5.48	921	6.02	952	6.52	983	7.01	1013	7.47	1045	7.90		
8600	877	5.58	909	6.14	940	6.68	971	7.18	1002	7.66	1033	8.12	1064	8.56		
9000	898	6.28	929	6.84	960	7.37	991	7.88	1022	8.36	1053	8.82	1084	9.26		
9400	918	7.01	950	7.57	981	8.10	1012	8.61	1043	9.09	1074	9.55	1105	9.99		
9800	940	7.78	972	8.34	1003	8.87	1034	9.38	1064	9.86	1095	10.32	1127	10.76		
10200	962	8.58	994	9.14	1025	9.68	1056	10.18	1086	10.67	1117	11.13	1149	11.56		
10600	984	9.42	1016	9.98	1047	10.52	1078	11.02	1109	11.51	1140	11.96	1171	12.40		
11000	1007	10.30	1039	10.86	1070	11.39	1101	11.90	1132	12.38	1163	12.84	1194	13.28		
11400	1031	11.20	1063	11.76	1094	12.30	1125	12.80	1156	13.29	1187	13.75	1218	14.18		
11800	1055	12.14	1087	12.70	1118	13.24	1149	13.74	1180	14.23	1211	14.69	1242	15.12		
12200	1080	13.11	1111	13.68	1142	14.21	1173	14.72	1204	15.20	1235	15.66	1266	16.10		
12600	1104	14.12	1136	14.68	1167	15.21	1198	15.72	1229	16.20	1260	16.66	1291	17.10		
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	1.8		2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive							
6600	1006	6.07	1039	6.48	1072	6.87	1107	7.25	1144	7.62	1182	7.98	1221	8.33	1263	8.68	1307	9.04
7000	1023	6.58	1055	6.98	1089	7.37	1124	7.75	1160	8.12	1198	8.48	1238	8.84	1280	9.19	1324	9.54
7400	1040	7.12	1072	7.53	1106	7.92	1141	8.30	1177	8.67	1215	9.03	1255	9.38	1297	9.74	1341	10.09
7800	1058	7.71	1090	8.11	1124	8.50	1159	8.88	1195	9.25	1233	9.61	1273	9.97	1315	10.32	1359	10.67
8200	1077	8.33	1109	8.73	1143	9.12	1178	9.50	1214	9.87	1252	10.23	1292	10.59	1334	10.94	1378	11.29
8600	1096	8.98	1129	9.39	1162	9.78	1197	10.16	1234	10.53	1272	10.89	1311	11.24	1353	11.60	1397	11.95
9000	1116	9.68	1149	10.08	1183	10.47	1218	10.85	1254	11.22	1292	11.58	1332	11.94	1373	12.29	1418	12.64
9400	1137	10.41	1170	10.82	1203	11.21	1238	11.59	1275	11.95	1313	12.32	1352	12.67	1394	13.02	1438	13.37
9800	1159	11.18	1191	11.59	1225	11.98	1260	12.35	1296	12.72	1334	13.09	1374	13.44	1416	13.79	1460	14.14
10200	1181	11.99	1213	12.39	1247	12.78	1282	13.16	1318	13.53	1356	13.89	1396	14.25	1438	14.60	1482	14.95
10600	1203	12.82	1236	13.23	1269	13.62	1304	14.00	1341	14.37	1379	14.73	1418	15.08	1460	15.44	1504	15.79
11000	1226	13.70	1259	14.10	1293	14.49	1327	14.87	1364	15.24	1402	15.60	1441	15.96	1483	16.31	1528	16.66
11400	1250	14.61	1282	15.01	1316	15.40	1351	15.78	1387	16.15	1425	16.51	1465	16.87	1507	17.22	-	-
11800	1274	15.55	1307	15.95	1340	16.34	1375	16.72	1411	17.09	-	-	-	-	-	-	-	-
12200	1298	16.52	1331	16.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	High Static 15 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
180 (15)	ZJ/ZF	5	5.75	1VP65	BK110	815	850	885	920	950	985	N/A
		5	5.75	1VP65	BK090	1010	1055	1095	1135	1180	1220	N/A
210 (17.5)	ZJ/ZF	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
240 (20)	ZJ/ZF	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
300 (25)	ZJ/ZF	7.5	8.63	1VP60	1B5V94	810	850	885	920	960	1000	N/A
		10	11.50	1VP75X	1B5V110	975	1005	1040	1070	1100	1135	1165
		15	17.25	1VP75X	1B5V94	1140	1180	1215	1255	1290	1330	1365
180 (15)	ZR	5	5.75	1VP65	BK110	815	850	885	920	950	985	N/A
		7.5	8.63	1VP65	BK090	1010	1055	1095	1135	1180	1220	N/A
240 (20)	ZR	7.5	8.63	1VP60	BK110	730	765	800	835	870	905	N/A
		10	11.50	1VP60	BK090	905	950	990	1035	1075	1120	N/A
300 (25)	ZR	7.5	8.63	1VP60	1B5V94	810	850	885	920	960	1000	N/A
		10	11.50	1VP75X	1B5V110	975	1005	1040	1070	1100	1135	1165
		15	17.25	1VP75X	1B5V94	1140	1180	1215	1255	1290	1330	1365

Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	Electric Heat kW[2]			
					18	36	54	72
180 (15)	ZJ ZR ZF	4500	0.10	0.10	0.10	0.10	0.20	0.20
		6000	0.10	0.10	0.10	0.20	0.30	0.40
		7500	0.10	0.10	0.10	0.30	0.40	0.60
210 (17.5) 240 (20) 300 (25)	ZJ ZR ZF	6000	0.10	0.10	0.10	0.10	0.20	0.20
		7500	0.10	0.10	0.10	0.20	0.30	0.40
		9000	0.15	0.15	0.10	0.30	0.40	0.60
		10500	0.15	0.15	0.20	0.40	0.60	0.80
		12000	0.20	0.20	0.30	0.50	0.70	0.90

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Drive Selection

1. Determine side or bottom supply duct application.
2. Determine desired airflow
3. Calculate or measure the amount of external static pressure.
4. Using the operating point determined from steps 1, 2 & 3, locate this point on the appropriate supply air blower performance table. (Linear interpolation may be necessary.)
5. Noting the RPM and BHP from step 4, locate the appropriate motor and/or drive on the RPM selection table.
6. Review the BHP compared to the motor options available. Select the appropriate motor and/or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine turns open to obtain the desired operation point.

Example

1. 6800 CFM
2. 2.0 iwg
3. Using the supply air blower performance table below, the following data point was located: 1020 RPM & 5.92 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 5.92 BHP exceeds the maximum continuous BHP rating of the 5.0 HP motor. The 7.5 HP motor is required.
6. 1020 RPM is within the range of the 7.5 HP drives.
7. Using the 7.5 HP motor and drive, 3.5 turns open will achieve 1020 RPM.

Example Supply Air Blower Performance

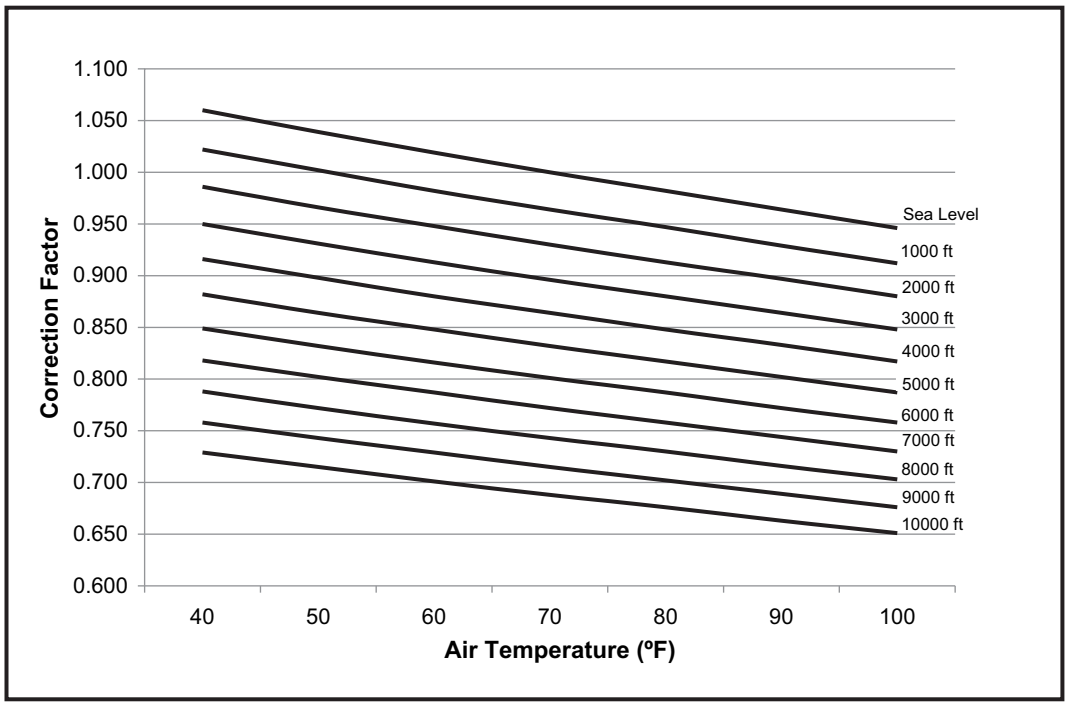
Air Flow (CFM)	Available External Static Pressure - IWG																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive										High Static 7.5 HP & Drive											
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
																					7.5 HP & Field Supplied Drive			

Table X: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
X	Y	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A

Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651



Gas Heat Minimum Supply Air

Size (Tons)	Heat Size	Supply Air (CFM)			
		Cooling		Heating	
		Min	Max	Min	Max
180 (15)	N30	4500	7000	4500	7000
	N40	4500	7000	4500	7000
210 (17.5)	N30	6000	8750	6000	8750
	N40	6000	8750	6000	8750
240 (20)	N30	6000	9400	6000	9400
	N40	6000	9400	6000	9400
300 (25)	N30	7500	12500	7500	12500
	N40	7500	12500	7500	12500

⚠ CAUTION

For units with VFD and gas heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across electric heating elements or gas heat exchanger tubes.

Electric Heat Minimum Supply Air

Size (Tons)	Voltage	Minimum Supply Air (CFM)			
		Heater kW			
		18	36	54	72
180 (15)	208/230-3-60	4500	4500	5000	5000
	460-3-60	4500	4500	5000	4500
	600-3-60	4500	4500	4500	4500
210 (17.5)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
240 (20)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
300 (25)	208/230-3-60	7500	7500	7500	7500
	460-3-60	7500	7500	7500	7500
	600-3-60	7500	7500	7500	7500

⚠ CAUTION

For units with VFD and electric heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across electric heating elements or gas heat exchanger tubes.

Indoor Blower Specifications

Size (Tons)	Model	Motor					Motor Sheave			Blower Sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
180 (15)	ZF	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX75
		5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	8.4	1	BK090	BX70
180 (15)	ZJ	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX83
		5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	8.4	1	BK090	BX81
210 (17.5)	ZJ/ZF	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
240 (20)	ZJ/ZF	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
300 (25)	ZJ/ZF	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	9.5	1 7/16	1B5V94	BX78
		10	1725	0.89	1.15	215T	5.8 - 7.0	1 3/8	1VP75X	11.1	1 7/16	1B5V110	5VX840
		15	1725	0.91	1.15	254T	6.2 - 7.4	1 5/8	1VP75X	9.5	1 7/16	1B5V94	5VX860

Indoor Blower Specifications

180 (15)	ZR	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX83
		7.5	1725	0.91	1.15	213T	5.2 - 6.4	1 3/8	1VP65	8.4	1	BK090	BX81
240 (20)	ZR	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	10.4	1 3/16	BK110	BX78
		10	1725	0.89	1.15	215T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
300 (25)	ZR	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	9.5	1 7/16	1B5V94	BX78
		10	1725	0.89	1.15	215T	5.8 - 7.0	1 3/8	1VP75X	11.1	1 7/16	1B5V110	5VX840
		15	1725	0.91	1.15	254T	6.2 - 7.4	1 5/8	1VP75X	9.5	1 7/16	1B5V94	5VX860

Power Exhaust Specifications

Voltage	Motor			Motor			CFM @ 0.2 ESP
	HP	RPM[1]	QTY	LRA	FLA	MCA	
208/230-1-60	3/4	1075	1	7.7	5.0	6.25	5250
460-1-60	3/4	1075	1	4.1	2.2	2.75	5250
575-1-60	3/4	1050	1	2.84	1.5	1.875	5250

1. Motors are multi-tapped and factory wired for high speed.

Electric Heat Multipliers

Voltage		kW Capacity Multipliers[1]
Nominal	Applied	
240	208	0.75
	230	0.92
480	460	0.92
600	575	0.92

1. Electric heaters are rated at nominal voltage. Use this table to determine the electric heat capacity for heaters applied at lower voltages.

Sound Performance

ZJ/ZR/ZF Indoor Sound Power Levels

Size (Tons)	CFM	ESP (IWG)	Blower		Sound Power, dB (10^{-12}) Watts							
					Sound Rating[1] dB (A)	Octave Band Centerline Frequency (Hz)						
			RPM	BHP		63	125	250	500	1000	2000	4000	8000
180 (15)	6000	1.0	1,080	4.6	91	88	90	90	87	85	81	81	76
210 (17.5)	7000	1.0	940	5.1	85	84	84	82	81	81	77	74	69
240 (20)	8000	1.0	1,020	6.6	86	85	85	83	82	82	78	75	70
300 (25)	10000	1.3	1,160	12.5	92	91	91	89	88	88	84	81	76

1. These values have been accessed using a model of sound propagation from a point source into the hemispheric/free field. The dBA values provided are to be used for reference only. Calculation of dBA values cover matters of system design and the fan manufacturer has no way of knowing the details of each system. This constitutes an exception to any specification or guarantee requiring a dBA value of sound data in any other form than sound power level ratings.

ZJ/ZR/ZF Outdoor Sound Power Levels

Size (Tons)	Sound Rating[1] dB (A)	Sound Power, dB (10^{-12}) Watts							
		Octave Band Centerline Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
180 (15)	92	90	93	91	89	86	83	80	75
210 (17.5)	92	91	94	92	89	86	83	81	76
240 (20)	92	91	94	92	89	87	83	81	76
300 (25)	92	92	95	93	89	87	84	81	77

1. Rated in accordance with AHRI 270 standard.

Electrical Data

ZJ180 - 300

ZJ180-300 - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	13.1	83.1	20.5	2.1	13.5	0	NONE	-	-	-	77.7	90
								E18	13.5	1	37.5	77.7	90
								E36	27	2	74.9	110.6	125
								E54	40.6	2	112.7	157.7	175
								E72	54.1	2	150.2	167	200
	230-3-60	13.1	83.1	20.5	2.1	13	0	NONE	-	-	-	77.1	90
								E18	18	1	43.3	77.1	90
								E36	36	2	86.6	124.5	125
								E54	54	2	129.9	146.2	175
								E72	72	2	173.2	189.5	225
	460-3-60	6.1	41	9.5	1.26	6.5	0	NONE	-	-	-	37.6	40
								E18	18	1	21.7	37.6	40
								E36	36	2	43.3	62.3	70
								E54	54	2	65	73.1	80
								E72	72	2	86.6	94.7	110
	575-3-60	4.4	33	6.8	0.66	5.2	0	NONE	-	-	-	26.7	30
								E18	18	1	17.3	28.2	30
								E36	36	2	34.6	49.8	50
								E54	54	2	52	58.5	70
								E72	72	2	69.3	75.8	90
210 (17.5)	208-3-60	14.5	98	22.6	2.1	13.5	0	NONE	-	-	-	83.5	90
								E18	13.5	1	37.5	83.5	90
								E36	27	2	74.9	110.6	125
								E54	40.6	2	112.7	157.7	175
								E72	54.1	2	150.2	167	200
	230-3-60	14.5	98	22.6	2.1	13	0	NONE	-	-	-	83	90
								E18	18	1	43.3	83	90
								E36	36	2	86.6	124.5	125
								E54	54	2	129.9	146.2	175
								E72	72	2	173.2	189.5	225
	460-3-60	6.3	55	9.9	1.26	6.5	0	NONE	-	-	-	38.4	40
								E18	18	1	21.7	38.4	40
								E36	36	2	43.3	62.3	70
								E54	54	2	65	73.1	80
								E72	72	2	86.6	94.7	110
	575-3-60	6	41	9.4	0.66	5.2	0	NONE	-	-	-	33.3	35
								E18	18	1	17.3	33.3	35
								E36	36	2	34.6	49.8	50
								E54	54	2	52	58.5	70
								E72	72	2	69.3	75.8	90

ZJ180-300 - Standard Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
240 (20)	208-3-60	15.6	110	24.4	2.2	13.5	0	NONE	-	-	-	88.6	100
								E18	13.5	1	37.5	88.6	100
								E36	27	2	74.9	110.6	125
								E54	40.6	2	112.7	157.7	175
								E72	54.1	2	150.2	167	200
	230-3-60	15.6	110	24.4	2.2	13	0	NONE	-	-	-	88.1	100
								E18	18	1	43.3	88.1	100
								E36	36	2	86.6	124.5	125
								E54	54	2	129.9	146.2	175
								E72	72	2	173.2	189.5	225
	460-3-60	7.8	52	12.1	1.1	6.5	0	NONE	-	-	-	44.1	50
								E18	18	1	21.7	44.1	50
								E36	36	2	43.3	62.3	70
								E54	54	2	65	73.1	80
								E72	72	2	86.6	94.7	110
	575-3-60	5.8	38.9	9.1	0.9	5.2	0	NONE	-	-	-	33.5	35
								E18	18	1	17.3	33.5	35
								E36	36	2	34.6	49.8	50
								E54	54	2	52	58.5	70
								E72	72	2	69.3	75.8	90
300 (25)	208-3-60	22.4	149	35	2.2	26	0	NONE	-	-	-	130.9	150
								E18	13.5	1	37.5	130.9	150
								E36	27	2	74.9	130.9	150
								E54	40.6	2	112.7	173.4	175
								E72	54.1	2	150.2	182.7	200
	230-3-60	22.4	149	35	2.2	25	0	NONE	-	-	-	129.7	150
								E18	18	1	43.3	129.7	150
								E36	36	2	86.6	139.5	150
								E54	54	2	129.9	161.2	175
								E72	72	2	173.2	204.5	225
	460-3-60	10.6	75	16.5	1.1	12.5	0	NONE	-	-	-	62.4	70
								E18	18	1	21.7	62.4	70
								E36	36	2	43.3	69.8	70
								E54	54	2	65	80.6	90
								E72	72	2	86.6	102.2	110
	575-3-60	7.7	54	12	0.9	10	0	NONE	-	-	-	46.9	50
								E18	18	1	17.3	46.9	50
								E36	36	2	34.6	55.8	60
								E54	54	2	52	64.5	70
								E72	72	2	69.3	81.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	13.1	83.1	20.5	2.1	13.5	10	NONE	-	-	-	87.7	100
								E18	13.5	1	37.5	87.7	100
								E36	27	2	74.9	123.1	125
								E54	40.6	2	112.7	170.2	175
								E72	54.1	2	150.2	179.5	200
	230-3-60	13.1	83.1	20.5	2.1	13	10	NONE	-	-	-	87.1	100
								E18	18	1	43.3	87.1	100
								E36	36	2	86.6	137	150
								E54	54	2	129.9	158.7	175
								E72	72	2	173.2	202	225
	460-3-60	6.1	41	9.5	1.26	6.5	5	NONE	-	-	-	42.6	45
								E18	18	1	21.7	42.6	45
								E36	36	2	43.3	68.5	70
								E54	54	2	65	79.3	90
								E72	72	2	86.6	101	110
	575-3-60	4.4	33	6.8	0.66	5.2	4	NONE	-	-	-	30.7	35
								E18	18	1	17.3	33.2	35
								E36	36	2	34.6	54.8	60
								E54	54	2	52	63.5	70
								E72	72	2	69.3	80.8	90
210 (17.5)	208-3-60	14.5	98	22.6	2.1	13.5	10	NONE	-	-	-	93.5	100
								E18	13.5	1	37.5	93.5	100
								E36	27	2	74.9	123.1	125
								E54	40.6	2	112.7	170.2	175
								E72	54.1	2	150.2	179.5	200
	230-3-60	14.5	98	22.6	2.1	13	10	NONE	-	-	-	93	100
								E18	18	1	43.3	93	100
								E36	36	2	86.6	137	150
								E54	54	2	129.9	158.7	175
								E72	72	2	173.2	202	225
	460-3-60	6.3	55	9.9	1.26	6.5	5	NONE	-	-	-	43.4	45
								E18	18	1	21.7	43.4	45
								E36	36	2	43.3	68.5	70
								E54	54	2	65	79.3	90
								E72	72	2	86.6	101	110
	575-3-60	6	41	9.4	0.66	5.2	4	NONE	-	-	-	37.3	40
								E18	18	1	17.3	37.3	40
								E36	36	2	34.6	54.8	60
								E54	54	2	52	63.5	70
								E72	72	2	69.3	80.8	90
240 (20)	208-3-60	15.6	110	24.4	2.2	13.5	10	NONE	-	-	-	98.6	110
								E18	13.5	1	37.5	98.6	110
								E36	27	2	74.9	123.1	125
								E54	40.6	2	112.7	170.2	175
								E72	54.1	2	150.2	179.5	200
	230-3-60	15.6	110	24.4	2.2	13	10	NONE	-	-	-	98.1	110
								E18	18	1	43.3	98.1	110
								E36	36	2	86.6	137	150
								E54	54	2	129.9	158.7	175
								E72	72	2	173.2	202	225
	460-3-60	7.8	52	12.1	1.1	6.5	5	NONE	-	-	-	49.1	50
								E18	18	1	21.7	49.1	50
								E36	36	2	43.3	68.5	70
								E54	54	2	65	79.3	90
								E72	72	2	86.6	101	110
	575-3-60	5.8	38.9	9.1	0.9	5.2	4	NONE	-	-	-	37.5	40
								E18	18	1	17.3	37.5	40
								E36	36	2	34.6	54.8	60
								E54	54	2	52	63.5	70
								E72	72	2	69.3	80.8	90

ZJ180-300 - Standard Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	22.4	149	35	2.2	26	10	NONE	-	-	-	140.9	150
								E18	13.5	1	37.5	140.9	150
								E36	27	2	74.9	140.9	150
								E54	40.6	2	112.7	185.9	200
								E72	54.1	2	150.2	195.2	200
	230-3-60	22.4	149	35	2.2	25	10	NONE	-	-	-	139.7	150
								E18	18	1	43.3	139.7	150
								E36	36	2	86.6	152	175
								E54	54	2	129.9	173.7	175
								E72	72	2	173.2	217	225
	460-3-60	10.6	75	16.5	1.1	12.5	5	NONE	-	-	-	67.4	70
								E18	18	1	21.7	67.4	70
								E36	36	2	43.3	76	80
								E54	54	2	65	86.8	90
								E72	72	2	86.6	108.5	110
	575-3-60	7.7	54	12	0.9	10	4	NONE	-	-	-	50.9	60
								E18	18	1	17.3	50.9	60
								E36	36	2	34.6	60.8	70
								E54	54	2	52	69.5	70
								E72	72	2	69.3	86.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - High Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	13.1	83.1	20.5	2.1	13.5	0	NONE	-	-	-	77.7	90
								E18	13.5	1	37.5	77.7	90
								E36	27	2	74.9	110.6	125
								E54	40.6	2	112.7	157.7	175
								E72	54.1	2	150.2	167	200
	230-3-60	13.1	83.1	20.5	2.1	13	0	NONE	-	-	-	77.1	90
								E18	18	1	43.3	77.1	90
								E36	36	2	86.6	124.5	125
								E54	54	2	129.9	146.2	175
								E72	72	2	173.2	189.5	225
	460-3-60	6.1	41	9.5	1.26	6.5	0	NONE	-	-	-	37.6	40
								E18	18	1	21.7	37.6	40
								E36	36	2	43.3	62.3	70
								E54	54	2	65	73.1	80
								E72	72	2	86.6	94.7	110
	575-3-60	4.4	33	6.8	0.66	5.2	0	NONE	-	-	-	26.7	30
								E18	18	1	17.3	28.2	30
								E36	36	2	34.6	49.8	50
								E54	54	2	52	58.5	70
								E72	72	2	69.3	75.8	90
210 (17.5)	208-3-60	14.5	98	22.6	2.1	20	0	NONE	-	-	-	91.4	110
								E18	13.5	1	37.5	91.4	110
								E36	27	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	14.5	98	22.6	2.1	19.4	0	NONE	-	-	-	90.7	110
								E18	18	1	43.3	90.7	110
								E36	36	2	86.6	132.5	150
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	6.3	55	9.9	1.26	9.7	0	NONE	-	-	-	42.4	50
								E18	18	1	21.7	42.4	50
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	6	41	9.4	0.66	7.8	0	NONE	-	-	-	36.4	40
								E18	18	1	17.3	36.4	40
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90
240 (20)	208-3-60	15.6	110	24.4	2.2	20	0	NONE	-	-	-	96.2	110
								E18	13.5	1	37.5	96.2	110
								E36	27	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	15.6	110	24.4	2.2	19.4	0	NONE	-	-	-	95.5	110
								E18	18	1	43.3	95.5	110
								E36	36	2	86.6	132.5	150
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	7.8	52	12.1	1.1	9.7	0	NONE	-	-	-	47.7	50
								E18	18	1	21.7	47.7	50
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	5.8	38.9	9.1	0.9	7.8	0	NONE	-	-	-	36.6	40
								E18	18	1	17.3	36.6	40
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90

ZJ180-300 - High Static Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	22.4	149	35	2.2	37.2	0	NONE	-	-	-	144.9	175
								E18	13.5	1	37.5	144.9	175
								E36	27	2	74.9	144.9	175
								E54	40.6	2	112.7	187.4	200
								E72	54.1	2	150.2	196.7	225
	230-3-60	22.4	149	35	2.2	34.6	0	NONE	-	-	-	141.7	175
								E18	18	1	43.3	141.7	175
								E36	36	2	86.6	151.5	175
								E54	54	2	129.9	173.2	200
								E72	72	2	173.2	216.5	250
	460-3-60	10.6	75	16.5	1.1	17.3	0	NONE	-	-	-	68.4	80
								E18	18	1	21.7	68.4	80
								E36	36	2	43.3	75.8	80
								E54	54	2	65	86.6	100
								E72	72	2	86.6	108.2	125
	575-3-60	7.7	54	12	0.9	14.5	0	NONE	-	-	-	52.5	60
								E18	18	1	17.3	52.5	60
								E36	36	2	34.6	61.4	70
								E54	54	2	52	70.1	80
								E72	72	2	69.3	87.4	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - High Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	13.1	83.1	20.5	2.1	13.5	10	NONE	-	-	-	87.7	100
								E18	13.5	1	37.5	87.7	100
								E36	27	2	74.9	123.1	125
								E54	40.6	2	112.7	170.2	175
								E72	54.1	2	150.2	179.5	200
	230-3-60	13.1	83.1	20.5	2.1	13	10	NONE	-	-	-	87.1	100
								E18	18	1	43.3	87.1	100
								E36	36	2	86.6	137	150
								E54	54	2	129.9	158.7	175
								E72	72	2	173.2	202	225
	460-3-60	6.1	41	9.5	1.26	6.5	5	NONE	-	-	-	42.6	45
								E18	18	1	21.7	42.6	45
								E36	36	2	43.3	68.5	70
								E54	54	2	65	79.3	90
								E72	72	2	86.6	101	110
	575-3-60	4.4	33	6.8	0.66	5.2	4	NONE	-	-	-	30.7	35
								E18	18	1	17.3	33.2	35
								E36	36	2	34.6	54.8	60
								E54	54	2	52	63.5	70
								E72	72	2	69.3	80.8	90
210 (17.5)	208-3-60	14.5	98	22.6	2.1	20	10	NONE	-	-	-	101.4	110
								E18	13.5	1	37.5	101.4	110
								E36	27	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	14.5	98	22.6	2.1	19.4	10	NONE	-	-	-	100.7	110
								E18	18	1	43.3	100.7	110
								E36	36	2	86.6	145	150
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	6.3	55	9.9	1.26	9.7	5	NONE	-	-	-	47.4	50
								E18	18	1	21.7	47.4	50
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	6	41	9.4	0.66	7.8	4	NONE	-	-	-	40.4	45
								E18	18	1	17.3	40.4	45
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90
240 (20)	208-3-60	15.6	110	24.4	2.2	20	10	NONE	-	-	-	106.2	125
								E18	13.5	1	37.5	106.2	125
								E36	27	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	15.6	110	24.4	2.2	19.4	10	NONE	-	-	-	105.5	110
								E18	18	1	43.3	105.5	110
								E36	36	2	86.6	145	150
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	7.8	52	12.1	1.1	9.7	5	NONE	-	-	-	52.7	60
								E18	18	1	21.7	52.7	60
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	5.8	38.9	9.1	0.9	7.8	4	NONE	-	-	-	40.6	45
								E18	18	1	17.3	40.6	45
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90

ZJ180-300 - High Static Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	22.4	149	35	2.2	37.2	10	NONE	-	-	-	154.9	175
								E18	13.5	1	37.5	154.9	175
								E36	27	2	74.9	154.9	175
								E54	40.6	2	112.7	199.9	200
								E72	54.1	2	150.2	209.2	225
	230-3-60	22.4	149	35	2.2	34.6	10	NONE	-	-	-	151.7	175
								E18	18	1	43.3	151.7	175
								E36	36	2	86.6	164	175
								E54	54	2	129.9	185.7	200
								E72	72	2	173.2	229	250
	460-3-60	10.6	75	16.5	1.1	17.3	5	NONE	-	-	-	73.4	90
								E18	18	1	21.7	73.4	90
								E36	36	2	43.3	82	90
								E54	54	2	65	92.8	100
								E72	72	2	86.6	114.5	125
	575-3-60	7.7	54	12	0.9	14.5	4	NONE	-	-	-	56.5	70
								E18	18	1	17.3	56.5	70
								E36	36	2	34.6	66.4	70
								E54	54	2	52	75.1	80
								E72	72	2	69.3	92.4	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ300 - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	22.4	149	35	2.2	20	0	NONE	-	-	-	124	125
								E18	13.5	1	37.5	124	125
								E36	27	2	74.9	124	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	22.4	149	35	2.2	19.4	0	NONE	-	-	-	123.4	125
								E18	18	1	43.3	123.4	125
								E36	36	2	86.6	132.5	150
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	10.6	75	16.5	1.1	9.7	0	NONE	-	-	-	59.2	60
								E18	18	1	21.7	59.2	60
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	7.7	54	12	0.9	7.8	0	NONE	-	-	-	44.2	50
								E18	18	1	17.3	44.2	50
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ300 - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	22.4	149	35	2.2	20	10	NONE	-	-	-	134	150
								E18	13.5	1	37.5	134	150
								E36	27	2	74.9	134	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	22.4	149	35	2.2	19.4	10	NONE	-	-	-	133.4	150
								E18	18	1	43.3	133.4	150
								E36	36	2	86.6	145	150
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	10.6	75	16.5	1.1	9.7	5	NONE	-	-	-	64.2	70
								E18	18	1	21.7	64.2	70
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	7.7	54	12	0.9	7.8	4	NONE	-	-	-	48.2	50
								E18	18	1	17.3	48.2	50
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR180 - 300

ZR180-300 - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	25	164	39	2.1	13.5	0	NONE	-	-	-	78.2	100
								E18	13.5	1	37.5	78.2	100
								E36	27	2	74.9	110.6	125
								E54	40.6	2	112.7	157.7	175
								E72	54.1	2	150.2	167	200
	230-3-60	25	164	39	2.1	13	0	NONE	-	-	-	77.7	100
								E18	18	1	43.3	77.7	100
								E36	36	2	86.6	124.5	125
								E54	54	2	129.9	146.2	175
								E72	72	2	173.2	189.5	225
	460-3-60	12.2	100	19	1.26	6.5	0	NONE	-	-	-	39	50
								E18	18	1	21.7	39	50
								E36	36	2	43.3	62.3	70
								E54	54	2	65	73.1	80
								E72	72	2	86.6	94.7	110
	575-3-60	9	78	14	0.66	5.2	0	NONE	-	-	-	28.1	35
								E18	18	1	17.3	28.2	35
								E36	36	2	34.6	49.8	50
								E54	54	2	52	58.5	70
								E72	72	2	69.3	75.8	90
240 (20)	208-3-60	30.1	225	47	2.2	20	0	NONE	-	-	-	96.5	125
								E18	13.5	1	37.5	96.5	125
								E36	27	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	30.1	225	47	2.2	19.4	0	NONE	-	-	-	95.9	125
								E18	18	1	43.3	95.9	125
								E36	36	2	86.6	132.5	150
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	16.7	114	26	1.1	9.7	0	NONE	-	-	-	51.7	60
								E18	18	1	21.7	51.7	60
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	12.2	80	19	0.9	7.8	0	NONE	-	-	-	38.9	50
								E18	18	1	17.3	38.9	50
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90
300 (25)	208-3-60	48.1	245	75	2.2	26	0	NONE	-	-	-	143	175
								E18	13.5	1	37.5	143	175
								E36	27	2	74.9	143	175
								E54	40.6	2	112.7	173.4	175
								E72	54.1	2	150.2	182.7	200
	230-3-60	48.1	245	75	2.2	25	0	NONE	-	-	-	142	175
								E18	18	1	43.3	142	175
								E36	36	2	86.6	142	175
								E54	54	2	129.9	161.2	175
								E72	72	2	173.2	204.5	225
	460-3-60	18.6	125	29	1.1	12.5	0	NONE	-	-	-	58.8	70
								E18	18	1	21.7	58.8	70
								E36	36	2	43.3	69.8	70
								E54	54	2	65	80.6	90
								E72	72	2	86.6	102.2	110
	575-3-60	14.7	100	23	0.9	10	0	NONE	-	-	-	46.7	60
								E18	18	1	17.3	46.7	60
								E36	36	2	34.6	55.8	60
								E54	54	2	52	64.5	70
								E72	72	2	69.3	81.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR180-300 - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	25	164	39	2.1	13.5	10	NONE	-	-	-	88.2	110
								E18	13.5	1	37.5	88.2	110
								E36	27	2	74.9	123.1	125
								E54	40.6	2	112.7	170.2	175
								E72	54.1	2	150.2	179.5	200
	230-3-60	25	164	39	2.1	13	10	NONE	-	-	-	87.7	110
								E18	18	1	43.3	87.7	110
								E36	36	2	86.6	137	150
								E54	54	2	129.9	158.7	175
								E72	72	2	173.2	202	225
	460-3-60	12.2	100	19	1.26	6.5	5	NONE	-	-	-	44	50
								E18	18	1	21.7	44	50
								E36	36	2	43.3	68.5	70
								E54	54	2	65	79.3	90
								E72	72	2	86.6	101	110
	575-3-60	9	78	14	0.66	5.2	4	NONE	-	-	-	32.1	40
								E18	18	1	17.3	33.2	40
								E36	36	2	34.6	54.8	60
								E54	54	2	52	63.5	70
								E72	72	2	69.3	80.8	90
240 (20)	208-3-60	30.1	225	47	2.2	20	10	NONE	-	-	-	106.5	125
								E18	13.5	1	37.5	106.5	125
								E36	27	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	30.1	225	47	2.2	19.4	10	NONE	-	-	-	105.9	125
								E18	18	1	43.3	105.9	125
								E36	36	2	86.6	145	150
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	16.7	114	26	1.1	9.7	5	NONE	-	-	-	56.7	70
								E18	18	1	21.7	56.7	70
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	12.2	80	19	0.9	7.8	4	NONE	-	-	-	42.9	50
								E18	18	1	17.3	42.9	50
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90
300 (25)	208-3-60	48.1	245	75	2.2	26	10	NONE	-	-	-	153	200
								E18	13.5	1	37.5	153	200
								E36	27	2	74.9	153	200
								E54	40.6	2	112.7	185.9	200
								E72	54.1	2	150.2	195.2	200
	230-3-60	48.1	245	75	2.2	25	10	NONE	-	-	-	152	200
								E18	18	1	43.3	152	200
								E36	36	2	86.6	152	200
								E54	54	2	129.9	173.7	200
								E72	72	2	173.2	217	225
	460-3-60	18.6	125	29	1.1	12.5	5	NONE	-	-	-	63.8	80
								E18	18	1	21.7	63.8	80
								E36	36	2	43.3	76	80
								E54	54	2	65	86.8	90
								E72	72	2	86.6	108.5	110
	575-3-60	14.7	100	23	0.9	10	4	NONE	-	-	-	50.7	60
								E18	18	1	17.3	50.7	60
								E36	36	2	34.6	60.8	70
								E54	54	2	52	69.5	70
								E72	72	2	69.3	86.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR180-300 - High Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	25	164	39	2.1	20	0	NONE	-	-	-	84.7	100
								E18	13.5	1	37.5	84.7	100
								E36	27	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	25	164	39	2.1	19.4	0	NONE	-	-	-	84.1	100
								E18	18	1	43.3	84.1	100
								E36	36	2	86.6	132.5	150
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	12.2	100	19	1.26	9.7	0	NONE	-	-	-	42.2	50
								E18	18	1	21.7	42.2	50
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	9	78	14	0.66	7.8	0	NONE	-	-	-	30.7	35
								E18	18	1	17.3	31.4	35
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90
240 (20)	208-3-60	30.1	225	47	2.2	26	0	NONE	-	-	-	102.5	125
								E18	13.5	1	37.5	102.5	125
								E36	27	2	74.9	126.2	150
								E54	40.6	2	112.7	173.4	175
								E72	54.1	2	150.2	182.7	200
	230-3-60	30.1	225	47	2.2	25	0	NONE	-	-	-	101.5	125
								E18	18	1	43.3	101.5	125
								E36	36	2	86.6	139.5	150
								E54	54	2	129.9	161.2	175
								E72	72	2	173.2	204.5	225
	460-3-60	16.7	114	26	1.1	12.5	0	NONE	-	-	-	54.5	70
								E18	18	1	21.7	54.5	70
								E36	36	2	43.3	69.8	70
								E54	54	2	65	80.6	90
								E72	72	2	86.6	102.2	110
	575-3-60	12.2	80	19	0.9	10	0	NONE	-	-	-	41.1	50
								E18	18	1	17.3	41.1	50
								E36	36	2	34.6	55.8	60
								E54	54	2	52	64.5	70
								E72	72	2	69.3	81.8	90
300 (25)	208-3-60	48.1	245	75	2.2	37.2	0	NONE	-	-	-	154.2	200
								E18	13.5	1	37.5	154.2	200
								E36	27	2	74.9	154.2	200
								E54	40.6	2	112.7	187.4	200
								E72	54.1	2	150.2	196.7	225
	230-3-60	48.1	245	75	2.2	34.6	0	NONE	-	-	-	151.6	175
								E18	18	1	43.3	151.6	175
								E36	36	2	86.6	151.6	175
								E54	54	2	129.9	173.2	200
								E72	72	2	173.2	216.5	250
	460-3-60	18.6	125	29	1.1	17.3	0	NONE	-	-	-	63.6	80
								E18	18	1	21.7	63.6	80
								E36	36	2	43.3	75.8	80
								E54	54	2	65	86.6	100
								E72	72	2	86.6	108.2	125
	575-3-60	14.7	100	23	0.9	14.5	0	NONE	-	-	-	51.2	60
								E18	18	1	17.3	51.2	60
								E36	36	2	34.6	61.4	70
								E54	54	2	52	70.1	80
								E72	72	2	69.3	87.4	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR180-300 - High Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	25	164	39	2.1	20	10	NONE	-	-	-	94.7	110
								E18	13.5	1	37.5	94.7	110
								E36	27	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	25	164	39	2.1	19.4	10	NONE	-	-	-	94.1	110
								E18	18	1	43.3	94.1	110
								E36	36	2	86.6	145	150
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	12.2	100	19	1.26	9.7	5	NONE	-	-	-	47.2	50
								E18	18	1	21.7	47.2	50
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	9	78	14	0.66	7.8	4	NONE	-	-	-	34.7	40
								E18	18	1	17.3	36.4	40
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90
240 (20)	208-3-60	30.1	225	47	2.2	26	10	NONE	-	-	-	112.5	125
								E18	13.5	1	37.5	112.5	125
								E36	27	2	74.9	138.7	150
								E54	40.6	2	112.7	185.9	200
								E72	54.1	2	150.2	195.2	200
	230-3-60	30.1	225	47	2.2	25	10	NONE	-	-	-	111.5	125
								E18	18	1	43.3	111.5	125
								E36	36	2	86.6	152	175
								E54	54	2	129.9	173.7	175
								E72	72	2	173.2	217	225
	460-3-60	16.7	114	26	1.1	12.5	5	NONE	-	-	-	59.5	70
								E18	18	1	21.7	59.5	70
								E36	36	2	43.3	76	80
								E54	54	2	65	86.8	90
								E72	72	2	86.6	108.5	110
	575-3-60	12.2	80	19	0.9	10	4	NONE	-	-	-	45.1	50
								E18	18	1	17.3	45.1	50
								E36	36	2	34.6	60.8	70
								E54	54	2	52	69.5	70
								E72	72	2	69.3	86.8	90
300 (25)	208-3-60	48.1	245	75	2.2	37.2	10	NONE	-	-	-	164.2	200
								E18	13.5	1	37.5	164.2	200
								E36	27	2	74.9	164.2	200
								E54	40.6	2	112.7	199.9	200
								E72	54.1	2	150.2	209.2	225
	230-3-60	48.1	245	75	2.2	34.6	10	NONE	-	-	-	161.6	200
								E18	18	1	43.3	161.6	200
								E36	36	2	86.6	164	200
								E54	54	2	129.9	185.7	200
								E72	72	2	173.2	229	250
	460-3-60	18.6	125	29	1.1	17.3	5	NONE	-	-	-	68.6	80
								E18	18	1	21.7	68.6	80
								E36	36	2	43.3	82	90
								E54	54	2	65	92.8	100
								E72	72	2	86.6	114.5	125
	575-3-60	14.7	100	23	0.9	14.5	4	NONE	-	-	-	55.2	60
								E18	18	1	17.3	55.2	60
								E36	36	2	34.6	66.4	70
								E54	54	2	52	75.1	80
								E72	72	2	69.3	92.4	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR300 - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	48.1	245	75	2.2	20	0	NONE	-	-	-	137	175
								E18	13.5	1	37.5	137	175
								E36	27	2	74.9	137	175
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	48.1	245	75	2.2	19.4	0	NONE	-	-	-	136.4	175
								E18	18	1	43.3	136.4	175
								E36	36	2	86.6	136.4	175
								E54	54	2	129.9	154.2	175
								E72	72	2	173.2	197.5	225
	460-3-60	18.6	125	29	1.1	9.7	0	NONE	-	-	-	56	70
								E18	18	1	21.7	56	70
								E36	36	2	43.3	66.3	70
								E54	54	2	65	77.1	90
								E72	72	2	86.6	98.7	110
	575-3-60	14.7	100	23	0.9	7.8	0	NONE	-	-	-	44.5	50
								E18	18	1	17.3	44.5	50
								E36	36	2	34.6	53.1	60
								E54	54	2	52	61.7	70
								E72	72	2	69.3	79	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZR300 - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	48.1	245	75	2.2	20	10	NONE	-	-	-	147	175
								E18	13.5	1	37.5	147	175
								E36	27	2	74.9	147	175
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	48.1	245	75	2.2	19.4	10	NONE	-	-	-	146.4	175
								E18	18	1	43.3	146.4	175
								E36	36	2	86.6	146.4	175
								E54	54	2	129.9	166.7	175
								E72	72	2	173.2	210	225
	460-3-60	18.6	125	29	1.1	9.7	5	NONE	-	-	-	61	70
								E18	18	1	21.7	61	70
								E36	36	2	43.3	72.5	80
								E54	54	2	65	83.3	90
								E72	72	2	86.6	105	110
	575-3-60	14.7	100	23	0.9	7.8	4	NONE	-	-	-	48.5	60
								E18	18	1	17.3	48.5	60
								E36	36	2	34.6	58.1	60
								E54	54	2	52	66.7	70
								E72	72	2	69.3	84	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZF180 - 300

ZF180-300 - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
180 (15)	208-3-60	25	25	164	164	39	39	4.1	13.5	0	NONE	-	-	-	78	100
											E18	13.5	1	37.5	78	100
											E36	27	2	74.9	110.6	125
											E54	40.6	2	112.7	157.7	175
											E72	54.1	2	150.2	167	200
	230-3-60	25	25	164	164	39	39	3.9	13	0	NONE	-	-	-	77.1	100
											E18	18	1	43.3	77.1	100
											E36	36	2	86.6	124.5	125
											E54	54	2	129.9	146.2	175
											E72	72	2	173.2	189.5	225
	460-3-60	12.8	12.8	100	100	20	20	2.15	6.5	0	NONE	-	-	-	39.6	50
											E18	18	1	21.7	39.6	50
											E36	36	2	43.3	62.3	70
											E54	54	2	65	73.1	80
											E72	72	2	86.6	94.7	110
	575-3-60	9.6	9.6	78	78	15	15	1.6	5.2	0	NONE	-	-	-	30	35
											E18	18	1	17.3	30	35
											E36	36	2	34.6	49.8	50
											E54	54	2	52	58.5	70
											E72	72	2	69.3	75.8	90
210 (17.5)	208-3-60	27.6	27.6	203	203	43	43	4.1	13.5	0	NONE	-	-	-	83.8	110
											E18	13.5	1	37.5	83.8	110
											E36	27	2	74.9	110.6	125
											E54	40.6	2	112.7	157.7	175
											E72	54.1	2	150.2	167	200
	230-3-60	27.6	27.6	203	203	43	43	3.9	13	0	NONE	-	-	-	82.9	110
											E18	18	1	43.3	82.9	110
											E36	36	2	86.6	124.5	125
											E54	54	2	129.9	146.2	175
											E72	72	2	173.2	189.5	225
	460-3-60	14.3	14.3	98	98	22	22	2.15	6.5	0	NONE	-	-	-	43	50
											E18	18	1	21.7	43	50
											E36	36	2	43.3	62.3	70
											E54	54	2	65	73.1	80
											E72	72	2	86.6	94.7	110
	575-3-60	12.9	12.9	84	84	18	18	1.6	5.2	0	NONE	-	-	-	37.4	50
											E18	18	1	17.3	37.4	50
											E36	36	2	34.6	49.8	50
											E54	54	2	52	58.5	70
											E72	72	2	69.3	75.8	90
240 (20)	208-3-60	35.8	35.8	239	239	52	52	4.1	13.5	0	NONE	-	-	-	102.3	125
											E18	13.5	1	37.5	102.3	125
											E36	27	2	74.9	110.6	125
											E54	40.6	2	112.7	157.7	175
											E72	54.1	2	150.2	167	200
	230-3-60	35.8	35.8	239	239	52	52	3.9	13	0	NONE	-	-	-	101.4	125
											E18	18	1	43.3	101.4	125
											E36	36	2	86.6	124.5	125
											E54	54	2	129.9	146.2	175
											E72	72	2	173.2	189.5	225
	460-3-60	17.9	17.9	125	125	28	28	2.15	6.5	0	NONE	-	-	-	51.1	60
											E18	18	1	21.7	51.1	60
											E36	36	2	43.3	62.3	70
											E54	54	2	65	73.1	80
											E72	72	2	86.6	94.7	110
	575-3-60	12.8	12.8	80	80	20	20	1.6	5.2	0	NONE	-	-	-	37.2	50
											E18	18	1	17.3	37.2	50
											E36	36	2	34.6	49.8	50
											E54	54	2	52	58.5	70
											E72	72	2	69.3	75.8	90

ZF180-300 - Standard Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	26	0	NONE	-	-	-	131.7	175
											E18	13.5	1	37.5	131.7	175
											E36	27	2	74.9	131.7	175
											E54	40.6	2	112.7	173.4	175
											E72	54.1	2	150.2	182.7	200
	230-3-60	48.1	34	245	240			5.8	25	0	NONE	-	-	-	130.7	175
											E18	18	1	43.3	130.7	175
											E36	36	2	86.6	139.5	175
											E54	54	2	129.9	161.2	175
											E72	72	2	173.2	204.5	225
	460-3-60	18.6	16	125	140			2.9	12.5	0	NONE	-	-	-	57.6	70
											E18	18	1	21.7	57.6	70
											E36	36	2	43.3	69.8	70
											E54	54	2	65	80.6	90
											E72	72	2	86.6	102.2	110
	575-3-60	14.7	12.9	100	108			2.2	10	0	NONE	-	-	-	45.7	60
											E18	18	1	17.3	45.7	60
											E36	36	2	34.6	55.8	60
											E54	54	2	52	64.5	70
											E72	72	2	69.3	81.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZF180-300 - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
180 (15)	208-3-60	25	25	164	164	39	39	4.1	13.5	10	NONE	-	-	-	88	110
											E18	13.5	1	37.5	88	110
											E36	27	2	74.9	123.1	125
											E54	40.6	2	112.7	170.2	175
											E72	54.1	2	150.2	179.5	200
	230-3-60	25	25	164	164	39	39	3.9	13	10	NONE	-	-	-	87.1	110
											E18	18	1	43.3	87.1	110
											E36	36	2	86.6	137	150
											E54	54	2	129.9	158.7	175
											E72	72	2	173.2	202	225
	460-3-60	12.8	12.8	100	100	20	20	2.15	6.5	5	NONE	-	-	-	44.6	50
											E18	18	1	21.7	44.6	50
											E36	36	2	43.3	68.5	70
											E54	54	2	65	79.3	90
											E72	72	2	86.6	101	110
	575-3-60	9.6	9.6	78	78	15	15	1.6	5.2	4	NONE	-	-	-	34	40
											E18	18	1	17.3	34	40
											E36	36	2	34.6	54.8	60
											E54	54	2	52	63.5	70
											E72	72	2	69.3	80.8	90
210 (17.5)	208-3-60	27.6	27.6	203	203	43	43	4.1	13.5	10	NONE	-	-	-	93.8	110
											E18	13.5	1	37.5	93.8	110
											E36	27	2	74.9	123.1	125
											E54	40.6	2	112.7	170.2	175
											E72	54.1	2	150.2	179.5	200
	230-3-60	27.6	27.6	203	203	43	43	3.9	13	10	NONE	-	-	-	92.9	110
											E18	18	1	43.3	92.9	110
											E36	36	2	86.6	137	150
											E54	54	2	129.9	158.7	175
											E72	72	2	173.2	202	225
	460-3-60	14.3	14.3	98	98	22	22	2.15	6.5	5	NONE	-	-	-	48	60
											E18	18	1	21.7	48	60
											E36	36	2	43.3	68.5	70
											E54	54	2	65	79.3	90
											E72	72	2	86.6	101	110
	575-3-60	12.9	12.9	84	84	18	18	1.6	5.2	4	NONE	-	-	-	41.4	50
											E18	18	1	17.3	41.4	50
											E36	36	2	34.6	54.8	60
											E54	54	2	52	63.5	70
											E72	72	2	69.3	80.8	90
240 (20)	208-3-60	35.8	35.8	239	239	52	52	4.1	13.5	10	NONE	-	-	-	112.3	125
											E18	13.5	1	37.5	112.3	125
											E36	27	2	74.9	123.1	125
											E54	40.6	2	112.7	170.2	175
											E72	54.1	2	150.2	179.5	200
	230-3-60	35.8	35.8	239	239	52	52	3.9	13	10	NONE	-	-	-	111.4	125
											E18	18	1	43.3	111.4	125
											E36	36	2	86.6	137	150
											E54	54	2	129.9	158.7	175
											E72	72	2	173.2	202	225
	460-3-60	17.9	17.9	125	125	28	28	2.15	6.5	5	NONE	-	-	-	56.1	70
											E18	18	1	21.7	56.1	70
											E36	36	2	43.3	68.5	70
											E54	54	2	65	79.3	90
											E72	72	2	86.6	101	110
	575-3-60	12.8	12.8	80	80	20	20	1.6	5.2	4	NONE	-	-	-	41.2	50
											E18	18	1	17.3	41.2	50
											E36	36	2	34.6	54.8	60
											E54	54	2	52	63.5	70
											E72	72	2	69.3	80.8	90

ZF180-300 - Standard Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	26	10	NONE	-	-	-	141.7	175
											E18	13.5	1	37.5	141.7	175
											E36	27	2	74.9	141.7	175
											E54	40.6	2	112.7	185.9	200
											E72	54.1	2	150.2	195.2	200
	230-3-60	48.1	34	245	240			5.8	25	10	NONE	-	-	-	140.7	175
											E18	18	1	43.3	140.7	175
											E36	36	2	86.6	152	175
											E54	54	2	129.9	173.7	175
											E72	72	2	173.2	217	225
	460-3-60	18.6	16	125	140			2.9	12.5	5	NONE	-	-	-	62.6	80
											E18	18	1	21.7	62.6	80
											E36	36	2	43.3	76	80
											E54	54	2	65	86.8	90
											E72	72	2	86.6	108.5	110
	575-3-60	14.7	12.9	100	108			2.2	10	4	NONE	-	-	-	49.7	60
											E18	18	1	17.3	49.7	60
											E36	36	2	34.6	60.8	70
											E54	54	2	52	69.5	70
											E72	72	2	69.3	86.8	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZF180-300 - Hi Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
180 (15)	208-3-60	25	25	164	164	39	39	4.1	13.5	0	NONE	-	-	-	78	100
											E18	13.5	1	37.5	78	100
											E36	27	2	74.9	110.6	125
											E54	40.6	2	112.7	157.7	175
											E72	54.1	2	150.2	167	200
	230-3-60	25	25	164	164	39	39	3.9	13	0	NONE	-	-	-	77.1	100
											E18	18	1	43.3	77.1	100
											E36	36	2	86.6	124.5	125
											E54	54	2	129.9	146.2	175
											E72	72	2	173.2	189.5	225
	460-3-60	12.8	12.8	100	100	20	20	2.15	6.5	0	NONE	-	-	-	39.6	50
											E18	18	1	21.7	39.6	50
											E36	36	2	43.3	62.3	70
											E54	54	2	65	73.1	80
											E72	72	2	86.6	94.7	110
	575-3-60	9.6	9.6	78	78	15	15	1.6	5.2	0	NONE	-	-	-	30	35
											E18	18	1	17.3	30	35
											E36	36	2	34.6	49.8	50
											E54	54	2	52	58.5	70
											E72	72	2	69.3	75.8	90
210 (17.5)	208-3-60	27.6	27.6	203	203	43	43	4.1	20	0	NONE	-	-	-	90.3	110
											E18	13.5	1	37.5	90.3	110
											E36	27	2	74.9	118.7	125
											E54	40.6	2	112.7	165.9	175
											E72	54.1	2	150.2	175.2	200
	230-3-60	27.6	27.6	203	203	43	43	3.9	19.4	0	NONE	-	-	-	89.3	110
											E18	18	1	43.3	89.3	110
											E36	36	2	86.6	132.5	150
											E54	54	2	129.9	154.2	175
											E72	72	2	173.2	197.5	225
	460-3-60	14.3	14.3	98	98	22	22	2.15	9.7	0	NONE	-	-	-	46.2	60
											E18	18	1	21.7	46.2	60
											E36	36	2	43.3	66.3	70
											E54	54	2	65	77.1	90
											E72	72	2	86.6	98.7	110
	575-3-60	12.9	12.9	84	84	18	18	1.6	7.8	0	NONE	-	-	-	40	50
											E18	18	1	17.3	40	50
											E36	36	2	34.6	53.1	60
											E54	54	2	52	61.7	70
											E72	72	2	69.3	79	90
240 (20)	208-3-60	35.8	35.8	239	239	52	52	4.1	20	0	NONE	-	-	-	108.8	125
											E18	13.5	1	37.5	108.8	125
											E36	27	2	74.9	118.7	125
											E54	40.6	2	112.7	165.9	175
											E72	54.1	2	150.2	175.2	200
	230-3-60	35.8	35.8	239	239	52	52	3.9	19.4	0	NONE	-	-	-	107.8	125
											E18	18	1	43.3	107.8	125
											E36	36	2	86.6	132.5	150
											E54	54	2	129.9	154.2	175
											E72	72	2	173.2	197.5	225
	460-3-60	17.9	17.9	125	125	28	28	2.15	9.7	0	NONE	-	-	-	54.3	70
											E18	18	1	21.7	54.3	70
											E36	36	2	43.3	66.3	70
											E54	54	2	65	77.1	90
											E72	72	2	86.6	98.7	110
	575-3-60	12.8	12.8	80	80	20	20	1.6	7.8	0	NONE	-	-	-	39.8	50
											E18	18	1	17.3	39.8	50
											E36	36	2	34.6	53.1	60
											E54	54	2	52	61.7	70
											E72	72	2	69.3	79	90

ZF180-300 - Hi Static Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	37.2	0	NONE	-	-	-	142.9	175
											E18	13.5	1	37.5	142.9	175
											E36	27	2	74.9	142.9	175
											E54	40.6	2	112.7	187.4	200
											E72	54.1	2	150.2	196.7	225
	230-3-60	48.1	34	245	240			5.8	34.6	0	NONE	-	-	-	140.3	175
											E18	18	1	43.3	140.3	175
											E36	36	2	86.6	151.5	175
											E54	54	2	129.9	173.2	200
											E72	72	2	173.2	216.5	250
	460-3-60	18.6	16	125	140			2.9	17.3	0	NONE	-	-	-	62.4	80
											E18	18	1	21.7	62.4	80
											E36	36	2	43.3	75.8	80
											E54	54	2	65	86.6	100
											E72	72	2	86.6	108.2	125
	575-3-60	14.7	12.9	100	108			2.2	14.1	0	NONE	-	-	-	49.8	60
											E18	18	1	17.3	49.8	60
											E36	36	2	34.6	60.9	70
											E54	54	2	52	69.6	80
											E72	72	2	69.3	86.9	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZF180-300 - Hi Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
180 (15)	208-3-60	25	25	164	164	39	39	4.1	13.5	10	NONE	-	-	-	88	110
											E18	13.5	1	37.5	88	110
											E36	27	2	74.9	123.1	125
											E54	40.6	2	112.7	170.2	175
											E72	54.1	2	150.2	179.5	200
	230-3-60	25	25	164	164	39	39	3.9	13	10	NONE	-	-	-	87.1	110
											E18	18	1	43.3	87.1	110
											E36	36	2	86.6	137	150
											E54	54	2	129.9	158.7	175
											E72	72	2	173.2	202	225
	460-3-60	12.8	12.8	100	100	20	20	2.15	6.5	5	NONE	-	-	-	44.6	50
											E18	18	1	21.7	44.6	50
											E36	36	2	43.3	68.5	70
											E54	54	2	65	79.3	90
											E72	72	2	86.6	101	110
	575-3-60	9.6	9.6	78	78	15	15	1.6	5.2	4	NONE	-	-	-	34	40
											E18	18	1	17.3	34	40
											E36	36	2	34.6	54.8	60
											E54	54	2	52	63.5	70
											E72	72	2	69.3	80.8	90
210 (17.5)	208-3-60	27.6	27.6	203	203	43	43	4.1	20	10	NONE	-	-	-	100.3	125
											E18	13.5	1	37.5	100.3	125
											E36	27	2	74.9	131.2	150
											E54	40.6	2	112.7	178.4	200
											E72	54.1	2	150.2	187.7	200
	230-3-60	27.6	27.6	203	203	43	43	3.9	19.4	10	NONE	-	-	-	99.3	125
											E18	18	1	43.3	99.3	125
											E36	36	2	86.6	145	150
											E54	54	2	129.9	166.7	175
											E72	72	2	173.2	210	225
	460-3-60	14.3	14.3	98	98	22	22	2.15	9.7	5	NONE	-	-	-	51.2	60
											E18	18	1	21.7	51.2	60
											E36	36	2	43.3	72.5	80
											E54	54	2	65	83.3	90
											E72	72	2	86.6	105	110
	575-3-60	12.9	12.9	84	84	18	18	1.6	7.8	4	NONE	-	-	-	44	50
											E18	18	1	17.3	44	50
											E36	36	2	34.6	58.1	60
											E54	54	2	52	66.7	70
											E72	72	2	69.3	84	90
240 (20)	208-3-60	35.8	35.8	239	239	52	52	4.1	20	10	NONE	-	-	-	118.8	150
											E18	13.5	1	37.5	118.8	150
											E36	27	2	74.9	131.2	150
											E54	40.6	2	112.7	178.4	200
											E72	54.1	2	150.2	187.7	200
	230-3-60	35.8	35.8	239	239	52	52	3.9	19.4	10	NONE	-	-	-	117.8	150
											E18	18	1	43.3	117.8	150
											E36	36	2	86.6	145	150
											E54	54	2	129.9	166.7	175
											E72	72	2	173.2	210	225
	460-3-60	17.9	17.9	125	125	28	28	2.15	9.7	5	NONE	-	-	-	59.3	70
											E18	18	1	21.7	59.3	70
											E36	36	2	43.3	72.5	80
											E54	54	2	65	83.3	90
											E72	72	2	86.6	105	110
	575-3-60	12.8	12.8	80	80	20	20	1.6	7.8	4	NONE	-	-	-	43.8	50
											E18	18	1	17.3	43.8	50
											E36	36	2	34.6	58.1	60
											E54	54	2	52	66.7	70
											E72	72	2	69.3	84	90

ZF180-300 - Hi Static Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	37.2	10	NONE	-	-	-	152.9	200
											E18	13.5	1	37.5	152.9	200
											E36	27	2	74.9	152.9	200
											E54	40.6	2	112.7	199.9	200
											E72	54.1	2	150.2	209.2	225
	230-3-60	48.1	34	245	240			5.8	34.6	10	NONE	-	-	-	150.3	175
											E18	18	1	43.3	150.3	175
											E36	36	2	86.6	164	175
											E54	54	2	129.9	185.7	200
											E72	72	2	173.2	229	250
	460-3-60	18.6	16	125	140			2.9	17.3	5	NONE	-	-	-	67.4	80
											E18	18	1	21.7	67.4	80
											E36	36	2	43.3	82	90
											E54	54	2	65	92.8	100
											E72	72	2	86.6	114.5	125
	575-3-60	14.7	12.9	100	108			2.2	14.1	4	NONE	-	-	-	53.8	60
											E18	18	1	17.3	53.8	60
											E36	36	2	34.6	65.9	70
											E54	54	2	52	74.6	80
											E72	72	2	69.3	91.9	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZF180-300 - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	20	0	NONE	-	-	-	125.7	150
											E18	13.5	1	37.5	125.7	150
											E36	27	2	74.9	125.7	150
											E54	40.6	2	112.7	165.9	175
											E72	54.1	2	150.2	175.2	200
	230-3-60	48.1	34	245	240			5.8	19.4	0	NONE	-	-	-	125.1	150
											E18	18	1	43.3	125.1	150
											E36	36	2	86.6	132.5	150
											E54	54	2	129.9	154.2	175
											E72	72	2	173.2	197.5	225
	460-3-60	18.6	16	125	140			2.9	9.7	0	NONE	-	-	-	54.8	70
											E18	18	1	21.7	54.8	70
											E36	36	2	43.3	66.3	70
											E54	54	2	65	77.1	90
											E72	72	2	86.6	98.7	110
	575-3-60	14.7	12.9	100	108			2.2	7.8	0	NONE	-	-	-	43.5	50
											E18	18	1	17.3	43.5	50
											E36	36	2	34.6	53.1	60
											E54	54	2	52	61.7	70
											E72	72	2	69.3	79	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

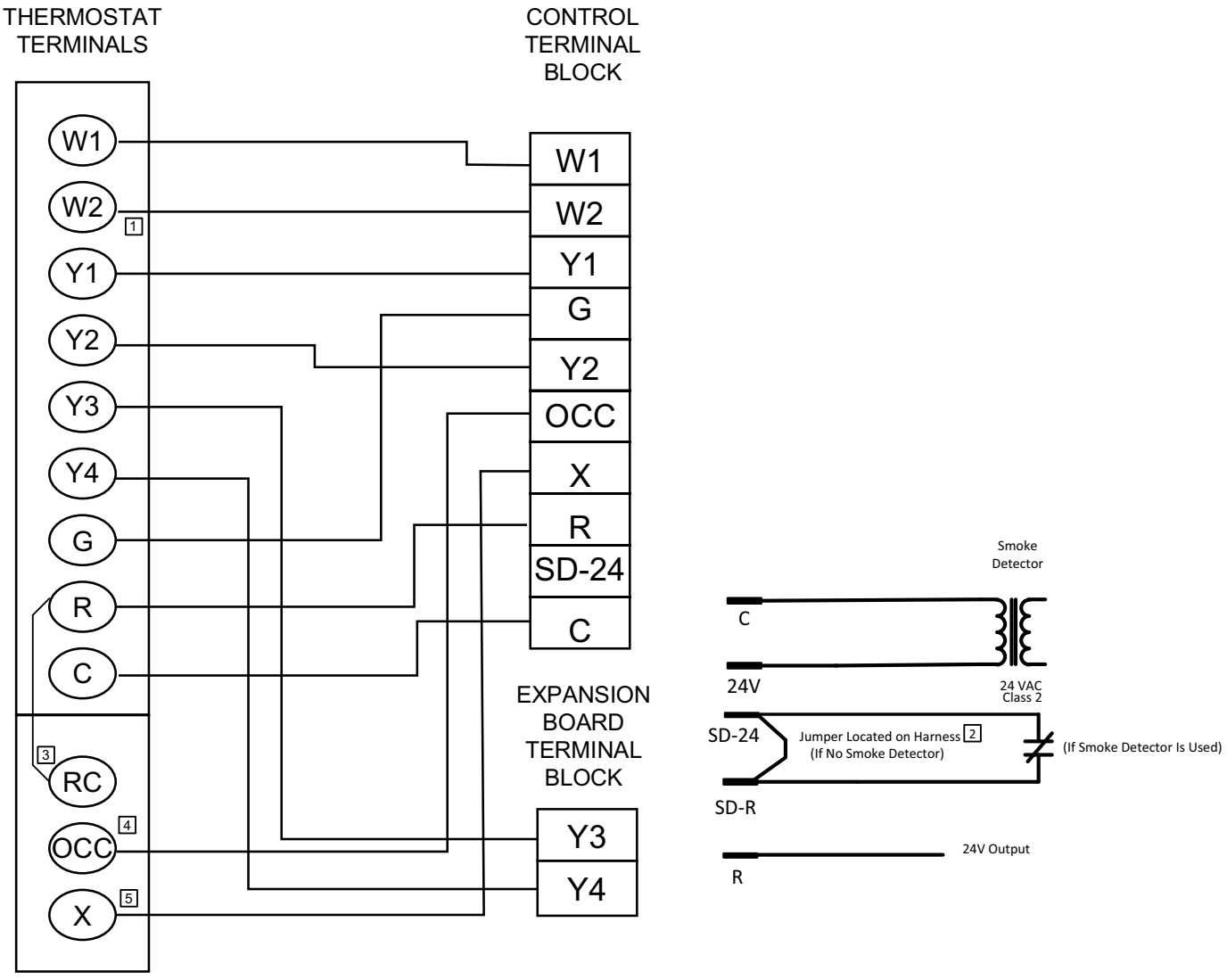
ZF180-300 - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)						OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat (Field Installed Accessory Only)				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA		LRA		MCC		FLA	FLA	FLA	Model	kW	Stages	Amps		
		C1	C2	C1	C2	C1	C2									
300 (25)	208-3-60	48.1	34	245	240			5.8	20	10	NONE	-	-	-	135.7	175
											E18	13.5	1	37.5	135.7	175
											E36	27	2	74.9	135.7	175
											E54	40.6	2	112.7	178.4	200
											E72	54.1	2	150.2	187.7	200
	230-3-60	48.1	34	245	240			5.8	19.4	10	NONE	-	-	-	135.1	175
											E18	18	1	43.3	135.1	175
											E36	36	2	86.6	145	175
											E54	54	2	129.9	166.7	175
											E72	72	2	173.2	210	225
	460-3-60	18.6	16	125	140			2.9	9.7	5	NONE	-	-	-	59.8	70
											E18	18	1	21.7	59.8	70
											E36	36	2	43.3	72.5	80
											E54	54	2	65	83.3	90
											E72	72	2	86.6	105	110
	575-3-60	14.7	12.9	100	108			2.2	7.8	4	NONE	-	-	-	47.5	60
											E18	18	1	17.3	47.5	60
											E36	36	2	34.6	58.1	60
											E54	54	2	52	66.7	70
											E72	72	2	69.3	84	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ/ZR/ZF180-300 Wiring Diagrams

ZJ180-300 Typical Control Diagram



1 Second stage heating not required on single stage heating units.

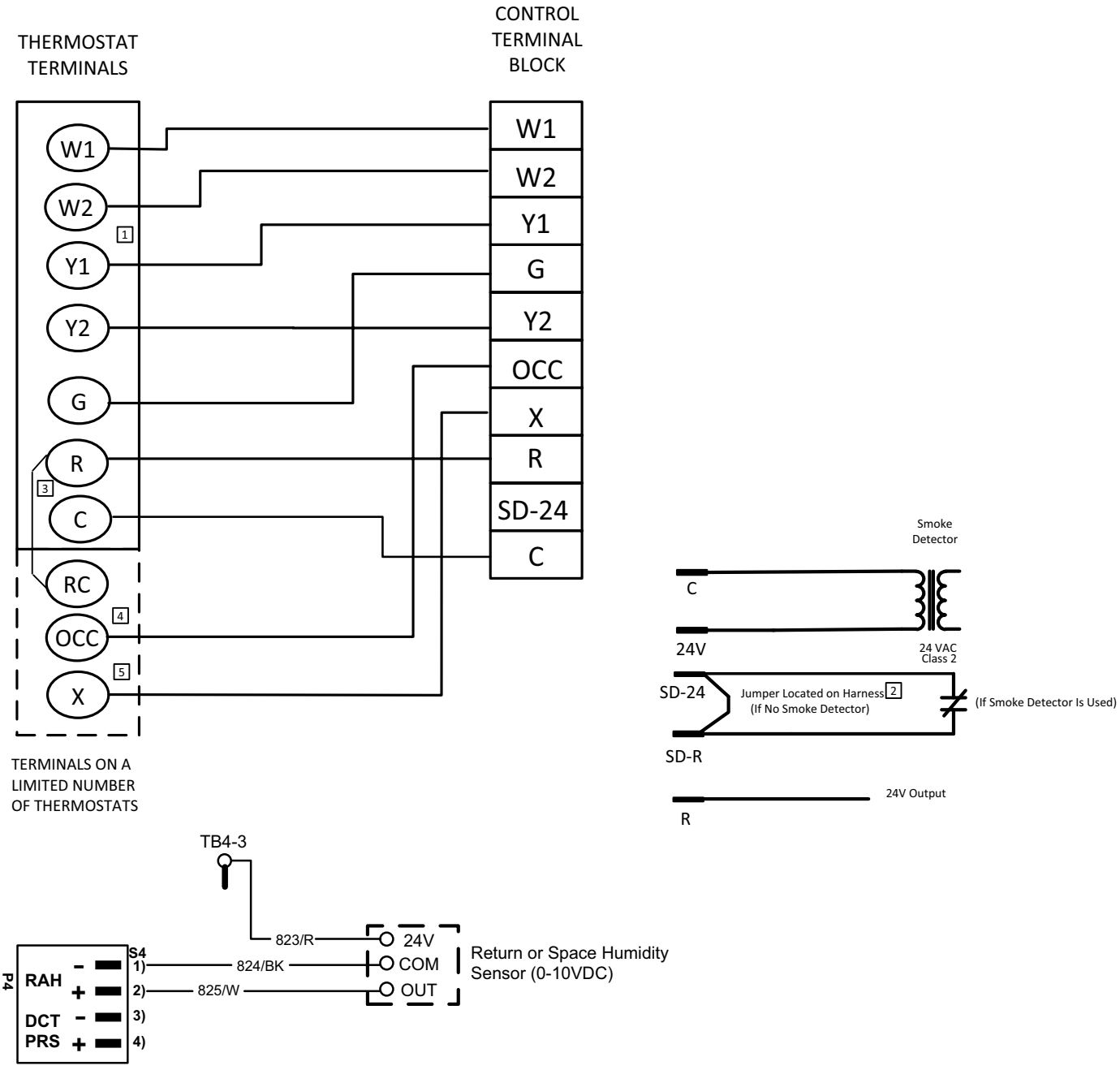
2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

ZR180-300 Typical Control Diagram



1 Second stage heating not required on single stage heating units.

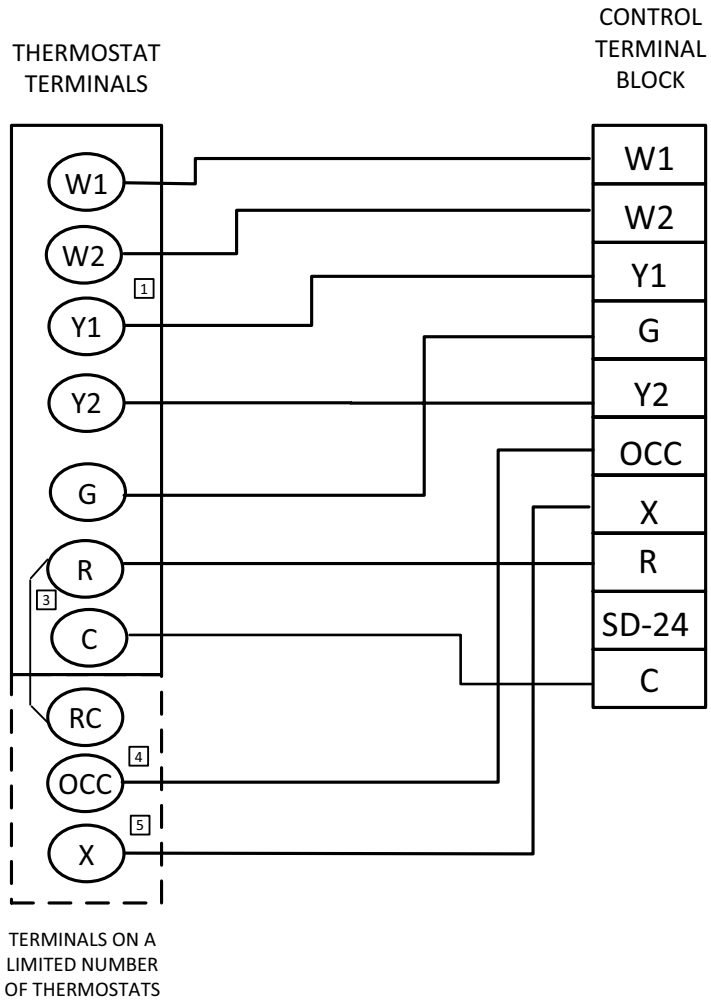
2 Jumper is required if there is no Smoke Detector circuit.

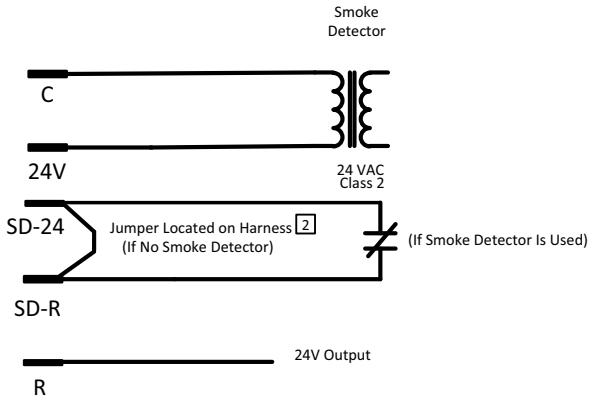
3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

ZF180-300 Typical Control Diagram





1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

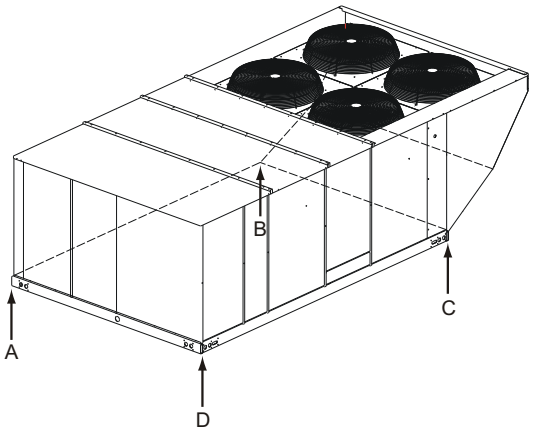
3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

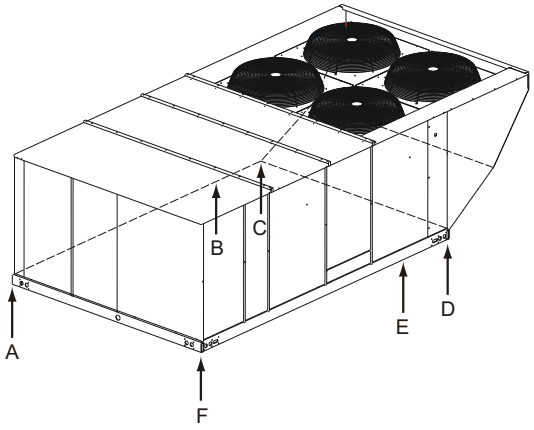
5 X is an input to the thermostat to display Error Status conditions.

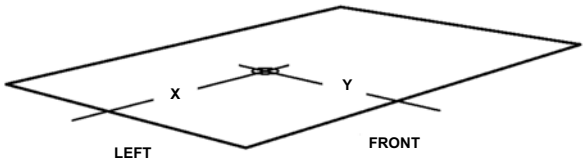
Weights and Dimensions

ZJ/ZR Unit 4 Point Load Weight

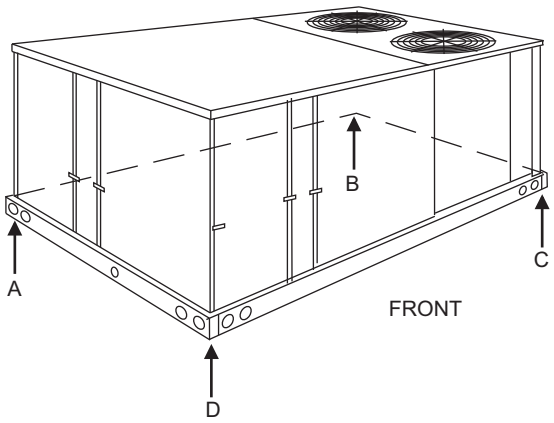


ZJ/ZR Unit 6 Point Load Weight

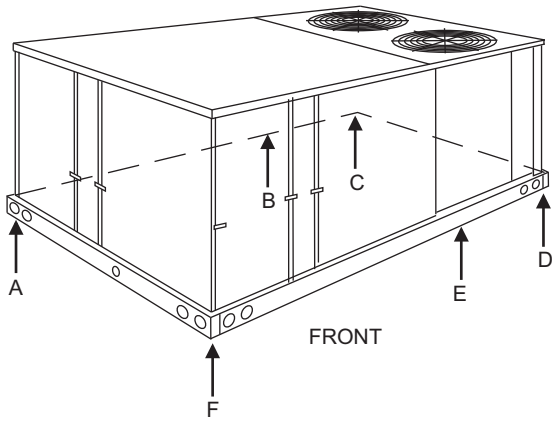




ZF Unit 4 Point Load Weight



ZF Unit 6 Point Load Weight



ZJ/ZR/ZF180-300 Unit Weights

Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
180 (15)	ZJ	2614	2609	85.25	44	467	781	852	510	287	392	568	620	428	313
210 (17.5)	ZJ	2670	2665	85.25	44	477	797	870	520	293	401	580	633	437	320
240 (20)	ZJ	2702	2697	85.05	44	485	805	878	529	298	406	585	638	443	326
300 (25)	ZJ	2788	2783	85.25	44	498	833	908	544	306	419	606	661	457	334
180 (15)	ZR	2365	2360	85.25	44	422	706	770	461	260	355	514	561	387	284
240 (20)	ZR	2665	2660	85.05	44	478	794	866	522	294	401	477	630	437	321
300 (25)	ZR	2765	2760	85.25	44	494	826	901	539	304	415	601	656	453	332
180 (15)	ZF	1875	1870	65.26	45	438	477	498	458	288	304	322	337	318	301
210 (17.5)	ZF	2011	2006	70.98	45	470	511	534	491	309	327	346	361	341	323
240 (20)	ZF	2538	2533	70	44	589	622	679	643	389	404	419	457	440	425
300 (25)	ZF	2602	2597	70	44.5	611	645	689	652	403	418	434	464	447	431

ZJ/ZR/ZF180-300 Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	165	160
Power Exhaust	90	85
Electric Heat[1]	40	40
Gas Heat[2]	240	240
Double Wall	260	260
Motorized Damper	150	150
Barometric Damper	50	45
Econ./Motorized Damper Rain Hood	60	55
Econ./Power Exhaust Rain Hood	95	90
Wood Skid	220	220
Roof Curb	190	185
Hot Gas Bypass	10	10
Supply Fan VFD	See Supply Fan VFD Weights	

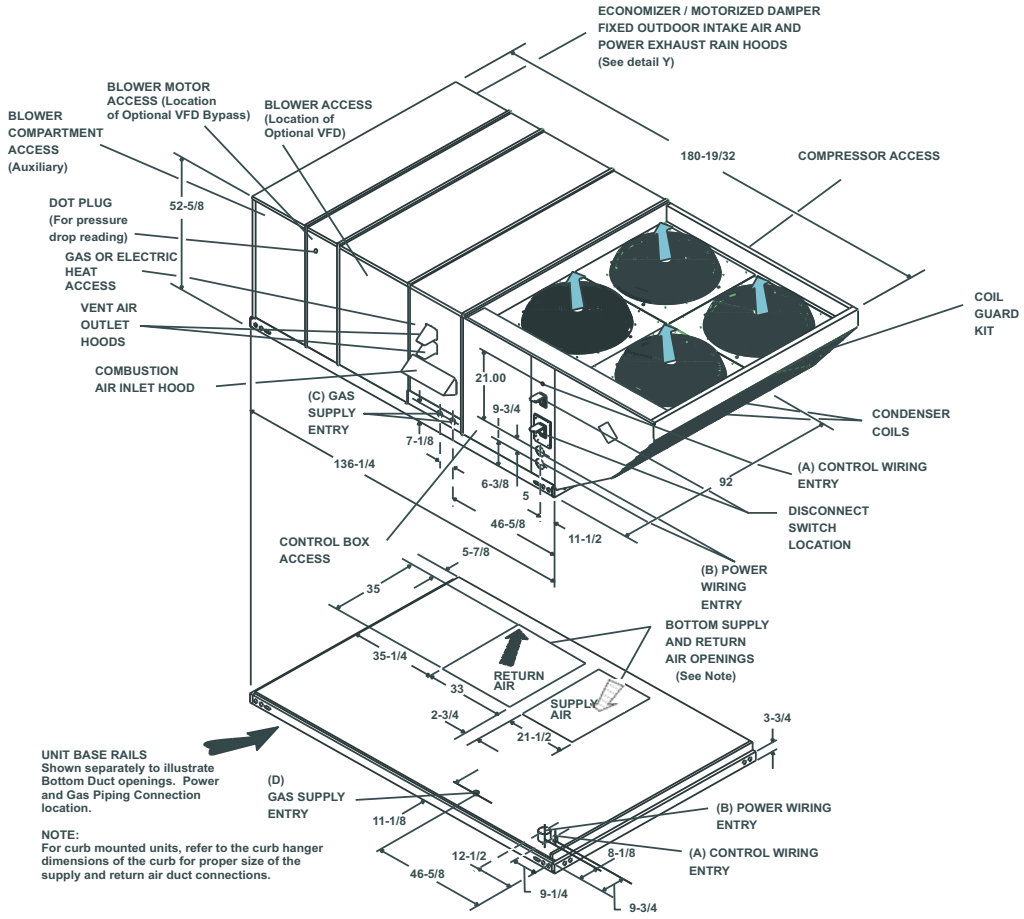
1. Weight given is for the maximum heater size available (72KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).

Supply Fan VFD Weights, in Lbs.

Supply Fan Motor	230V	460V	575V
W/O Manual Bypass			
5.0 hp	25	25	30
7.5 hp	30	30	30
10.0 hp	30	30	35
15.0 hp	30	30	40
W/Manual Bypass			
5.0 hp	30	30	35
7.5 hp	35	35	35
10.0 hp	35	35	40
15.0 hp	40	35	45

Unit Dimensions

ZJ/ZR Unit Dimensions Front View



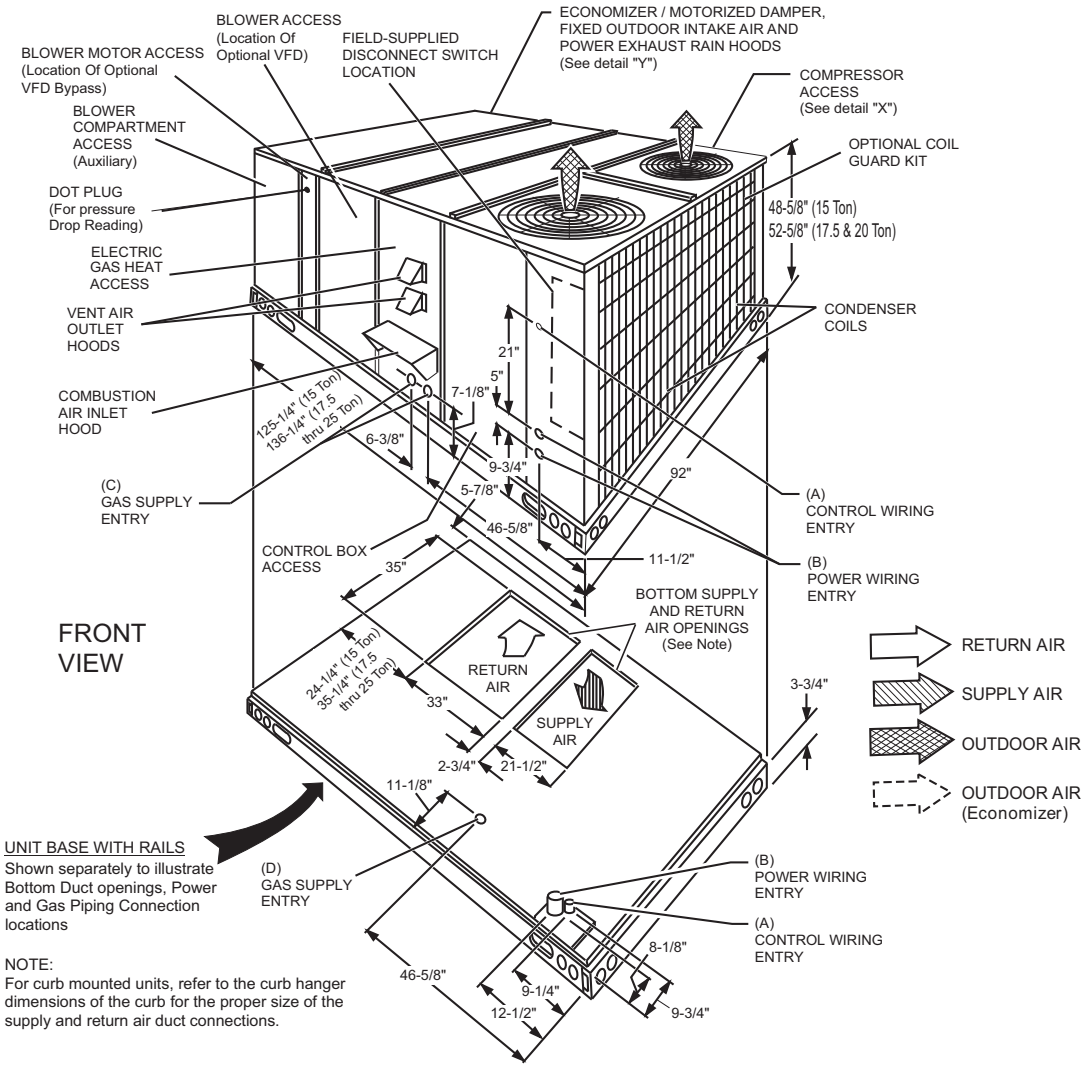
Utilities Entry

Hole	Opening Size Diameter	Used For	
A	1-1/8” KO	Control Wiring	Front
	3/4” NPS (Fem.)		Bottom
B	3-5/8” KO	Power Wiring	Front
	3” NPS (Fem.)		Bottom
C	2-3/8” KO	Gas Piping (Front)[1]	
D	1-11/16” Hole	Gas Piping (Bottom)[1,2]	

1. One-inch Gas Piping NPT Required.
2. Opening in the bottom to the unit can be located by the slice in the insulation.

NOTE: All entry holes should be field sealed to prevent rain water entry into the building.

ZF Unit Dimensions Front View



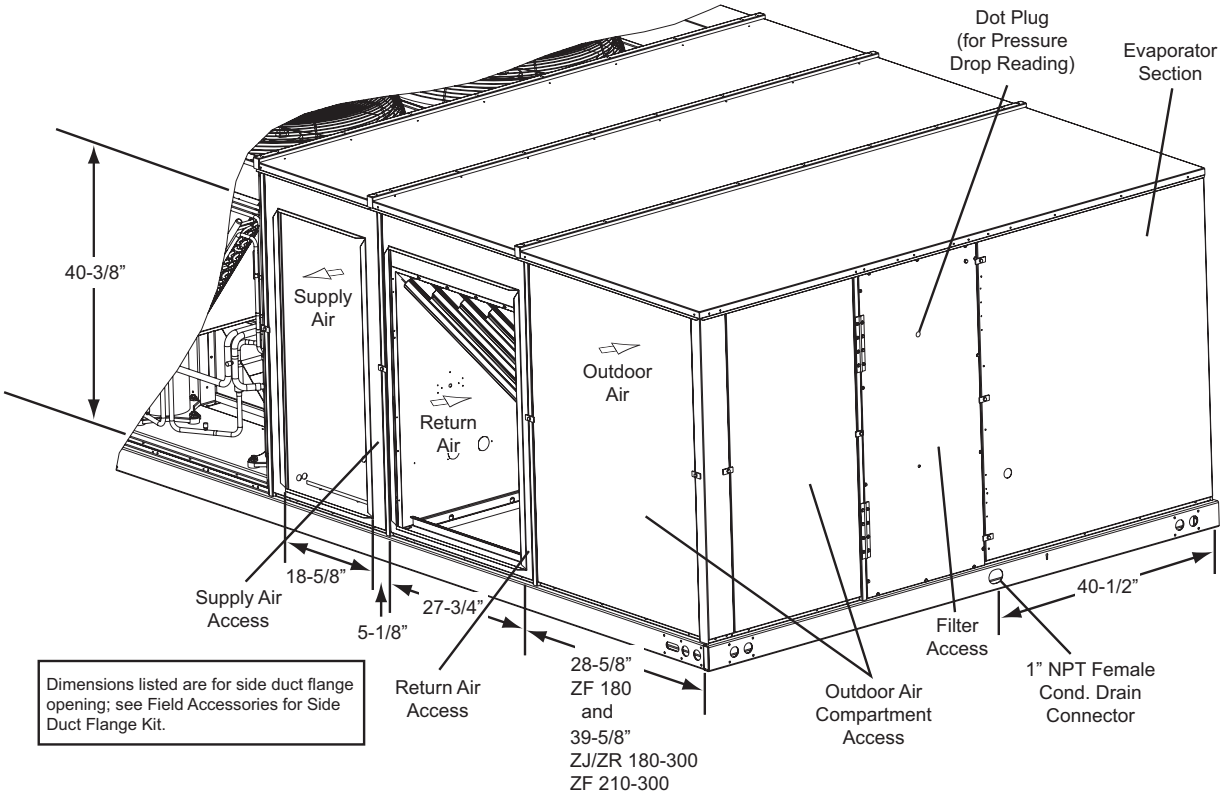
Utilities Entry

Hole	Opening Size Diameter	Used For	
A	1-1/8" KO	Control Wiring	Front
	3/4" NPS (Fem.)		Bottom
B	3-5/8" KO	Power Wiring	Front
	3" NPS (Fem.)		Bottom
C	2-3/8" KO	Gas Piping (Front)[1]	
D	1-11/16" Hole	Gas Piping (Bottom)[1,2]	

1. One-inch Gas Piping NPT Required.
2. Opening in the bottom to the unit can be located by the slice in the insulation.

NOTE: All entry holes should be field sealed to prevent rain water entry into the building.

ZJ/ZR/ZF Unit Dimensions Rear View



NOTE: Units are shipped with the bottom duct openings covered. An accessory flange kit is available for connecting side ducts.

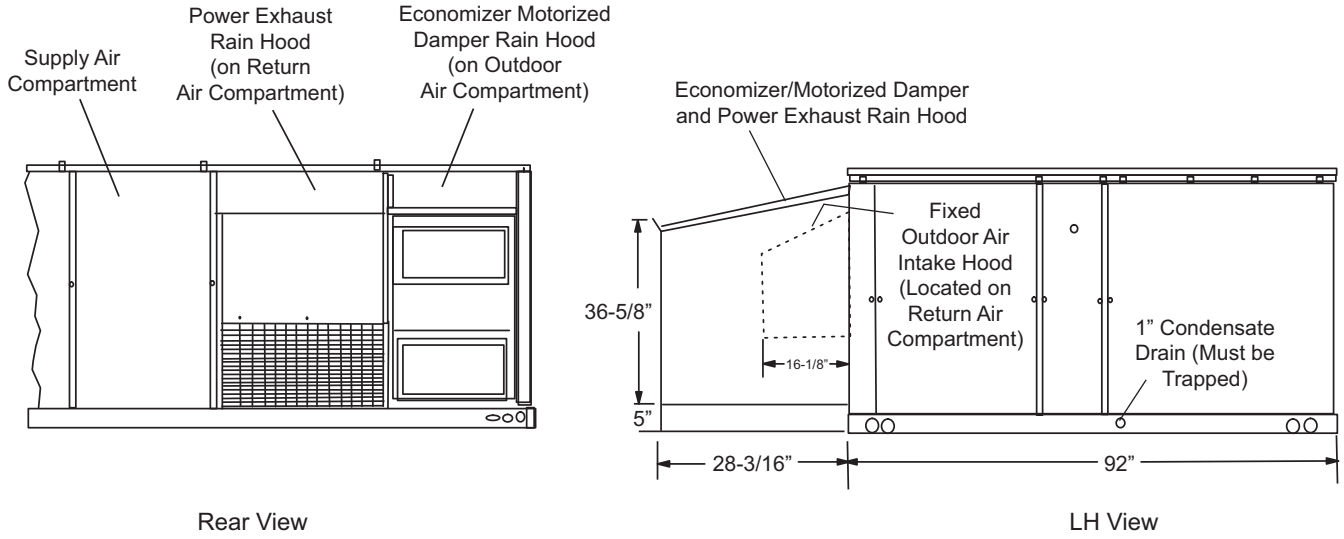
For <u>bottom</u> duct applications:

1. Remove the side panels from the supply and return air compartments to gain access to the bottom supply and return air duct covers.
2. Remove and discard the bottom duct covers. Duct openings are closed with sheet metal covers except when the unit includes a power exhaust option. The covering consists of a heavy black paper composition.
3. Replace the side supply and return air compartment panels.

For <u>side</u> duct applications:

1. Replace the side panels on the supply and return air compartments with the accessory flange kit panels.
2. Connect ductwork to the flanges on those panels.

ZJ/ZR/ZF Unit Dimensions Rain Hood



Detail "Y"
Unit with Rain Hoods

ZJ/ZR/ZF180-300 Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72 With 36 Maximum Horizontal Overhang (For Condenser Air Discharge)	Right	36
Front	36	Bottom[2]	0
Rear	24 (W/O Economizer)	Left	24 (W/O Economizer)
	49 (W/Economizer)		36 (W/Economizer)[3]

1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustible floors made from wood or class A, B or C roof covering materials.
3. If economizer is factory installed, the unassembled rain hood must be removed from its ride along position in front of the evaporator coil, or in the outdoor air compartment, prior to final installation.

Note: ELEC/ELEC Models: Units and ductwork are approved for zero clearance to combustible material when equipped with electric heaters.

GAS/ELEC Models: A 1" clearance must be provided between any combustible material and the supply air ductwork for a distance of 3 feet from the unit.

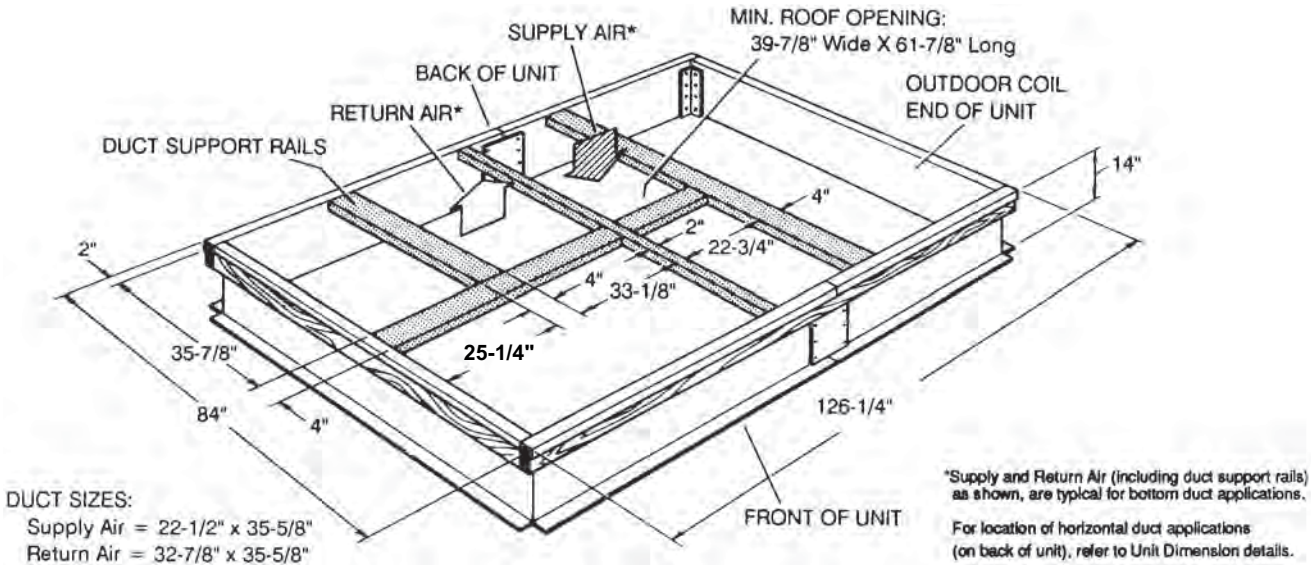
The products of combustion must not be allowed to accumulate within a confined space and recirculate.

Locate unit so that the vent air outlet hood is at least:

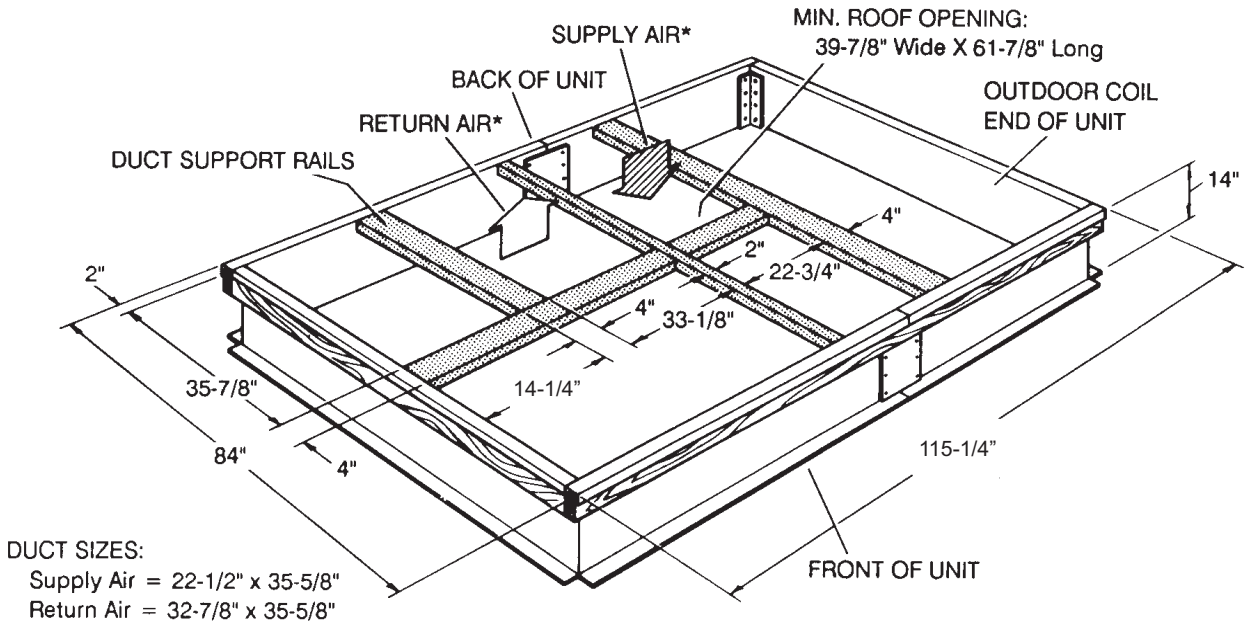
- Three (3) feet above any force air inlet located within 10 horizontal feet (excluding those integral to the unit).
- Four (4) feet below, four horizontal feet from, or one foot above any door or gravity air inlet into the building.
- Four (4) feet from electric and gas meters, regulators and relief equipment.

Unit Accessory Dimensions

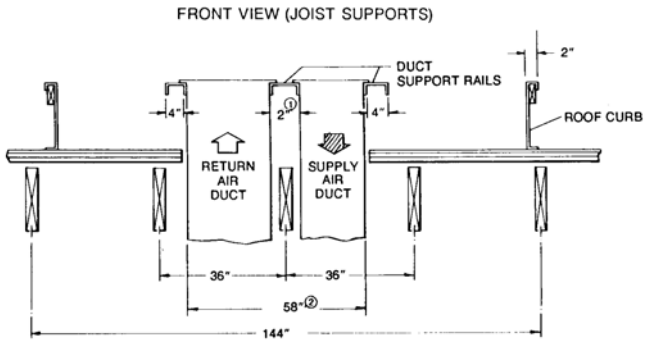
ZJ/ZR180-300, ZF210-300 Roof Curb



ZF180 Roof Curb



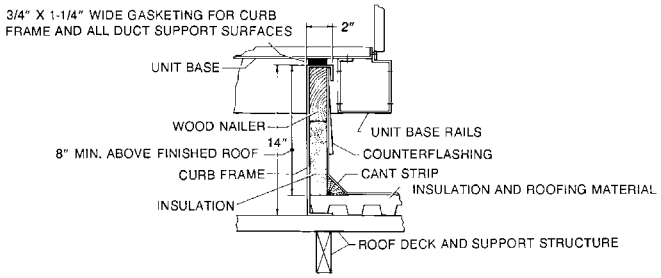
ZJ/ZR/ZF180-300 Roof Curb Duct Openings



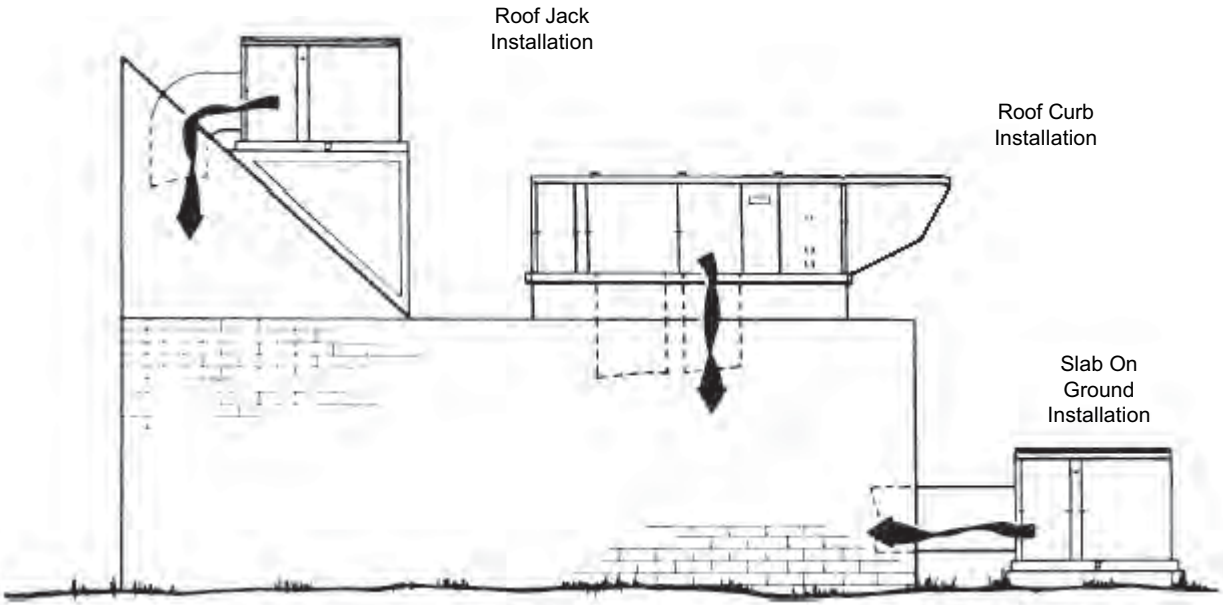
1. The 2” space between the ducts allows for “jumping” an existing roof joist.
2. The 58-1/2” overall dimension of the ducts allows ductwork penetration between roof joists that are spaced on 72” centers.

NOTE: Ducts can be installed into the curb from the roof. All electrical and gas line connections can be made inside the curb.

ZJ/ZR/ZF180-300 Cut Away of Roof Curb



ZJ/ZR/ZF180-300 Typical Installation



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5168277-YTG-I-0118
Supersedes: 5168277-YTG-H-0917

York International Corporation
5005 York Drive
Norman, OK 73069

Submittal

Trane U.S. Inc.

Prepared For:
<customer>
<company>

Sold To:

Date: 12/11/2019

Customer P.O. Number:
Customer Project Number:

Job Number:
Job Name: Montclair Honeywell

Trane is pleased to provide the enclosed submittal for your review and approval.

Product Summary

Qty	Model Description
2	Horizon™ (OAD/N Rev6 - OADG/OANG) - Horizon™ - Outdoor Air Unit (Revision 6)

The attached information describes the equipment we propose to furnish for this project and is submitted for your approval.

Product Data - Horizon™ - Outdoor Air Unit (Revision 6)

Size	Qty	Description	Model Number
D012	1	Horizon™ - Outdoor Air Unit (Revision 6)	OADG012A1-DAB10AK00-C1AE00000-21A000010-A00A00000-A00A00000-000000000

Tag(s): 14 ton

Unit Voltage: 208-3-60
Warranty: 1-Year Parts Only (manufacturer warranty)
Warranty: 5-Year Digital/Variable Speed/Standard Scroll Compressor / 25-Year Heat Exchanger
Airflow Configuration: Vertical Discharge/No Return
Indoor Coil Type: DX 6-Row
Reheat: Fin & Tube Modulating HGRH
Compressor: Digital Scroll-1st Circuit Only
Outdoor Coil Type: Air Cooled Fin & Tube
Heat Type - Primary: [OAD] Indirect Fired NG (IF) - Standard Efficiency (80%)
Heat Capacity - Primary: 400 MBH, (10:1 Turndown NG, 8:1 Turndown LP)
Supply Fan Motor Type: Direct Drive w/VFD
Unit Controls: Discharge Air Control - UC600
Building Interface: BACnet
Filter Options: MERV-8,30%
Damper Options: 100% OA 2-Position Damper
Electrical Options: Non-Fused Disconnect
Condenser Fan Options: Standard Condenser Fan
Installation: Outdoor
Cooling Controls: Reliatel
Supply Discharge Air Sensor (FLD)
2 inch Double Wall Construction
Stainless Steel Drip Pan
Blower HP - 1.5
Blower RPM - 1656
Supply Fan - ANPA 16
Unit Amps - FLA: 55 Amps
Min Circuit Ampacity - MCA: 60.1 Amps
Maximum Fuse Size - MFS: 80 Amps

Product Data - Horizon™ - Outdoor Air Unit (Revision 6)

Size	Qty	Description	Model Number
N040	1	Horizon™ - Outdoor Air Unit (Revision 6)	OANG040A1-DAB10BT00-L1AJ00000-21A000010-A00A00A00-A00A00000-000000000

Tag(s): 40 ton

Unit Voltage: 208-3-60
Warranty: 1-Year Parts Only (manufacturer warranty)
Warranty: 5-Year Digital/Variable Speed/Standard Scroll Compressor / 25-Year Heat Exchanger
Airflow Configuration: Vertical Discharge/No Return
Indoor Coil Type: DX 6-Row
Reheat: Fin & Tube Modulating HGRH
Compressor: Digital Scroll-1st Circuit Only
Outdoor Coil Type: Air Cooled Fin & Tube
Heat Type - Primary: [OAN] Indirect Fired NG (IF) - High Efficiency (+80%)
Heat Capacity - Primary: 1000 MBH (20:1 Turndown NG, 16:1 Turndown LP)
Supply Fan Motor Type: Direct Drive w/VFD
Unit Controls: Discharge Air Control - UC600
Building Interface: BACnet
Filter Options: MERV-8,30%
Damper Options: 100% OA 2-Position Damper
Electrical Options: Non-Fused Disconnect
Condenser Fan Options: Standard Condenser Fan
Hailguards: Hailguards
Installation: Outdoor
Cooling Controls: Reliatel
Supply Discharge Air Sensor (FLD)
2 inch Double Wall Construction
Stainless Steel Drip Pan
Blower HP - 7.5
Blower RPM - 1890
Supply Fan - ANPA 20
Unit Amps - FLA: 157 Amps
Min Circuit Ampacity - MCA: 164.1 Amps
Maximum Fuse Size - MFS: 175 Amps

Tag: **14 ton** Comments:

Unit Information

Model:	**Horizon™ (OAD/N Rev6 - OADG/OANG)**	Unit Length:	**148** in	Weight Operating:	**3056** lb*
Size:	**D012**	Unit Width:	**95** in	***Note: Weight does not include CURB weight. See CURB submittal for actual***	
Quantity:	**1**	Unit Height:	**68** in	**Refrigerant Charge**	
Supply Airflow:	**3,000** CFM	Elevation:	**0** ft	Circuit 1:	**33** lbs
Outside Airflow:	**3,000** CFM	Ambient Air DB:	**95** F		
Minimum Airflow:	**2,949** CFM				

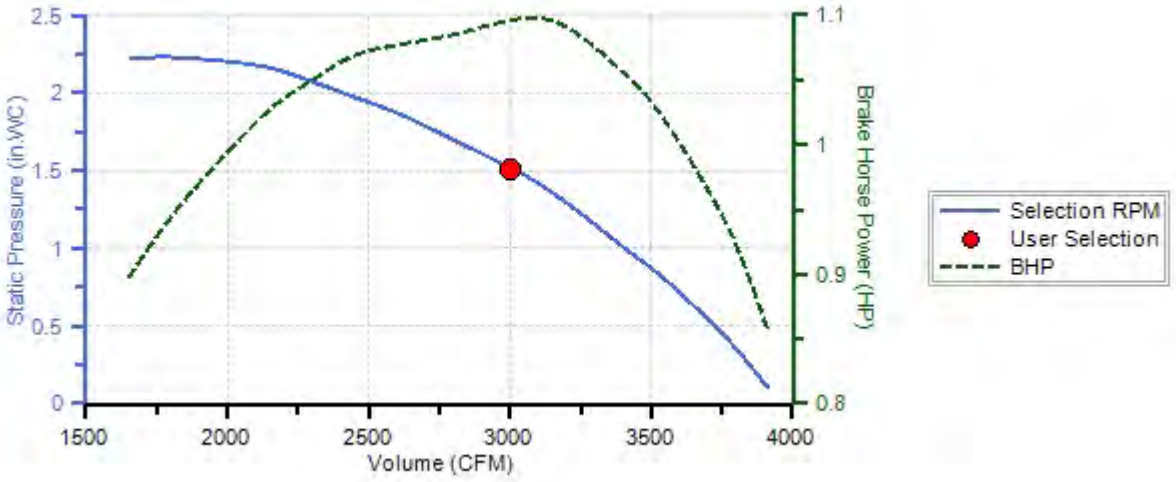
Cooling Performance

Gross Total Capacity:	**166.7** MBh	Evaporator Face Area:	**10.42** sq ft
Gross Sensible Capacity:	**122.7** MBh	Evaporator Rows / FPI:	**6 / 14**
Net Total Capacity:	**163.9** MBh	Condenser Face Area:	**30** sq ft
Net Sensible Capacity:	**119.9** MBh	Condenser Rows / FPI :	**2 / 14**
Entering Air DB / WB (Coil):	**95 / 74** F	Air Velocity:	**287** fpm
Leaving Air DB / WB (Coil):	**58.1 / 58.0** F	Coil Air PD:	**0.32** in H2O
Leaving Air DB / WB (Reheat):	**70 / 62.37** F	EER:	**13.9**
Leaving Air DB / WB (Unit):	**71 / 62.7** F	Watts:	**11753**
MRC:	**39.12** lb/h	MRE:	**3.33** lb/kWh

Heating Performance

Heat Type:	**Gas Furnace**	Entering Air DB:	**10** F
Input Capacity	**400** MBh	Leaving Air DB:	**108.8** F
Output Capacity:	**320** MBh	Coil Air PD:	**0.08** in H2O

Supply Fan ANPA 16



Supply Pressure Drop Summary

External Static Pressure:	**1.00**	in H2O
Cabinet:	**0.01**	in H2O
Cooling Coil:	**0.32**	in H2O
Base Filter:	**0.01**	in H2O
Filter:	**0.03**	in H2O
Primary Heat:	**0.08**	in H2O
HGRH:	**0.02**	in H2O
Outdoor:	**0.04**	in H2O
Total Static Pressure:	**1.51**	in H2O

Supply Fan Conditions

Fan Motor BHP:	**1.10**	BHP
Operating RPM:	**1656**	RPM
Minimum RPM:	**1171**	RPM

Unit Electrical Data

Unit Voltage-Ph-Hz:	**208-3-60**	Min Circuit Ampacity - MCA:	**60.1** Amps
Unit Amps - FLA:	**55** Amps	Maximum Fuse Size - MFS:	**80** Amps

Electrical Summary

Component	Fan Service	Qty	HP (ea.)	FLA (ea.)	RLA (ea.)	LRA (ea.)
Controls		**1**		**2.4**		
Digital Scroll		**1**			**20.4**	**156**
Scroll		**1**			**19**	**123**
	Supply	**1**	**1.5**	**4.8**		
	Condenser	**2**	**1**	**4.2**		

Standard Radiated Sound Power Level (dBA)

63	125	250	500	1000	2000	4000	8000	Total dBA
59.7	**69.7**	**76.7**	**81.7**	**81.7**	**81.7**	**82.7**	**78.7**	**88.7**

Sound power levels are listed for informational purposes only and are not guaranteed.

Notes

- Unit Electrical amps include the greater of compressor or electrical heat amps.
- Unit's electrical as shown above are for single point power. If dual power is required please contact the factory.

Tag: **40 ton** Comments:

Unit Information

Model:	**Horizon™ (OAD/N Rev6 - OADG/OANG)**	Unit Length:	**218** in	Weight Operating:	**7294** lb*
Size:	**N040**	Unit Width:	**98** in	***Note: Weight does not include CURB weight. See CURB submittal for actual***	
Quantity:	**1**	Unit Height:	**108** in	**Refrigerant Charge**	
Supply Airflow:	**8,000** CFM	Elevation:	**0** ft	Circuit 1:	**57.9** lbs
Outside Airflow:	**8,000** CFM	Ambient Air DB:	**95** F	Circuit 2:	**47.9** lbs
Minimum Airflow:	**7,465** CFM				

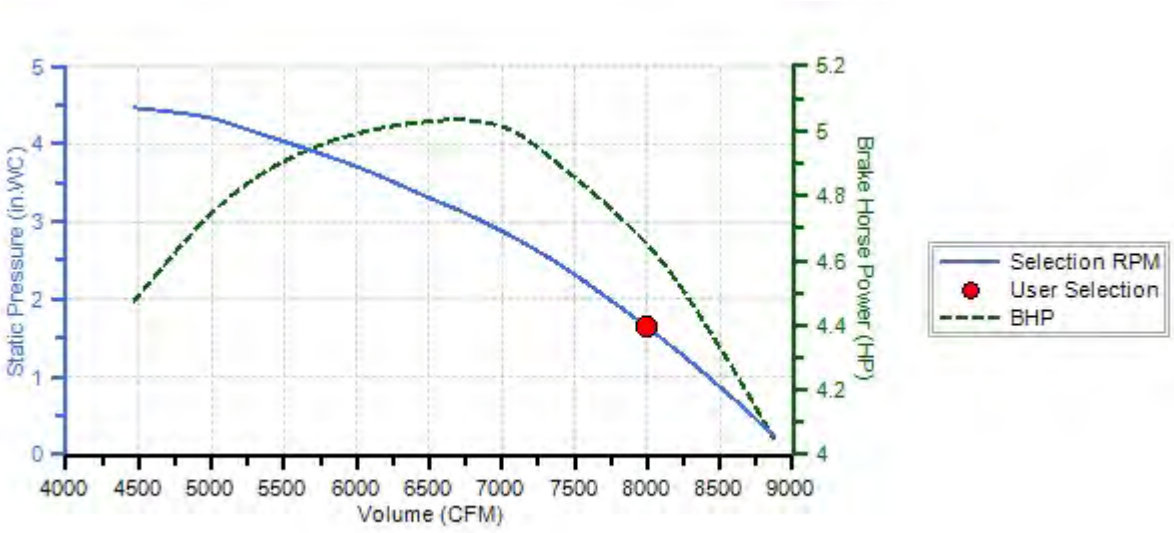
Cooling Performance

Gross Total Capacity:	**549.1** MBh	Evaporator Face Area:	**25.6** sq ft
Gross Sensible Capacity:	**316.4** MBh	Evaporator Rows / FPI:	**6 / 14**
Net Total Capacity:	**537.3** MBh	Condenser Face Area:	**60** sq ft
Net Sensible Capacity:	**304.6** MBh	Condenser Rows / FPI :	**3 / 14**
Entering Air DB / WB (Coil):	**95 / 78** F	Air Velocity:	**312** fpm
Leaving Air DB / WB (Coil):	**59.5 / 59.5** F	Coil Air PD:	**0.36** in H2O
Leaving Air DB / WB (Reheat):	**70 / 63.27** F	EER:	**13.3**
Leaving Air DB / WB (Unit):	**71.6 / 63.8** F	Watts:	**40444**
MRC:	**210.45** lb/h	MRE:	**5.20** lb/kWh

Heating Performance

Heat Type:	**Gas Furnace**	Entering Air DB:	**10** F
Input Capacity	**1000** MBh	Leaving Air DB:	**103.8** F
Output Capacity:	**810** MBh	Coil Air PD:	**0.13** in H2O

Supply Fan ANPA 20



Supply Pressure Drop Summary

External Static Pressure:	**1.00** in H2O
Cooling Coil:	**0.36** in H2O
Filter:	**0.05** in H2O
Primary Heat:	**0.13** in H2O
HGRH:	**0.01** in H2O
Outdoor:	**0.09** in H2O
Total Static Pressure:	**1.64** in H2O

Supply Fan Conditions

Fan Motor BHP:	**4.64** BHP
Operating RPM:	**1890** RPM
Minimum RPM:	**1418** RPM

Unit Electrical Data

Unit Voltage-Ph-Hz:	**208-3-60**	Min Circuit Ampacity - MCA:	**164.1** Amps
Unit Amps - FLA:	**157** Amps	Maximum Fuse Size - MFS:	**175** Amps

Electrical Summary

Component	Fan Service	Qty	HP (ea.)	FLA (ea.)	RLA (ea.)	LRA (ea.)
	Condenser	**4**	**1.5**	**5.5**		
Controls		**1**		**2.4**		
Digital Scroll		**1**			**28.2**	**240**
Scroll		**3**			**28.2**	**240**
	Supply	**1**	**7.5**	**19.8**		

Standard Radiated Sound Power Level (dBA)

63	125	250	500	1000	2000	4000	8000	Total dBA
54.7	**63.7**	**71.7**	**78.7**	**79.7**	**78.7**	**80.7**	**75.7**	**85.7**

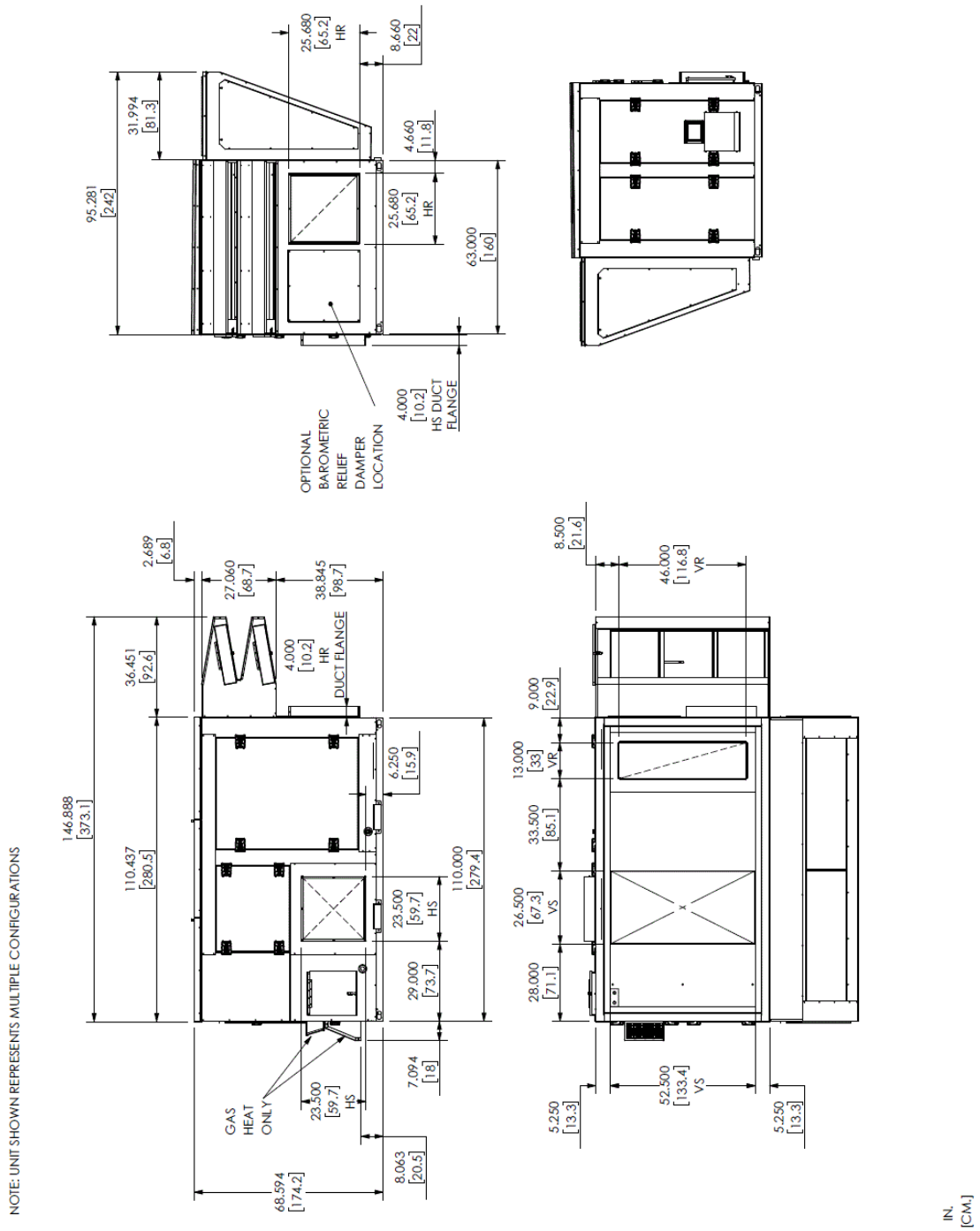
Sound power levels are listed for informational purposes only and are not guaranteed.

Notes

- Unit Electrical amps include the greater of compressor or electrical heat amps.
- Unit's electrical as shown above are for single point power. If dual power is required please contact the factory.

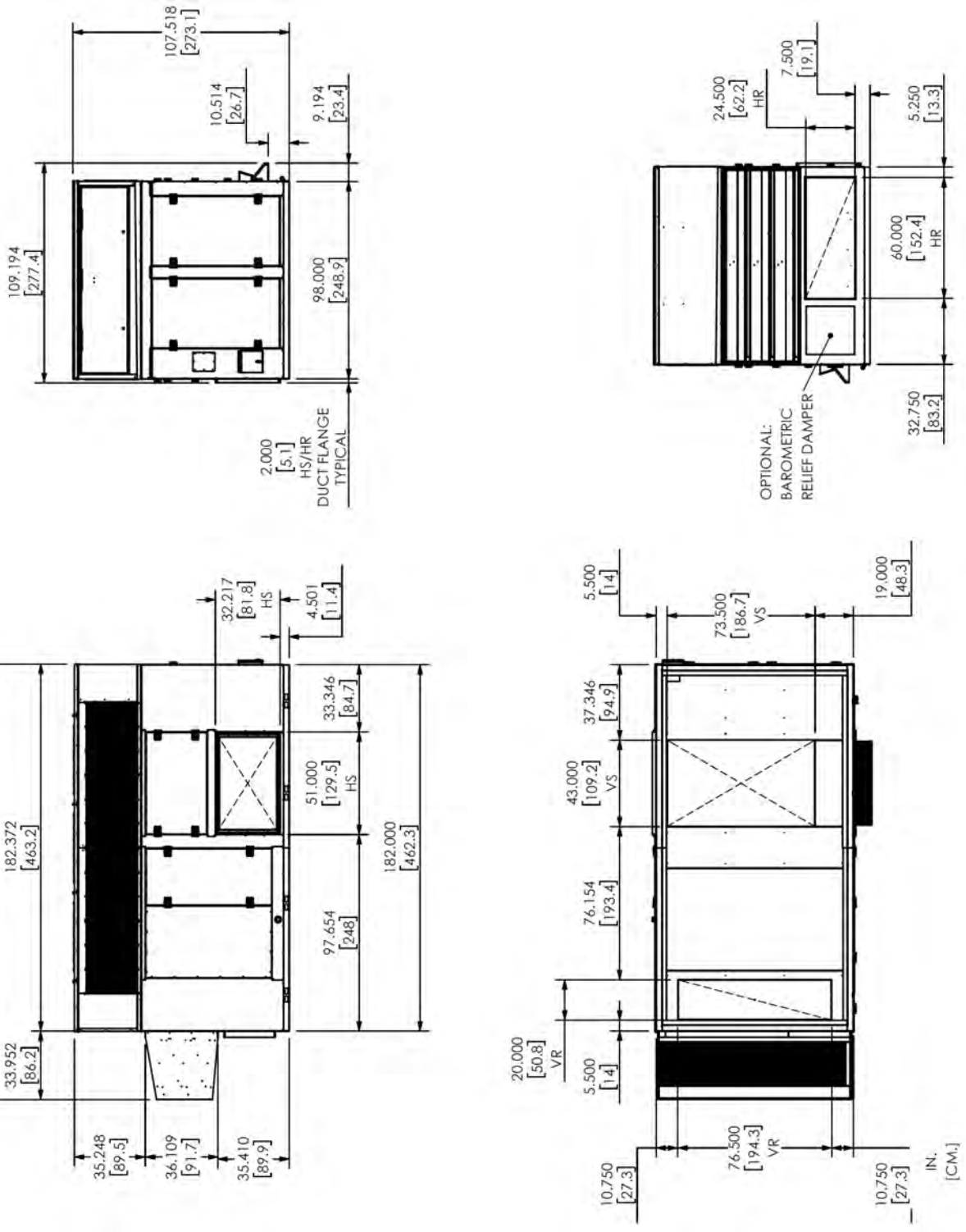
Unit Dimensions - 10-20 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 14 ton



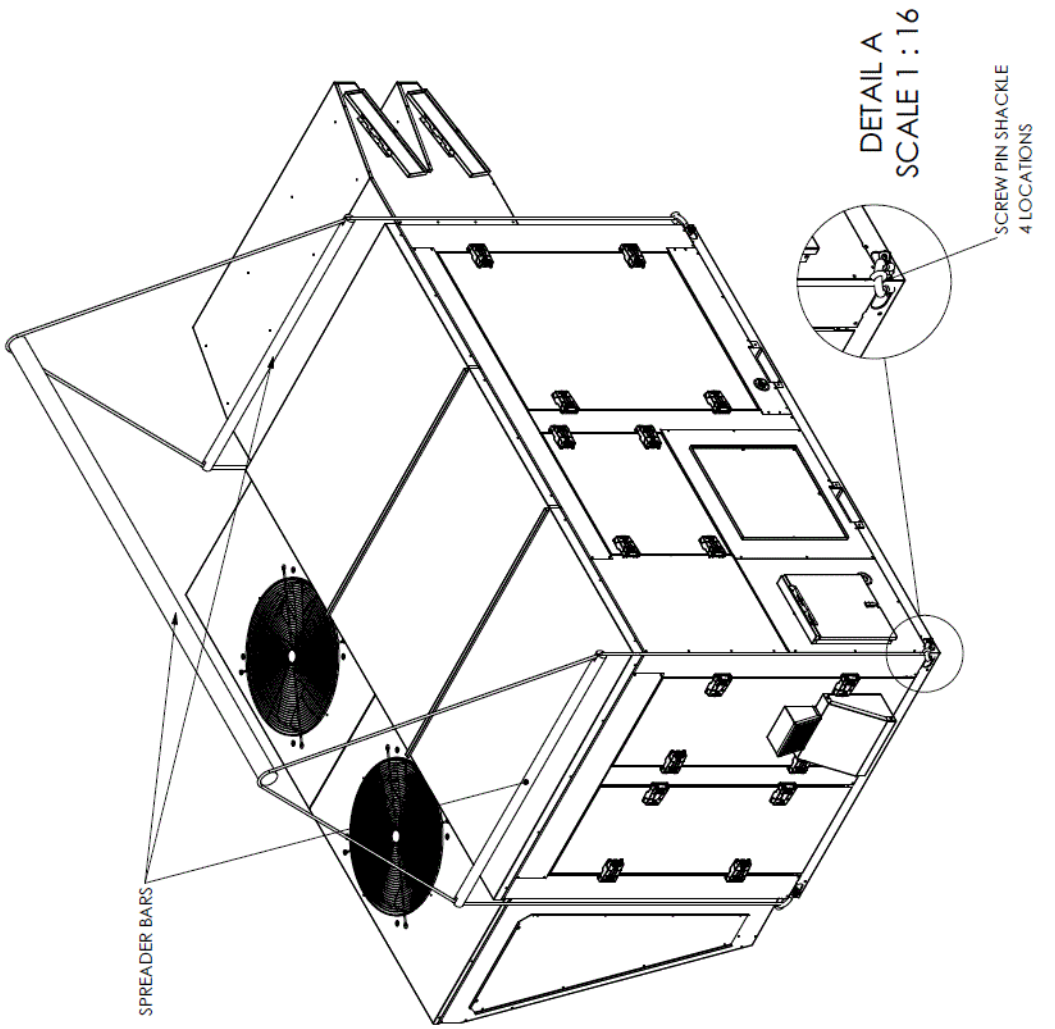
Unit Dimensions - 40-80 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 40 ton



Rigging Diagram - 10-20 Ton PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 14 ton

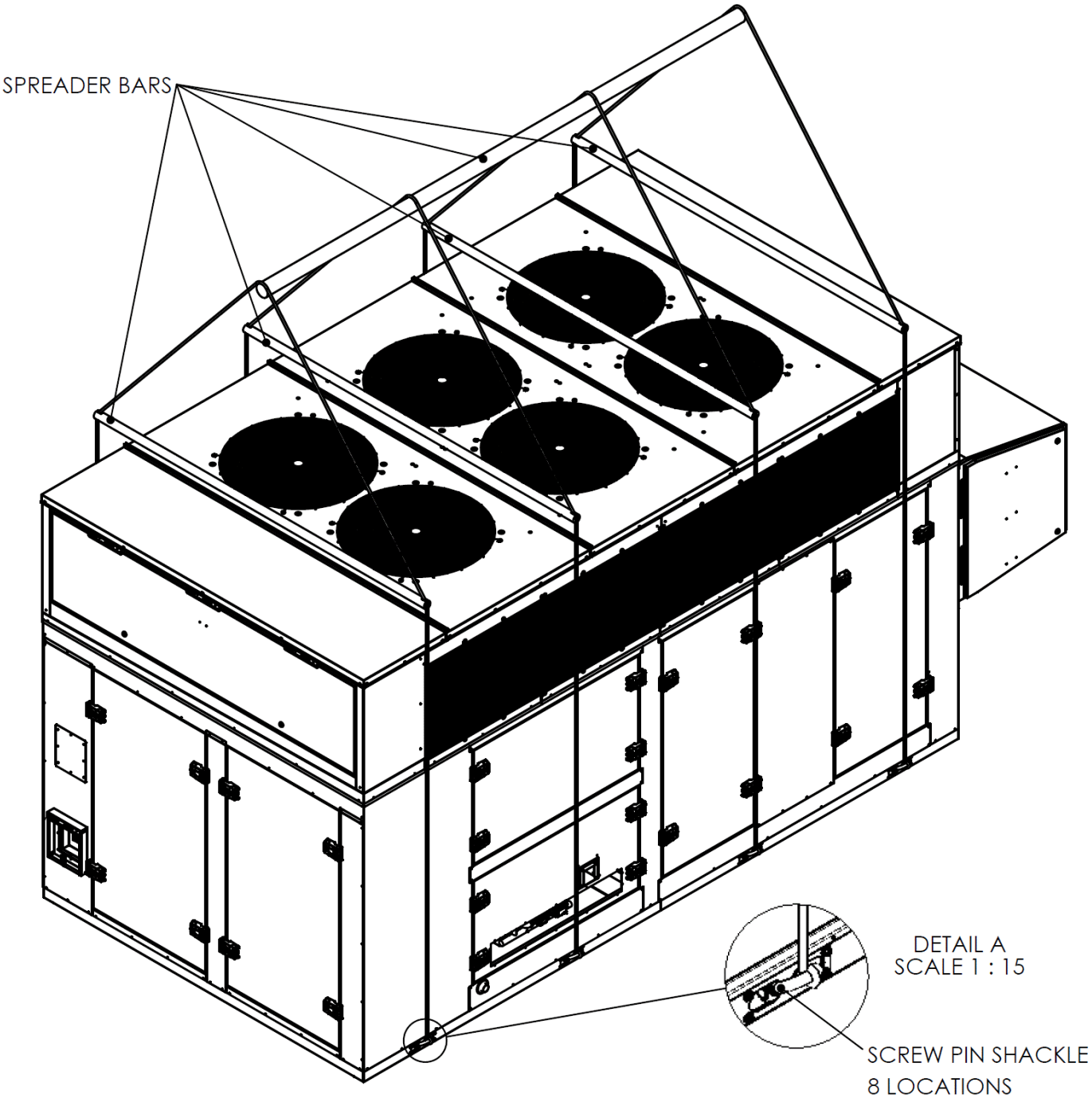


NOTE: UNIT SHOWN REPRESENTS MULTIPLE CONFIGURATIONS

IN.
[CM.]

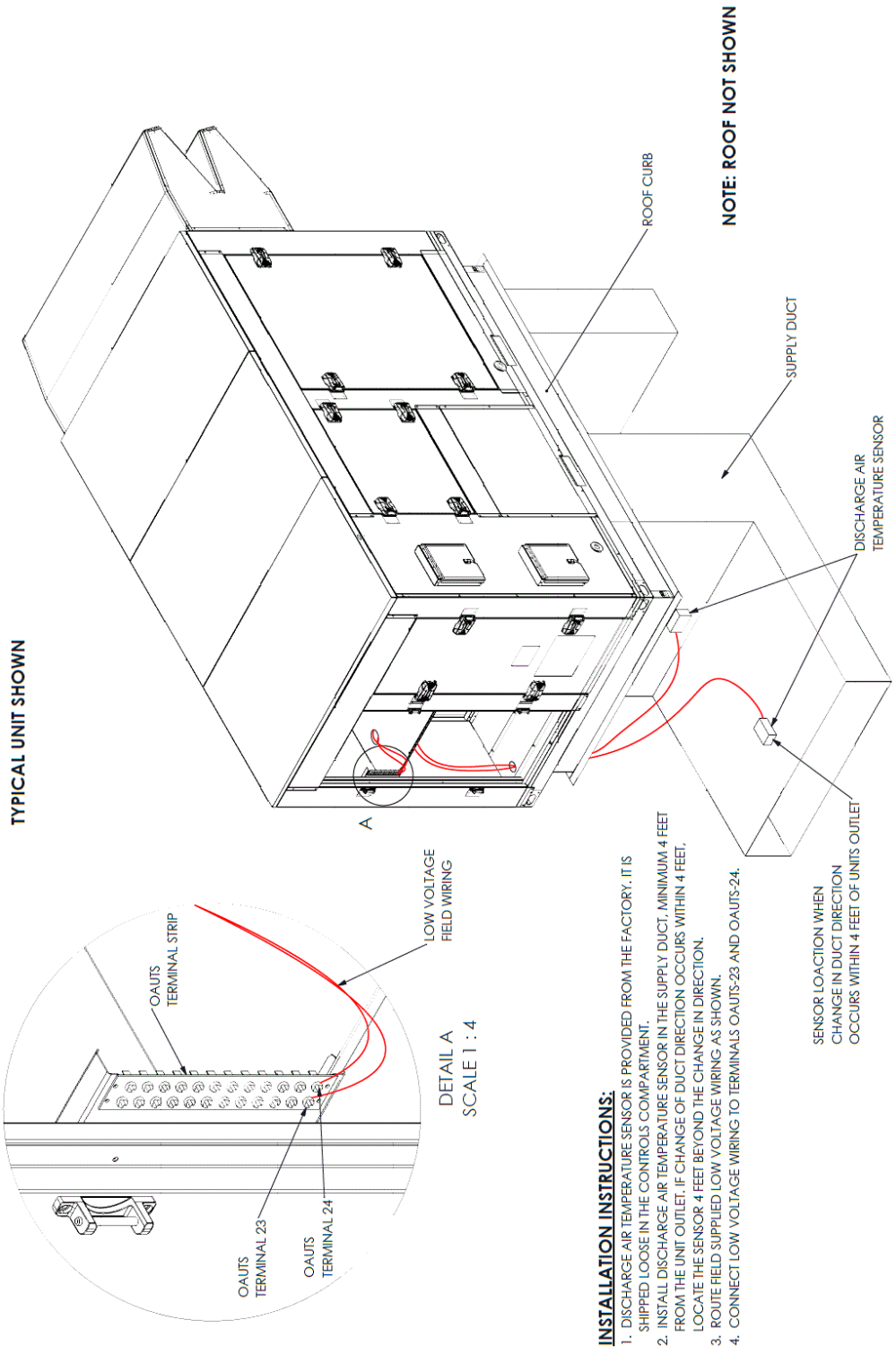
Rigging Diagram - 40-80 Ton PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 40 ton



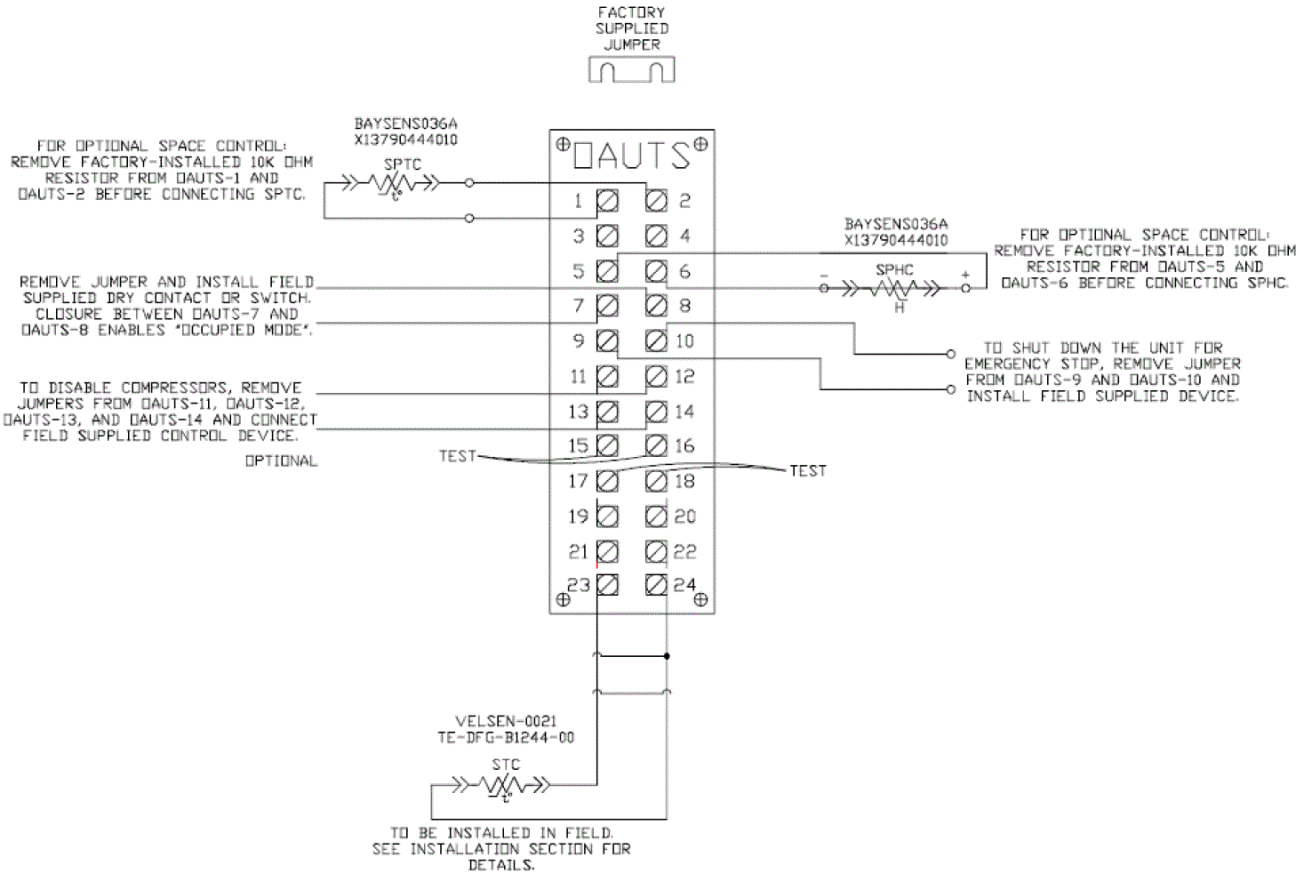
Field Wiring - 3-54 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 2 Tags: 14 ton, 40 ton



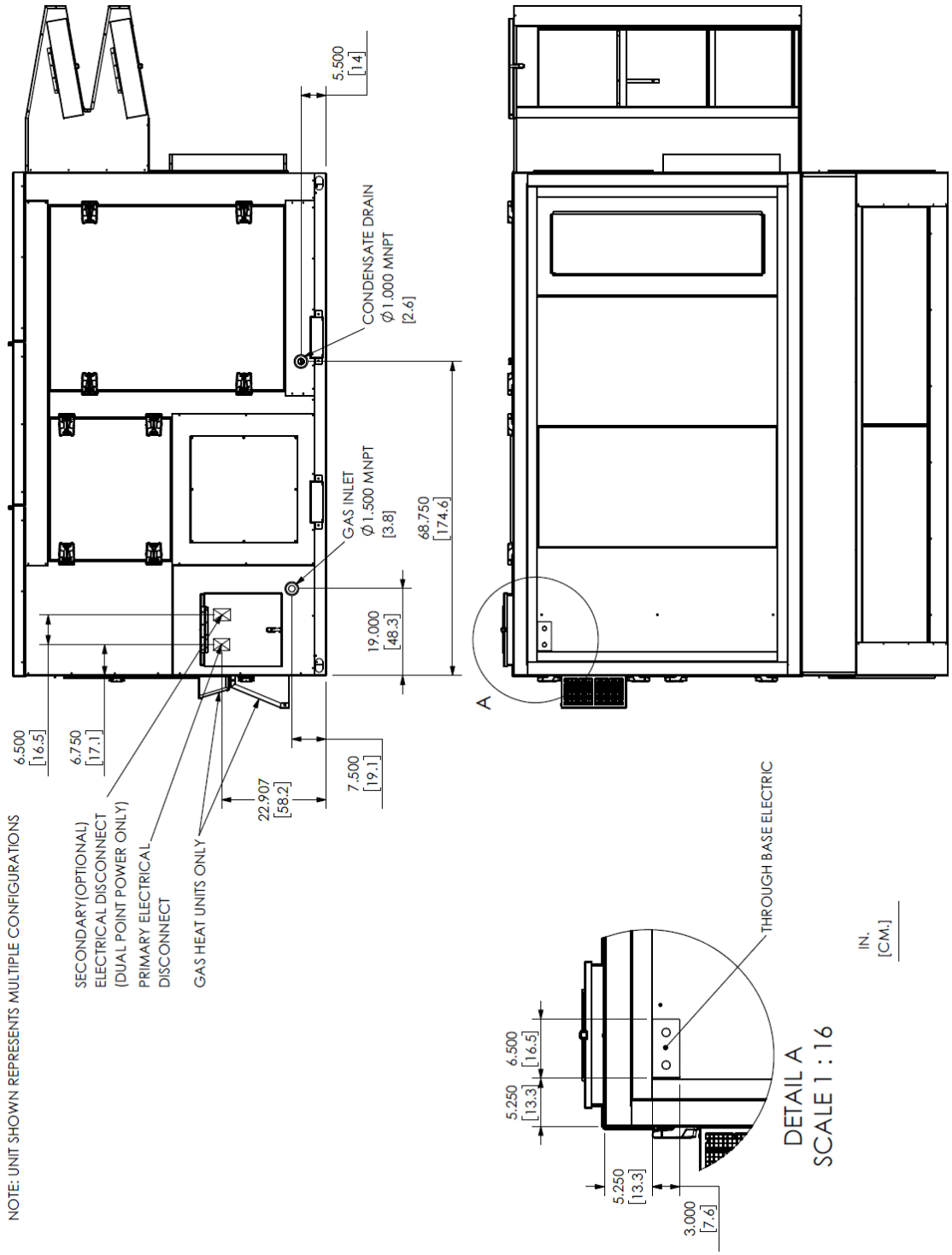
Field Wiring - 3-54 Ton T-410A PKGD Unitary Cooling Rooftop

Qty: 2 Tags: 14 ton, 40 ton



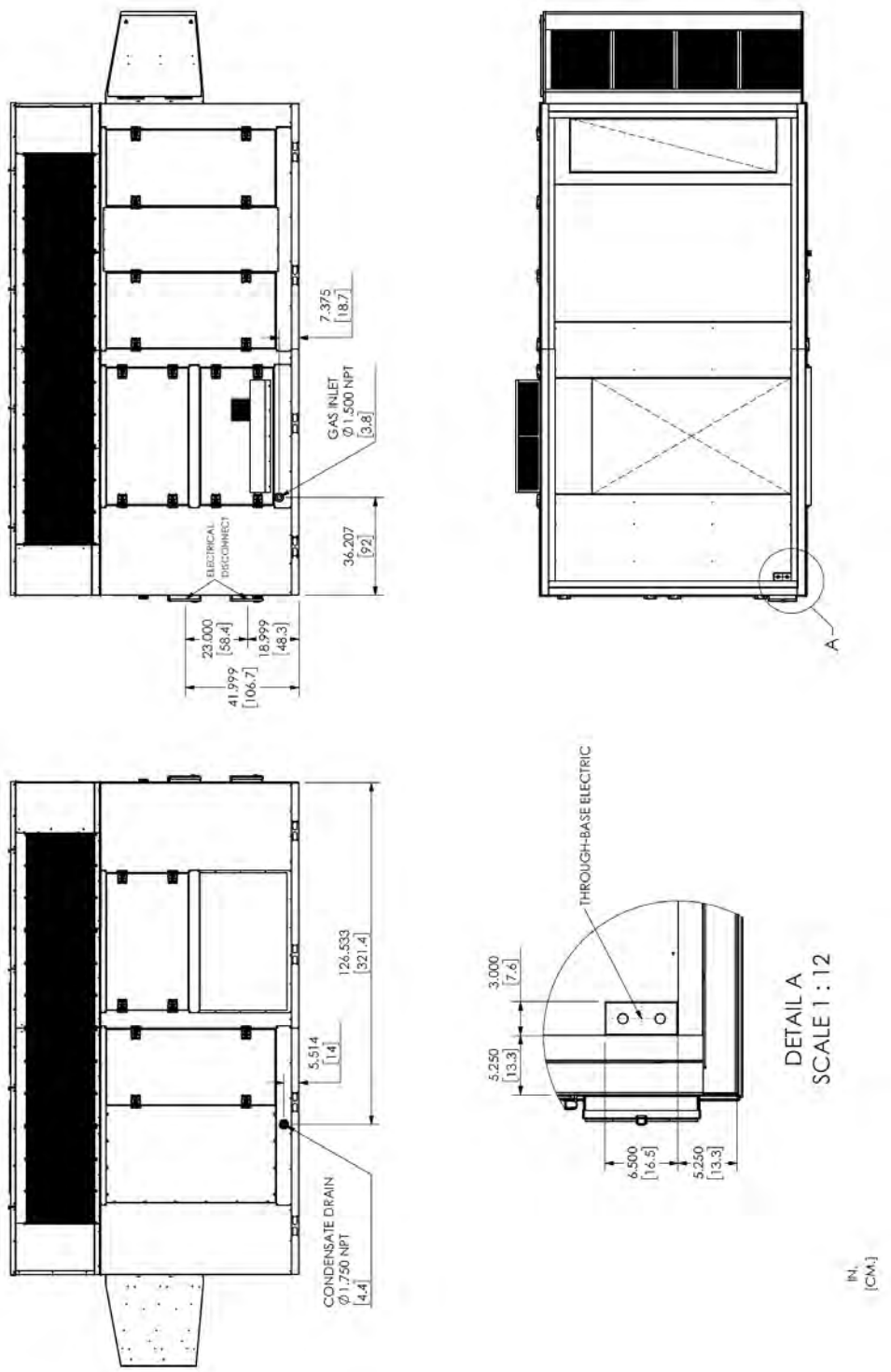
Utility Connections - 10-20 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 14 ton



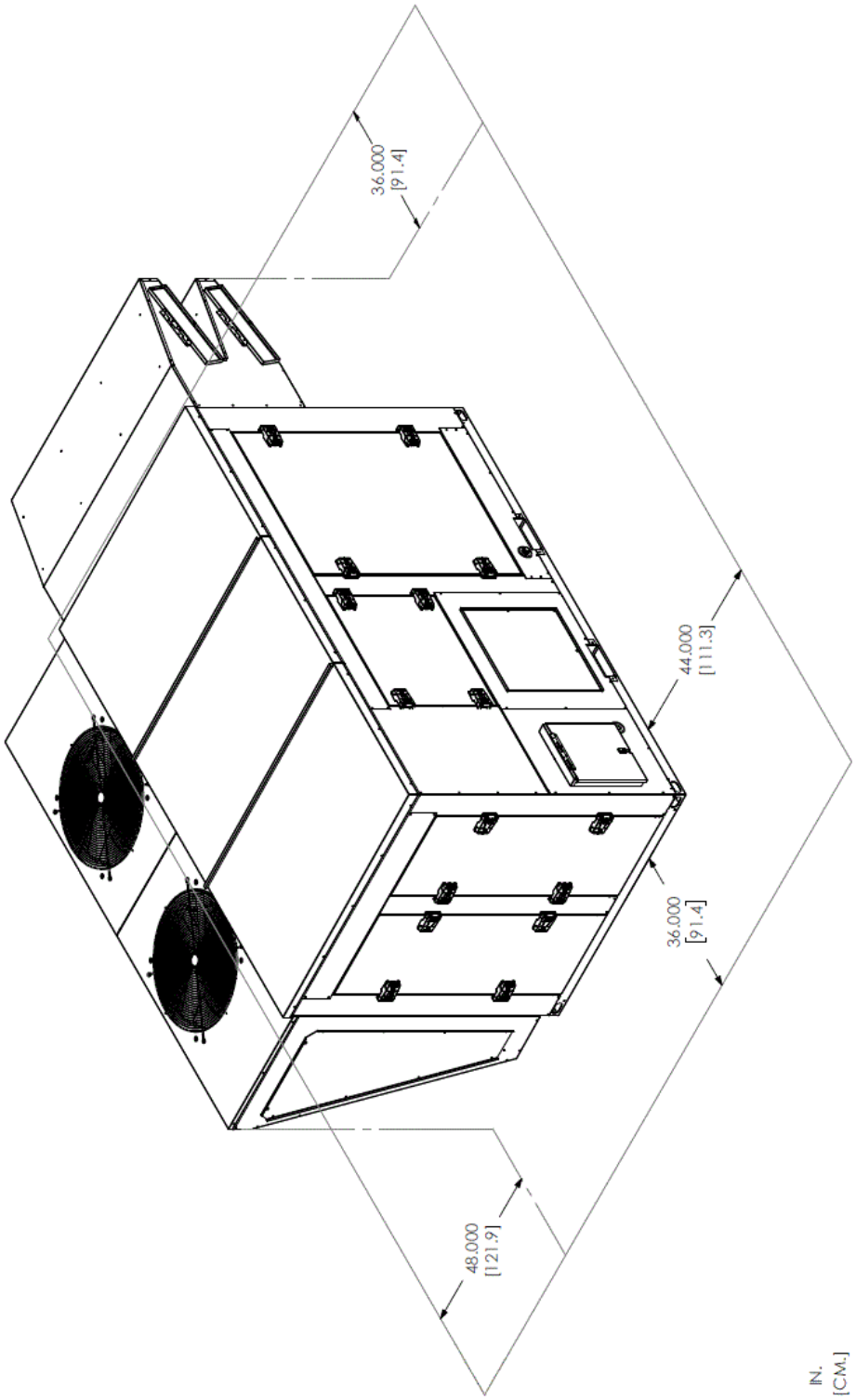
Utility Connections - 40-80 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 40 ton



Clearance Diagrams - 10-20 Ton R-410A PKGD Unitary Cooling Rooftop

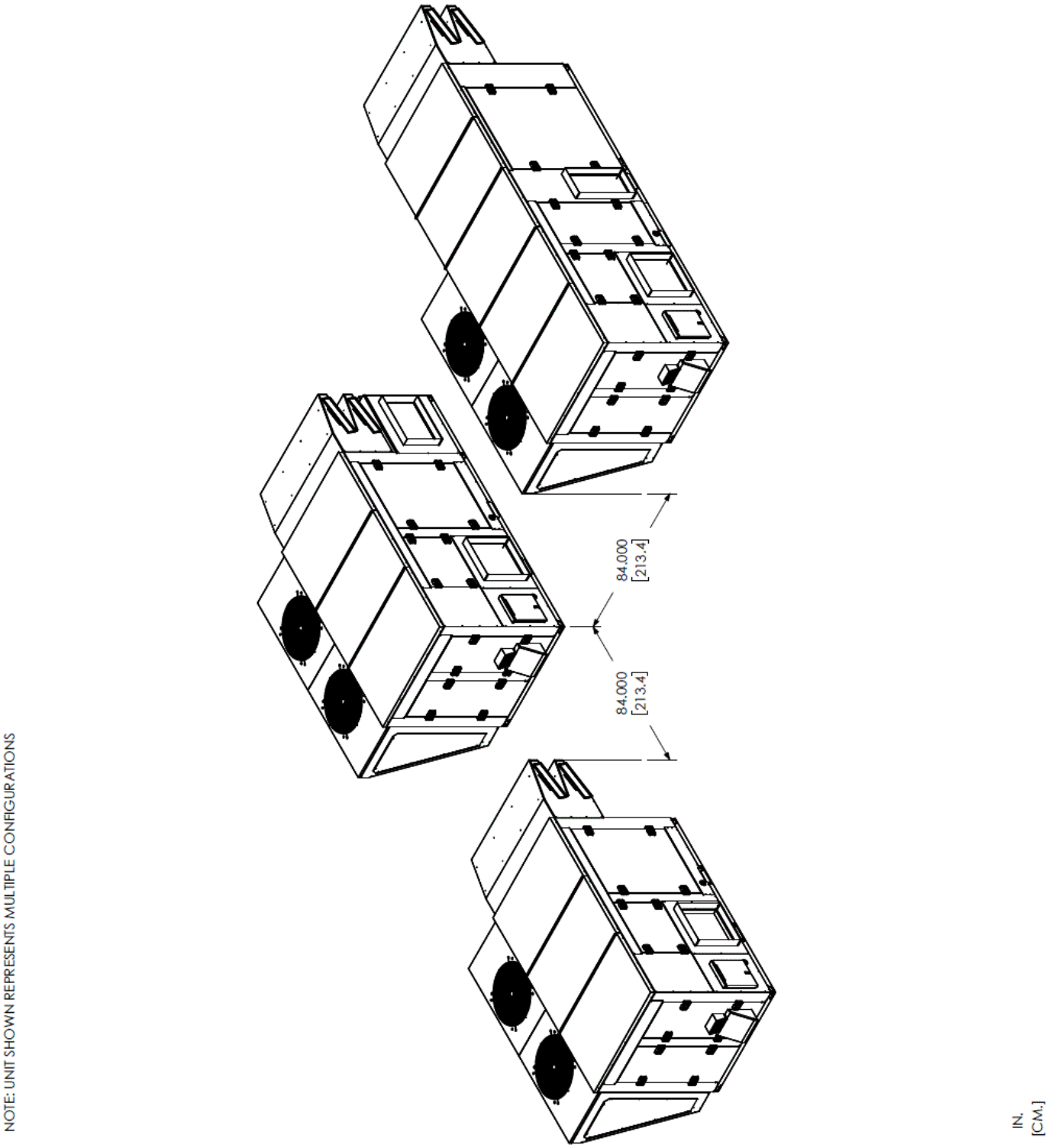
Qty: 1 Tags: 14 ton



NOTE: UNIT SHOWN REPRESENTS MULTIPLE CONFIGURATIONS

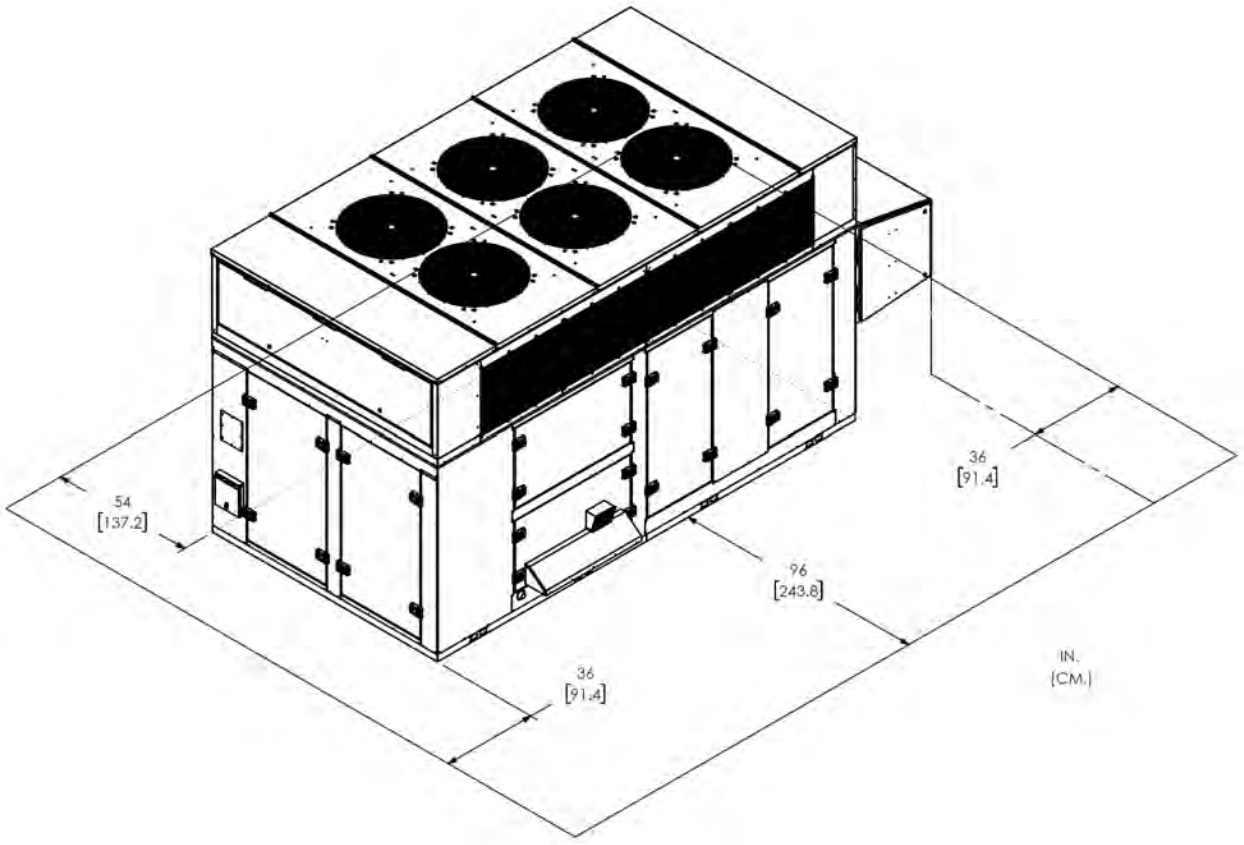
Clearance Diagrams - 10-20 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 14 ton



Clearance Diagrams - 40-80 Ton R-410A PKGD Unitary Cooling Rooftop

Qty: 1 Tags: 40 ton



Mechanical Specifications - Tag(s): 14 ton, 40 ton

Casing

Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 1000 hours in a salt spray test in compliance with ASTM B117. Unit shall have a 2 inch thick Antimicrobial Insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.

Unit Top

The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top

Sensors

A factory installed combination outdoor air sensor located in the outdoor air hood is designed to sense both outdoor air temperature and relative humidity for use by the microprocessor controller to make required ventilation, cooling, dehumidification and heating decisions. Refer to the Sequence of Operations section of the Installation, Operation and Maintenance manual for detailed unit control and operational modes. A factory installed sensing tube is designed to sense the supply air temperature downstream of the indoor fan section.

Indoor Coil Type: DX 6-Row

Internally finned, inch copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil shall be leak tested to 500 psig and pressure tested to 500 psig. A Stainless Steel double-sloped condensate drain pan with provision for through the unit wall condensate drain is standard. Evaporator coil will have 6 interlaced rows for superior sensible and latent cooling.

Reheat: Fin & Tube Modulating HGRH

This option shall consist of a modulating hot-gas reheat coil located on the leaving air side of the evaporator coil pre-piped and circuited with a low pressure switch. Refer to the Sequence of Operations section of the Installation, Operation and Maintenance manual for detailed unit control and operational modes.

Compressor: Digital Scroll-1st Circuit Only

All units shall have direct-drive, hermetic, digital scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included. Compressor shall be able to fully modulate from 20%-100%.

Outdoor Coil Type: Air Cooled Fin & Tube

(Fin and Tube Coil) - Internally finned, copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig. The condenser coil shall have a fin design with slight gaps for ease of cleaning.
Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets. Fans shall be statically and dynamically balanced.

Heat Capacity - Primary: 1000 MBH (20:1 Turndown NG, 16:1 Turndown LP)

Primary heat is supplied using indirect fired gas heating. The heating section shall have a progressive tubular heat exchanger design using Stainless Steel burners and type 439 Stainless Steel tubes. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DS) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Units shall be comply with the California requirement for low NOx emissions. Unit shall be suitable for use with Natural Gas. Minimum incoming gas pressure of 7" W.C. and Maximum pressure of 14" W.C. required. Factory provided 25 year heat exchanger warranty.

Heat Capacity - Primary: 400 MBH, (10:1 Turndown NG, 8:1 Turndown LP)

Primary heat is supplied using indirect fired gas heating. The heating section shall have a progressive tubular heat exchanger design using Stainless Steel burners and type 439 Stainless Steel tubes. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DS) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Units shall be comply with the California requirement for low NOx emissions. Unit shall be suitable for use with Natural Gas. Minimum incoming gas pressure of 7" W.C. and Maximum pressure of 14" W.C. required. Factory provided 25 year heat exchanger warranty.

Supply Fan Motor Type: Direct Drive w/VFD

Supply Fan motor shall be direct drive type with factory installed Variable Frequency Drive (unless no controls option is selected, VFD can be provided by others). All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 2005 (EPACT). All Fans shall be mounted on rubber vibration isolators, to reduce the transmission of noise.

Unit Controls: Discharge Air Control - UC600

Discharge Air Control

For complete sequence of operations, please see IOM.

Filter Options: MERV-8,30%

Aluminum Mesh Filters (D, K and N Cabinets) and Galvanized Mesh Bird Screen (B and G Cabinets) shall be installed on the intake of the unit. In addition, one row of 2 inch MERV-8 rated filters (30 percent) shall be installed prior to the evaporator coil. Unit shall be equipped with a 6” filter rack upstream of the evaporator. Frame shall be field-adjustable to match any filter combination specified in the attached selection.

Damper Options: 100% OA 2-Position Damper

The unit shall have a factory installed and integrated 100% outdoor air hood with damper controlled a by direct coupled actuator and 2 inch permanent and washable aluminum mesh filters accessible through a hinged access panel. The return air damper tray is blocked off to allow 100% outdoor airflow.

Electrical Options: Non-Fused Disconnect

A 3-pole, molded case, HACR circuit breaker with provisions for through the base electrical connections shall be installed. The disconnect switch will be installed in the unit in a water tight enclosure. Wiring will be provided from the switch to the unit high voltage terminal block. The switch will be UL/CSA agency recognized. The disconnect switch will be sized per NEC and UL guidelines but will not be used in place of unit overcurrent protection.
Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and a fault code will be stored in the monitor for the most recent 25 faults. Upon correction of the fault condition the unit will reset and restart automatically.
1. Phase Unbalance Protection: Factory set 2%
2. Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage
3. Phase Loss/Reversal

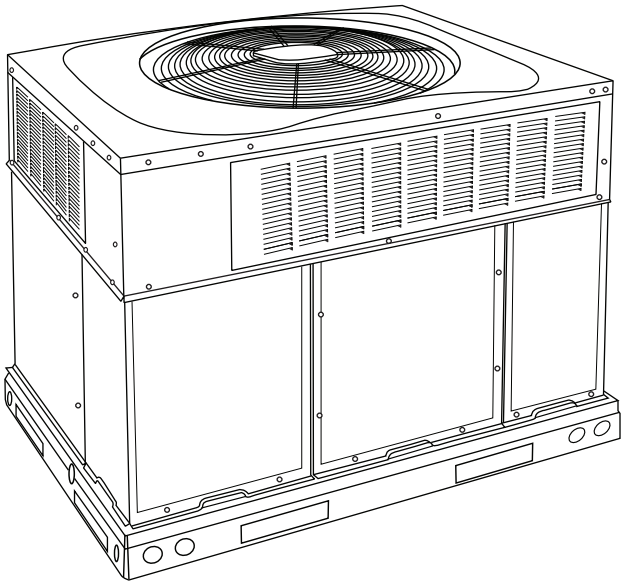
Hailguards: Hailguards

Hail guards shall be installed on the outside of the condenser coil. The guards shall consist of perforated metal, of the same gauge and color as the unit itself. Airflow through the hail guards shall not be restricted due to location or size of the perforations. Guards shall be removable to accommodate coil cleaning.

48VG−A and 48VG−B
Performance™ 16 SEER 2−Stage Packaged Air Conditioner and Gas Furnace System with Puron® (R−410A) Refrigerant
Single and Three Phase
2 to 5 Nominal Tons (Sizes 24−60)

Carrier
turn to the experts

Product Data



A09033

Fig. 1 − Unit 48VG−A and 48VG−B

Single−Packaged Products with Energy−Saving Features and Puron® refrigerant.

- 15.0 to 16.0 SEER
- 12.0 − 12.5 EER
- 81% AFUE (Single phase models)
- Meets Energy Star requirements
- Direct Spark Ignition
- Factory−Installed TXV
- Multi−speed ECM Blower Motor−Standard
- Sound Levels as low as 72dBA
- Two Stage Cooling
- Two Stage Heating (208/230 VAC models)
- Dehumidification Feature

FEATURES/BENEFITS

One−piece heating and cooling units with low sound levels, easy installation, low maintenance, and dependable performance.

Puron Refrigerant is Carrier's unique refrigerant designed to help protect the environment. Puron is an HFC refrigerant which does not contain chlorine that can harm the ozone layer. Puron refrigerant is in service in millions of systems proving highly reliable, environmentally sound performance.

Easy Installation

Factory−assembled package is a compact, fully self−contained, combination gas heating/electric cooling unit that is prewired, pre−piped, and pre−charged for minimum installation expense. These units are available in a variety of standard and optional heating/cooling size combinations with voltage options to meet residential and light commercial requirements. Units are lightweight and install easily on a rooftop or at ground level. The high tech composite base eliminates rust problems associated with ground level applications.

Innovative Unit Base Design

On the inside a high−tech composite material will not rust and incorporates a sloped drain pan which improves drainage and helps inhibit mold, algae and bacterial growth. On the outside metal base rails provide added stability as well as easier handling and rigging.

Convertible duct configuration

Unit is designed for use in either downflow or horizontal applications. Each unit is converted from horizontal to downflow and includes two horizontal duct covers. Downflow operation is provided in the field to allow vertical ductwork connections. The basepan seals on the bottom openings to ensure a positive seal in the vertical airflow mode.

Efficient operation

High−efficiency design offers SEER (Seasonal Energy Efficiency Ratios) of 15.0 to 16.0, 12.0 to 12.5 EER, and AFUE (Annual Fuel Utilization Efficiency) ratings as high as 81%.

Energy−saving, direct spark ignition saves gas by operating only when the room thermostat calls for heating. Standard units are furnished with natural gas controls. A low−cost field installed kit for propane conversion is available for all units.

Low NOx units designed for California installations. These models meet the California maximum oxides of nitrogen (NOx) emissions requirement of 40 nanograms/joule or less as shipped from the factory and MUST be installed in California Air Quality Management Districts and wherever a Low NOx rule exists.

Durable, dependable components

Compressors have two stages of cooling and are designed for high efficiency. Each compressor is hermetically sealed against contamination to help promote longer life and dependable operation. Each compressor also has vibration isolation to provide quieter operation. All compressors have internal high pressure and overcurrent protection.

Monoport inshot burners produce precise air−to−gas mixture, which provides for clean and efficient combustion. The large monoport on the inshot (or injection type) burners seldom, if ever, requires cleaning. All gas furnace components are accessible in one compartment.

Turbo−tubular™ heat exchangers are constructed of aluminized steel for corrosion resistance and optimum heat transfer for improved efficiency. The tubular design permits hot gases to make multiple passes across the path of the supply air.

In addition, dimples located on the heat exchanger walls force the hot gases to stay in close contact with the walls, improving heat transfer.

Stainless steel heat exchanger available as factory installed option.

Multi−speed ECM Blower Motor is standard on all models.

High Efficiency 2-Speed Inducer Motor on single phase models.

Direct-drive PSC (Permanent Split Capacitor) condenser-fan motors are designed to help reduce energy consumption and provide for cooing operation down to 40°F (4.4°C) outdoor temperature. Motormaster® II low ambient kit is available as a field-installed accessory.

Thermostatic Expansion Valve - A hard shutoff, balance port TXV maintains a constant superheat at the evaporator exit (cooling cycle) resulting in higher overall system efficiency.

Refrigerant system is designed to provide dependability. Liquid filter driers are used to promote clean, unrestricted operation. Each unit leaves the factory with a full refrigerant charge. Refrigerant service connections make checking operating pressures easier.

High and Low Pressure Switches provide added reliability for the compressor.

Indoor and Outdoor coils are computer-designed for optimum heat transfer and efficiency. The indoor coil is fabricated from copper tube and aluminum fins and is located inside the unit for protection against damage. The outdoor coil is internally mounted on the top tier of the unit.

Low sound ratings ensure a quiet indoor and outdoor environment with sound ratings as low as 72dBA.

Dehumidification Feature

This unit has independent fan speeds for low stage cooling and high stage cooling. In addition, 208/230 VAC models have the field-selectable capability to run an enhanced dehumidification ('DHUM') speed on high stage cooling (as low as 320CFM per ton). Coupled with the improved dehumidification associated with low stage cooling, the DHUM speed allows for a complete dehumidification solution independent of cooling stage. 208/230 VAC models also have independent fan speeds for low stage gas heating and high stage gas heating. The dehumidification control must open the control circuit on humidity rise above the dehumidification set point.

Heating

- Reliable direct spark ignition system
- Inducer motors with ball bearings
- Low stage heating delivers 65% of high-stage capacity (208/230 VAC models)

Easy to service cabinets provide easy 3-panel accessibility to serviceable components during maintenance and installation. The basepan with integrated drain pan provides easy ground level installation with mounting pad. A nesting feature ensures a positive basepan to roof curb seal when the unit is roof mounted. A convenient 3/4-in. (19.05 mm) wide perimeter flange makes frame mounting on a rooftop easy.

Standard horizontal metal duct covers with insulation come with the unit and cover the horizontal duct openings. These can be left in place if the units are converted to downflow.

Integrated Gas Control (IGC) board provides safe and efficient control of heating and simplifies trouble-shooting through its built-in diagnostic function.

Cabinets are constructed of heavyduty, phosphated, zinc-coated prepainted steel capable of withstanding 500 hours in salt spray. Interior surfaces of the evaporator/heat exchanger compartment are insulated with foil-faced insulation, which keeps the conditioned air from being affected by the outdoor ambient temperature and provides improved indoor air quality. (Conforms to American Society of Heating, Refrigeration and Air Conditioning Engineers 62.2.) The sloped drain pan minimizes standing water in the drain. An external drain is provided.

Louvered grille provides hail and vandalism protection for the coil.

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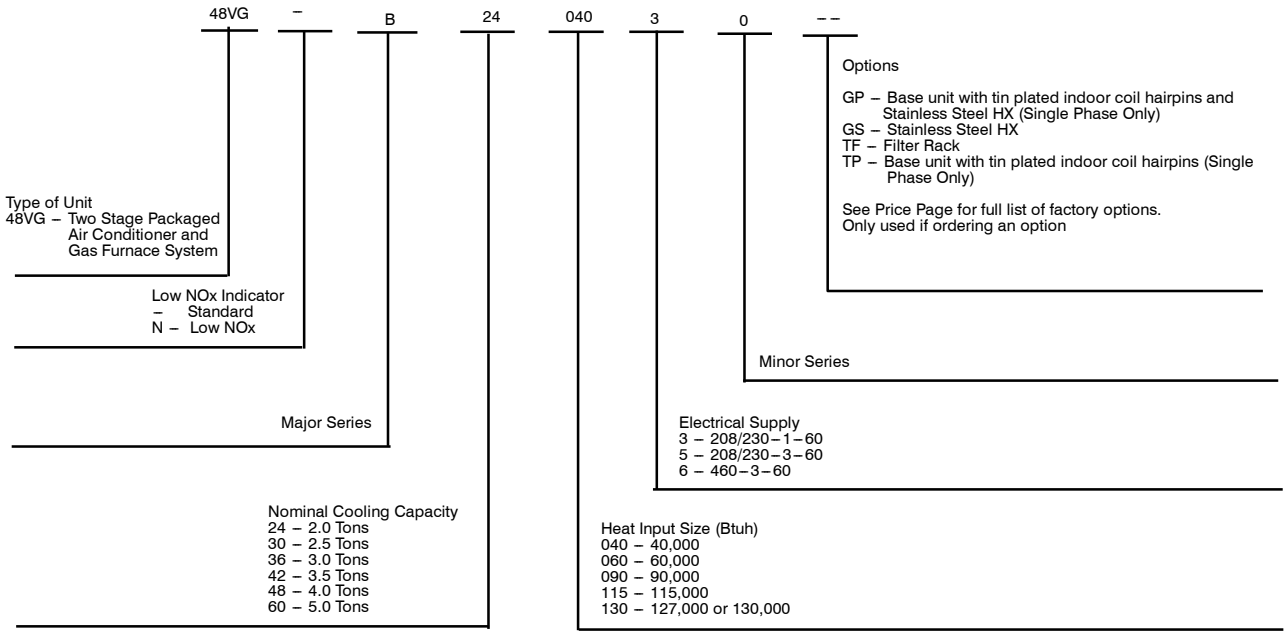
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MODEL NUMBER NOMENCLATURE



ASHRAE 90.1 COMPLIANT

GAS-FIRED

c UL us LISTED c UL us LISTED

AHRI CERTIFIED www.ahridirectory.org

Use of the AHRI Certified TM Mark indicates a manufacturer's participation in the program For verification of certification for individual products, go to www.ahridirectory.org.

ENERGY STAR

AHRI* CAPACITIES

Cooling Capacities and Efficiencies

Unit Size	Nominal Tons	Standard CFM (High / Low Stage)	Net Cooling Capacities - Btuh (High Stage)	EER @A**	SEER†
24	2	800 / 600	23000	12.0	15.0
30	2-1/2	1000 / 750	29000	12.0	15.0
36	3	1200 / 900	35400	12.5	16.0
42	3-1/2	1400 / 1050	42000	12.5	16.0
48	4	1600 / 1200	47500	12.3	16.0
60	5	1750 / 1200	57000	12.3	16.0

LEGEND
dB–Sound Levels (decibels)
db—Dry Bulb
SEER—Seasonal Energy Efficiency Ratio
wb—Wet Bulb
COP–Coefficient of Performance
* Air Conditioning, Heating & Refrigeration Institute.
**At "A" conditions–80°F (26.7°C) indoor db/67°F (19.4°C) indoor wb & 95°F (35°C) outdoor db.
† Rated in accordance with U.S. Government DOE Department of Energy) test procedures and/or AHRI Standards 210/240.

Notes:
1. Ratings are net values, reflecting the effects of circulating fan heat. Ratings are based on:
Cooling Standard: 80°F (26.7°C) db, 67°F wb (19.4°C) indoor entering–air temperature and 95°F db (35°C) outdoor entering–air temperature.
2. Before purchasing this appliance, read important energy cost and efficiency information available from AHRIdirectory.org.

Heating Capacities and Efficiencies
208/230 VAC Models Single Phase

UNIT SIZE	HEATING INPUT (BTUH) HIGH/LOW	OUTPUT CAPACITY (BTUH) HIGH / LOW	TEMPERATURE RISE RANGE HIGH °F (°C)	TEMPERATURE RISE RANGE LOW °F (°C)	AFUE (%)
24040 30040	40,000 / 26,000	33,000 / 22,000	25-55 (14-31)	25-55 (14-31)	81.0
24060 30060 36060 42060	60,000 / 39,000	49,000 / 32,000	25-55 (14-31)	25-55 (14-31)	81.0
36090 42090 48090 60090	90,000 / 58,500	74,000 / 48,000	35-65 (19-36)	35-65 (19-36)	81.0
48115 60115	115,000 / 75,000	94,000 / 62,000	30-60 (17-33)	30-60 (17-33)	81.0
48130 60130	127,000 / 84,500	104,000 / 70,000	35-65 (19-36)	35-65 (19-36)	81.0

LEGEND
AFUE – Annual Fuel Utilization Efficiency
NOTE: Before purchasing this appliance, read important energy cost and efficiency information available from AHRIdirectory.org.

208/230 VAC Models 3-Phase

UNIT SIZE	HEATING INPUT (BTUH) HIGH/LOW	OUTPUT CAPACITY (BTUH) HIGH / LOW	TEMPERATURE RISE RANGE HIGH °F (°C)	TEMPERATURE RISE RANGE LOW °F (°C)	AFUE (%)
24040 30040	40,000 / 26,000	32,000 / 21,000	20-50 (11-28)	15-45 (8-25)	78.0
24060 30060 36060 42060	60,000 / 39,000	49,000 / 31,000	25-55 (14-31)	25-55 (14-31)	78.6
36090 42090 48090 60090	90,000 / 58,500	74,000 / 47,000	35-65 (19-36)	35-65 (19-36)	79.2
48115 60115	115,000 / 75,000	93,000 / 61,000	30-60 (17-33)	30-60 (17-33)	80.1
48130 60130	130,000 / 84,500	103,000 / 68,000	35-65 (19-36)	35-65 (19-36)	80.0

LEGEND
AFUE – Annual Fuel Utilization Efficiency
NOTE: Before purchasing this appliance, read important energy cost and efficiency information available from AHRIdirectory.org.

460V Models

UNIT SIZE	HEATING INPUT (Btuh)	OUTPUT CAPACITY (Btuh)	TEMPERATURE RISE RANGE °F (°C)	AFUE (%)
36060 **42060**	60,000	47,000 47,000	25-55 (13.9-30.6)	78.5 78.5
36090 **42090** **48090** **60090**	90,000	73,000	35-65 (19.4-36.1)	80.4
48115 **60115**	115,000	93,000	30-60 (16.7-33.3)	80.3
48130 **60130**	130,000	103,000	35-65 (19.4-36.1)	78.9

LEGEND
AFUE—Annual Fuel Utilization Efficiency
NOTE: Before purchasing this appliance, read important energy cost and efficiency information available from AHRIdirectory.org.

A-Weighted Sound Power Level (dBA)

Unit Size	Sound Ratings (dBA)	TYPICAL OCTAVE BAND SPECTRUM (dBA without tone adjustment)						
		125	250	500	1000	2000	4000	8000
24	73	60.0	62.5	68.5	68.5	64.0	60.0	53.0
30	77	57.5	67.0	73.5	72.0	67.0	61.0	52.5
36	73	62.5	65.5	67.5	68.0	65.5	60.0	52.5
42	73	60.5	63.5	68.0	68.0	66.0	60.5	53.0
48	72	60.0	63.5	66.0	67.0	63.5	58.5	49.5
60	75	69.0	67.0	69.0	68.0	65.0	61.5	54.0

NOTE: Tested in accordance with AHRI Standard 270−1995 (not listed in AHRI).

PHYSICAL DATA

UNIT SIZE	24040	24060	30040	30060	36060	36090	42060	42090
NOMINAL CAPACITY (ton)	2	2	2−1/2	2−1/2	3	3	3−1/2	3−1/2
SHIPPING WEIGHT** lb.	352	352	359	359	455	455	455	455
SHIPPING WEIGHT** (kg)	160	160	163	163	206	206	206	206
COMPRESSORS	2−Stage Scroll							
Quantity	1							
REFRIGERANT (R−410A)								
Quantity lb.	6.4	6.4	8.3	8.3	8.1	8.1	8.7	8.7
Quantity (kg)	2.9	2.9	3.8	3.8	3.7	3.7	3.9	3.9
REFRIGERANT METERING DEVICE	TXV							
OUTDOOR COIL								
Rows...Fins/in.	1..21	1...21	2...21	2...21	2...21	2...21	2...21	2...21
Face Area (sq ft)	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
OUTDOOR FAN								
Nominal CFM	2500	2500	2700	2700	3000	3000	3000	3000
Diameter in.	24	24	24	24	26	26	26	26
Diameter (mm)	609.6	609.6	609.6	609.6	600.4	600.4	660.4	660.4
Motor Hp (Rpm)	1/10 (810)	1/10 (810)	1/5 (810)	1/5 (810)	1/5 (810)	1/5 (810)	1/5 (810	1/5 (810)
INDOOR COIL								
Rows...Fins/in.	3...17	3...17	3...17	3...17	3...17	3...17	3...17	3...17
Face Area (sq ft)	3.7	3.7	3.7	3.7	4.7	4.7	4.7	4.7
INDOOR BLOWER								
Nominal Low Stage Cooling Airflow (Cfm)	600	600	750	750	900	900	1050	1050
Nominal High Stage Cooling Airflow (Cfm)	800	800	1000	1000	1200	1200	1400	1400
Size in.	10x10	10x10	10x10	10x10	11x10	11x10	11x10	11x10
Size (mm.)	254x254	254x254	254x254	254x254	279.4x254	279.4x254	279.4x254	279.4x254
Motor HP (RPM)	1/2 (1050)	1/2 (1050)	1/2 (1050)	1/2 (1050)	3/4 (1000)	3/4 (1000)	3/4 (1075)	3/4 (1075)
FURNACE SECTION*								
Burner Orifice No. (Qty...Drill Size)					208/230 VAC Models		208/230 VAC Models	
Natural Gas (Factory Installed)	2...44	3...44	2...44	3...44	3...44	3…38	3...44	3...38
Propane Gas	2...55	3...55	2...55	3...55	3...55	3…53	3...55	3...53
					460 VAC Models		460 VAC Models	
					2…38		2…38	
					2…53		2…53	
HIGH-PRESSURE SWITCH (psig) Cut-out Reset (Auto)	650 +/− 15 420 +/− 25							
LOSS-OF-CHARGE / LOW-PRESSURE SWITCH (psig) cut-out Reset (auto)	50 +/− 7 95 +/− 7							
DUCT RETURN−AIR FILTERS†‡								
Throwaway Size in. (mm)	20x20x1 508x508x25	20x24x1 508x610x25			24x30x1 610x762x25			

*Based on altitude of 0 to 2000 ft (0−610 m).

† Required filter sizes shown are based on the larger of the AHRI (Air Conditioning Heating and Refrigeration Institute) rated cooling airflow or the heating airflow velocity of 300 ft/minute for throwaway type. Air filter pressure drop for non−standard filters must not exceed 0.08 IN. W.C.

‡ If using accessory filter rack refer to the filter rack installation instructions for correct filter sizes and quantity.

PHYSICAL DATA (CONT)

UNIT SIZE	48090	48115	48130	60090	60115	60130
NOMINAL CAPACITY (ton)	4	4	4	5	5	5
SHIPPING WEIGHT lb	500	500	500	520	520	520
SHIPPING WEIGHT kg	227	227	227	236	236	236
COMPRESSORS	2−Stage Scroll					
Quantity	1					
REFRIGERANT (R−410A)						
Quantity lb	10.8	10.8	10.8	12.1	12.1	12.1
Quantity (kg.)	4.9	4.9	4.9	5.5	5.5	5.5
REFRIGERANT METERING DEVICE	TXV					
OUTDOOR COIL						
Rows...Fins/in.	2...21	2...21	2...21	2...21	2...21	2...21
Face Area (sq ft)	19.4	19.4	19.4	21.4	21.4	21.4
OUTDOOR FAN						
Nominal Cfm	3300	3300	3300	3600	3600	3600
Diameter in.	26	26	26	26	26	26
Diameter (mm)	660.4	660.4	660.4	660.4	660.4	660.4
Motor Hp (Rpm)	1/5 (810)	1/5 (810)	1/5 (810)	1/5 (810)	1/5 (810)	1/5 (810)
INDOOR COIL						
Rows...Fins/in.	3...17	3...17	3...17	3...17	3...17	3...17
Face Area (sq ft)	5.7	5.7	5.7	5.7	5.7	5.7
INDOOR BLOWER						
Nominal Low Stage Cooling Airflow (Cfm)	1200	1200	1200	1200	1200	1200
Nominal High Stage Cooling Airflow (Cfm)	1600	1600	1600	1750	1750	1750
Size in.	11x10	11x10	11x10	11x10	11x10	11x10
Size (mm)	279.4x254	279.4x254	279.4x254	279.4x254	279.4x254	279.4x254
Motor HP (RPM)	1.0 (1075)	1.0 (1075)	1.0 (1075)	1.0 (1075)	1.0 (1075)	1.0 (1075)
FURNACE SECTION*						
Burner Orifice No. (Qty...Drill Size)						
Natural Gas (Factory Installed)	3...38	3...33	3...31	3...38	3...33	3...31
Propane Gas	3...53	3...51	3...49	3...53	3...51	3...49
HIGH−PRESSURE SWITCH (psig) Cut−out Reset (Auto)	650 +/− 15 420 +/− 25					
LOSS−OF−CHARGE / LOW−PRESSURE SWITCH (psig) cut−out Reset (auto)	50 +/−7 95 +/− 7					
DUCT RETURN−AIR FILTERS Throw−away†‡ **in. (mm)**	24x36x1 610x914x25					

*Based on altitude of 0 to 2000 ft (0−610 m).

† Required filter sizes shown are based on the larger of the AHRI (Air Conditioning Heating and Refrigeration Institute) rated cooling airflow or the heating airflow velocity of 300 ft/minute for throwaway type. Air filter pressure drop for non−standard filters must not exceed 0.08 IN. W.C.

‡ If using accessory filter rack refer to the filter rack installation instructions for correct filter sizes and quantity.

OPTIONS AND ACCESSORIES

ITEM	DESCRIPTION	FACTORY INSTALLED OPTION	FIELD INSTALLED ACCESSORY
Coil Options	Base unit with tin plated indoor coil hairpins	X	
Compressor Start Kit	Compressor Start Kit assists compressor start–up by providing additional starting torque on sing phase units only.		X
Corporate Thermostats	Thermostats provide control for the system heating and cooling functions.		X
Crankcase Heater	Crankcase Heater provides anti–floodback protection for low–load cooling applications.		X*
Economizer	Vertical Economizer with Jade Honeywell W7220 Controller, Honeywell communicating actuator, and dry bulb sensor. (Contact MicroMetl Customer Service at 1–800–662–4822 to order.)		X
	Horizontal Economizer with Jade Honeywell W7220 Controller, Honeywell communicating actuator, and dry bulb sensor. (Contact MicroMetl Customer Service at 1–800–662–4822 to order.)		X
Filter Rack	Filter Rack features easy installation, serviceability, and high–filtering performance for vertical applications. Includes 1–in. filter.	X	X
Flat Roof Curbs	Flat Roof Curbs in both 11–in (279 mm) and 14–in. (356 mm) sizes are available for roof mounted applications.		X
Flue Discharge Deflector	Directs flue gas exhaust 90 degrees upward from current discharge.		X
Heat Exchanger	Stainless Steel Heat Exchanger	X	
High Altitude Propane Conversion Kit	High Altitude Propane Conversion Kit is for use at 2001 to 6000 ft. (611–1829 m) above sea level. Kit consists of propane gas orifices that compensate for gas heat operation at high altitude.		X
Low Ambient Kit	Low Ambient Kit (Motormaster II Control) allows the use of mechanical cooling down to outdoor temperatures as low as 0°F (–18° C) when properly installed.		X
Manual Outside Air Damper	Manual Outside Air Damper includes hood and filter rack with adjustable damper blade for up to 25% outdoor air.		X
Natural to Propane Gas Conversion Kit	Natural to Propane Gas Conversion Kit allows for conversion from natural gas to propane gas (0–2000 ft) (0–610 m)		X
Propane to Natural Gas Conversion Kit	Propane to Natural Gas Conversion Kit allows for conversion from propane to natural gas for altitudes of 0–2000 ft (0–610 m)		X
Square–to–Round Duct Transition Kit	Square–to–Round Duct Transition Kit enable 24–48 size units to be fitted to 14 in. (356 mm) round ductwork.		X
Time Guard II	Automatically prevents the compressor from restarting for at least 4 minutes and 45 seconds after shutdown of the compressor. Not required when a corporate programmable thermostat is applied or with a RTU–MP control.		X

*Refer to Price Page for application detail.

UNIT DIMENSIONS – 48VG-A30

UNIT	ELECTRICAL CHARACTERISTICS	UNIT WT.		UNIT HEIGHT IN/MM	CENTER OF GRAVITY IN/MM		
		LB	KG	"A"	X	Y	Z
48VG(-/N)A30(040/060)50	208/230-3-60	351	159.3	44-1/8 | 1121	22-13/16 | 579.4	15-5/16 | 388.9	16-5/8 | 422.3

UNIT	VOLTAGE	CORNER WEIGHT LB/KG					
		"1"		"2"		"3"	"4"
48VG(-/N)A30(040/060)50	208/230	89.7	40.7	79.0	35.8	85.8 | 38.9	96.5 | 43.8

NOTE: ALL TABLE DATA RELEVANT FOR ALL FACTORY INSTALLED OPTIONS EXCEPT ECONOMIZER

REQUIRED CLEARANCES TO COMBUSTIBLE MATL. INCHES [MM]

TOP OF UNIT	14 [355.6]
DUCT SIDE OF UNIT	2 [50.8]
SIDE OPPOSITE DUCTS	14 [355.6]
BOTTOM OF UNIT	1/2 [12.7]
FLUE PANEL	36 [914.4]

NEC. REQUIRED CLEARANCES. INCHES [MM]

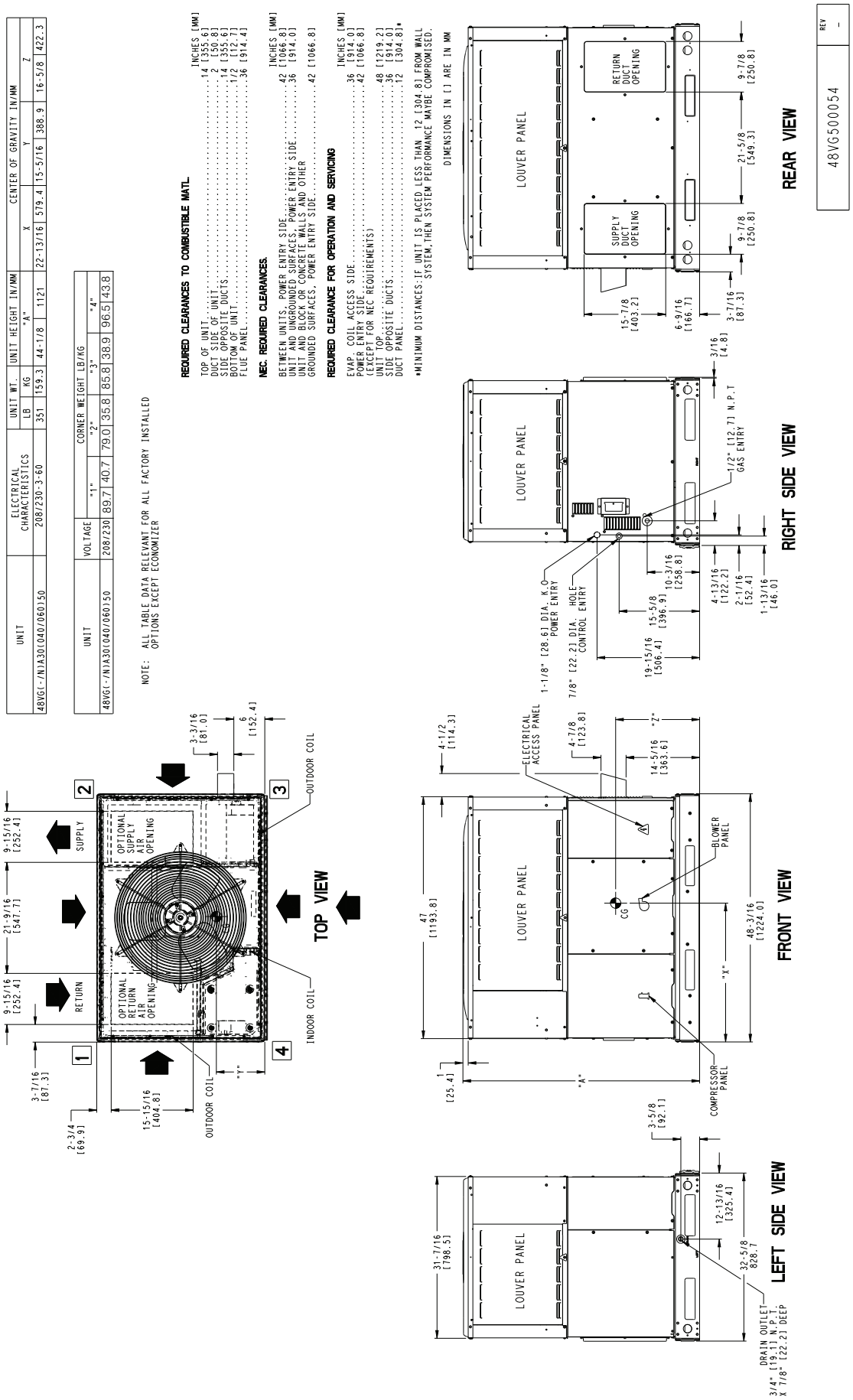
BETWEEN UNITS, POWER ENTRY SIDE	42 [1066.8]
UNIT AND UNGROUNDED SURFACES, POWER ENTRY SIDE	36 [914.0]
UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES, POWER ENTRY SIDE	42 [1066.8]

REQUIRED CLEARANCE FOR OPERATION AND SERVICING INCHES [MM]

EVAP. COIL ACCESS SIDE	36 [914.0]
POWER ENTRY SIDE (EXCEPT FOR NEC REQUIREMENTS)	42 [1066.8]
UNIT TOP	48 [1219.2]
SIDE OPPOSITE DUCTS	36 [914.0]
DUCT PANEL	12 [304.8]*

*MINIMUM DISTANCES: IF UNIT IS PLACED LESS THAN 12 [304.8] FROM WALL SYSTEM, THEN SYSTEM PERFORMANCE MAYBE COMPROMISED.

DIMENSIONS IN [ ] ARE IN MM



48VG500054	REV -

A14627

UNIT DIMENSIONS - 48VG-B24-30

UNIT	ELECTRICAL CHARACTERISTICS	UNIT WT.		UNIT HEIGHT IN/MM		CENTER OF GRAVITY IN/MM					
		LB	KG	"A"		X		Y		Z	
48VG(-/N)B24(040/060)30(--/GP/GS/TF/TP)	208/230-1-60	344	156.1	44-1/8	1121	22-13/16	579.4	15-5/16	388.9	15-13/16	401.6
48VG(-/N)B30(040/060)30(--/GP/GS/TF/TP)	208/230-1-60	351	159.3	44-1/8	1121	22-13/16	579.4	15-5/16	388.9	16-5/8	422.3

UNIT	VOLTAGE	CORNER WEIGHT LB/KG							
		"1"		"2"		"3"		"4"	
48VG(-/N)B24(040/060)30(--/GP/GS/TF/TP)	208/230	87.9	39.9	77.6	35.2	84.1	38.2	94.4	42.8
48VG(-/N)B30(040/060)30(--/GP/GS/TF/TP)	208/230	89.7	40.7	79.0	35.8	85.8	38.9	96.5	43.8

NOTE: ALL TABLE DATA RELEVANT FOR ALL FACTORY INSTALLED OPTIONS EXCEPT ECONOMIZER

REQUIRED CLEARANCES TO COMBUSTIBLE MATL.

	INCHES [MM]
TOP OF UNIT	14 [355.6]
DUCT SIDE OF UNIT	2 [50.8]
SIDE OPPOSITE DUCTS	14 [355.6]
BOTTOM OF UNIT	1/2 [12.7]
FLUE PANEL	36 [914.4]

NEC. REQUIRED CLEARANCES.

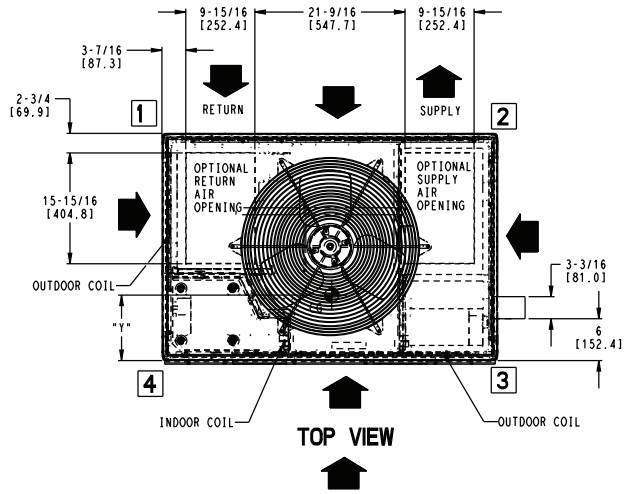
	INCHES [MM]
BETWEEN UNITS, POWER ENTRY SIDE	42 [1066.8]
UNIT AND UNGROUNDED SURFACES, POWER ENTRY SIDE	36 [914.0]
UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES, POWER ENTRY SIDE	42 [1066.8]

REQUIRED CLEARANCE FOR OPERATION AND SERVICING

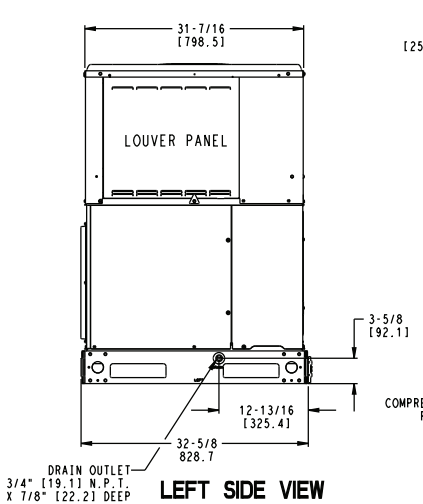
	INCHES [MM]
EVAP. COIL ACCESS SIDE	36 [914.0]
POWER ENTRY SIDE	42 [1066.8]
(EXCEPT FOR NEC REQUIREMENTS)	
UNIT TOP	48 [1219.2]
SIDE OPPOSITE DUCTS	36 [914.0]
DUCT PANEL	12 [304.8]*

*MINIMUM DISTANCES: IF UNIT IS PLACED LESS THAN 12 [304.8] FROM WALL SYSTEM, THEN SYSTEM PERFORMANCE MAYBE COMPROMISED.

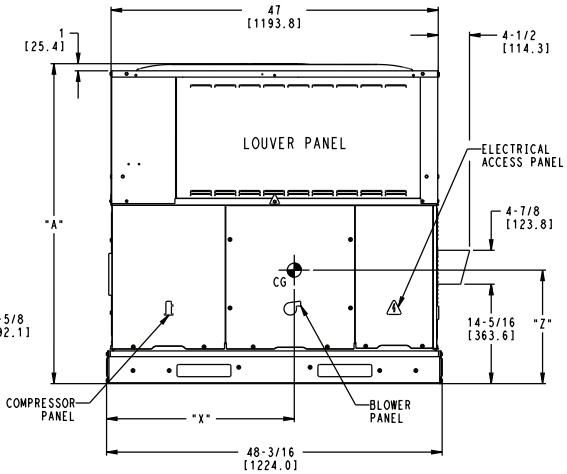
DIMENSIONS IN [] ARE IN MM



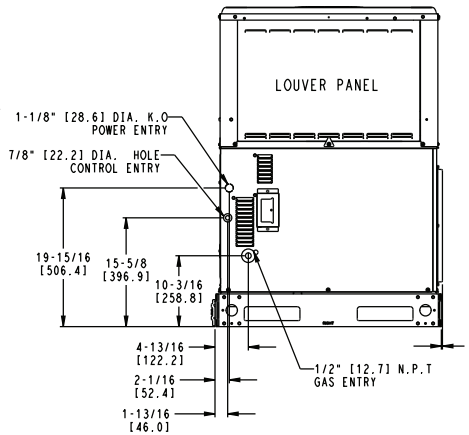
TOP VIEW



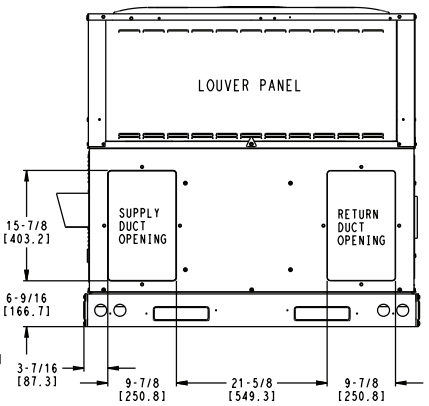
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW



REAR VIEW

48VG500115	REV -

A14591

UNIT DIMENSIONS – 48VG-A36-60

UNIT	ELECTRICAL CHARACTERISTICS	UNIT WT.		UNIT HEIGHT IN/MM	CENTER OF GRAVITY IN/MM					
		LB	KG	"A"	X		Y		Z	
48VG(-/N)A36(060/090)(5/6)0	208/230-3-60,460-3	447	202.8	44-3/4	1137	22-13/16	579.4	18	457.2	17-1/8	435.0
48VG(-/N)A42(060/090)(5/6)0	208/230-3-60,460-3	447	202.8	44-3/4	1137	22-13/16	579.4	18	457.2	17-1/8	435.0
48VG(-/N)A48(090/115/130)(5/6)0	208/230-3-60,460-3	492	223.2	50-3/4	1289	22-13/16	579.4	18	457.2	17-3/8	441.3
48VG(-/N)A60(090/115/130)(5/6)0	208/230-3-60,460-3	512	232.3	52-3/4	1340	22-13/16	579.4	18	457.2	17-5/8	447.7

UNIT	VOLTAGE	CORNER WEIGHT LB/KG					
		"1"		"2"		"3"	"4"
48VG(-/N)A36(060/090)(5/6)0	208/230/460	97.5	44.3	86.4	39.2	123.9	56.2	140.2	63.6
48VG(-/N)A42(060/090)(5/6)0	208/230/460	97.5	44.2	86.5	39.2	124.2	56.3	139.8	63.4
48VG(-/N)A48(090/115/130)(5/6)0	208/230/460	107.0	48.5	95.3	43.2	136.1	61.8	153.6	69.7
48VG(-/N)A60(090/115/130)(5/6)0	208/230/460	110.9	50.3	98.6	44.7	142.2	64.5	160.2	72.7

NOTE: ALL TABLE DATA RELEVANT FOR ALL FACTORY INSTALLED OPTIONS EXCEPT ECONOMIZER

REQUIRED CLEARANCES TO COMBUSTIBLE MATL. [INCHES [MM]

TOP OF UNIT.....14 [355.6]
DUCT SIDE OF UNIT.....2 [50.8]
SIDE OPPOSITE DUCTS.....14 [355.6]
BOTTOM OF UNIT.....1/2 [12.7]
FLUE PANEL.....36 [914.4]

NEC. REQUIRED CLEARANCES. [INCHES [MM]

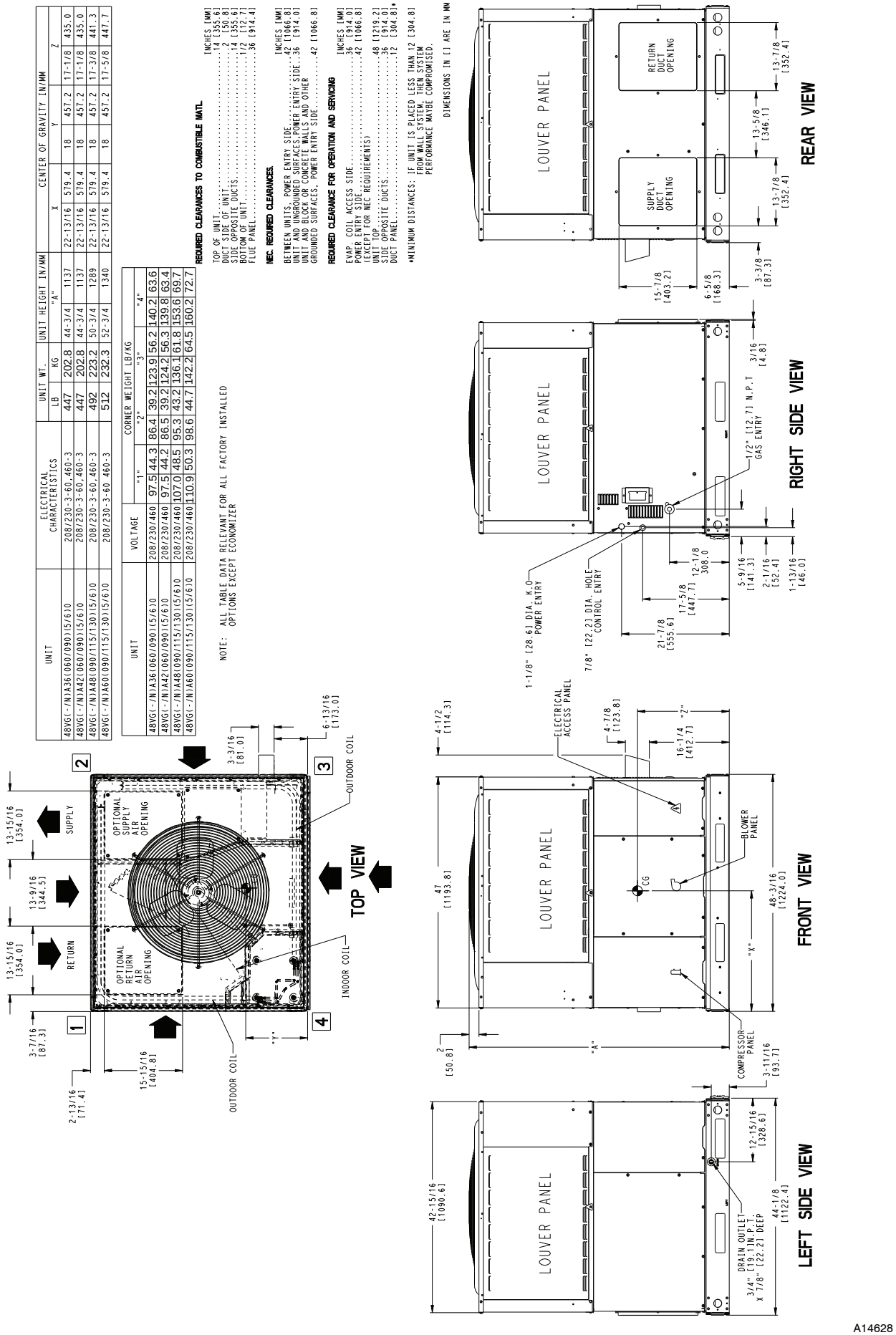
BETWEEN UNITS, POWER ENTRY SIDE.....42 [1066.8]
UNIT AND UNGROUNDED SURFACES,POWER ENTRY SIDE..36 [914.0]
UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES, POWER ENTRY SIDE.....42 [1066.8]

REQUIRED CLEARANCE FOR OPERATION AND SERVICING [INCHES [MM]

EVAP. COIL ACCESS SIDE.....36 [914.0]
POWER ENTRY SIDE.....42 [1066.8]
(EXCEPT FOR NEC REQUIREMENTS)
UNIT TOP.....48 [1219.2]
SIDE OPPOSITE DUCTS.....36 [914.0]
DUCT PANEL.....12 [304.8]*

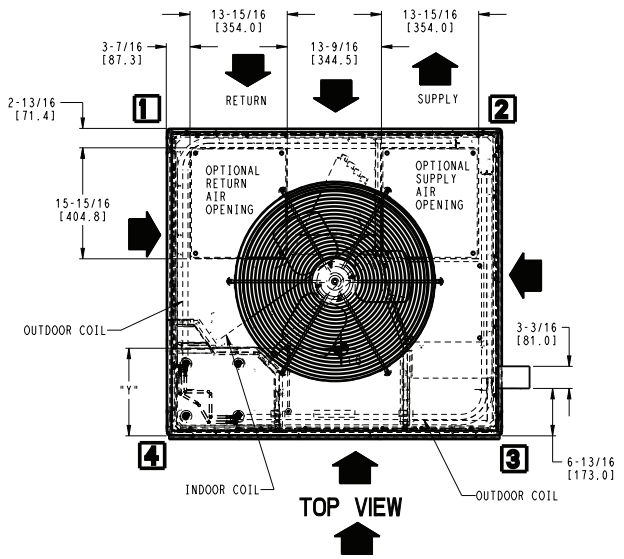
*MINIMUM DISTANCES: IF UNIT IS PLACED LESS THAN 12 [304.8] FROM WALL SYSTEM THEN SYSTEM PERFORMANCE MAYBE COMPROMISED.

DIMENSIONS IN [ ] ARE IN MM



A14628

UNIT DIMENSIONS - 48VG-B36-60



UNIT	ELECTRICAL CHARACTERISTICS	UNIT WT.		UNIT HEIGHT IN/MM		CENTER OF GRAVITY IN/MM					
		LB	KG	"A"		X		Y		Z	
48VG(-/N)B36(060/090)30(--/GP/GS/TF/TP)	208/230-1-60	447	202.8	44-3/4	1137	22-13/16	579.4	18	457.2	17-1/8	435.0
48VG(-/N)B42(060/090)30(--/GP/GS/TF/TP)	208/230-1-60	447	202.8	44-3/4	1137	22-13/16	579.4	18	457.2	17-1/8	435.0
48VG(-/N)B48(090/115/130)30(--/GP/GS/TF/TP)	208/230-1-60	492	223.2	50-3/4	1289	22-13/16	579.4	18	457.2	17-3/8	441.3
48VG(-/N)B60(090/115/130)30(--/GP/GS/TF/TP)	208/230-1-60	512	232.2	52-3/4	1340	22-13/16	579.4	18	457.2	17-5/8	447.7

UNIT	VOLTAGE	CORNER WEIGHT LB/KG							
		"1"		"2"		"3"		"4"	
48VG(-/N)B36(060/090)30(--/GP/GS/TF/TP)	208/230	97.5	44.3	86.4	39.2	123.9	56.2	140.2	63.6
48VG(-/N)B42(060/090)30(--/GP/GS/TF/TP)	208/230	97.5	44.2	86.5	39.2	124.2	56.3	139.8	63.4
48VG(-/N)B48(090/115/130)30(--/GP/GS/TF/TP)	208/230	107.0	48.5	95.3	43.2	136.1	61.8	153.6	69.7
48VG(-/N)B60(090/115/130)30(--/GP/GS/TF/TP)	208/230	110.9	50.3	98.6	44.7	142.2	64.5	160.2	72.7

NOTE: ALL TABLE DATA RELEVANT FOR ALL FACTORY INSTALLED OPTIONS EXCEPT ECONOMIZER

REQUIRED CLEARANCES TO COMBUSTIBLE MATL.

	INCHES [MM]
TOP OF UNIT	14 [355.6]
DUCT SIDE OF UNIT	2 [50.8]
SIDE OPPOSITE DUCTS	14 [355.6]
BOTTOM OF UNIT	1/2 [12.7]
FLUE PANEL	36 [914.4]

NEC. REQUIRED CLEARANCES.

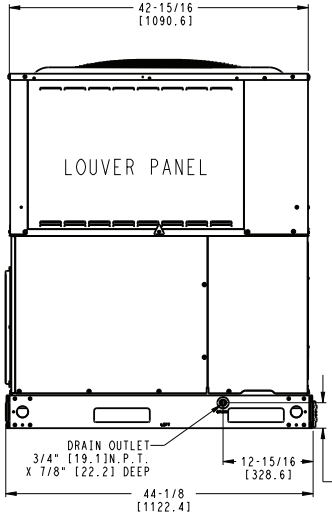
	INCHES [MM]
BETWEEN UNITS, POWER ENTRY SIDE	42 [1066.8]
UNIT AND UNGROUNDED SURFACES,POWER ENTRY SIDE	36 [914.0]
UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES, POWER ENTRY SIDE	42 [1066.8]

REQUIRED CLEARANCE FOR OPERATION AND SERVICING

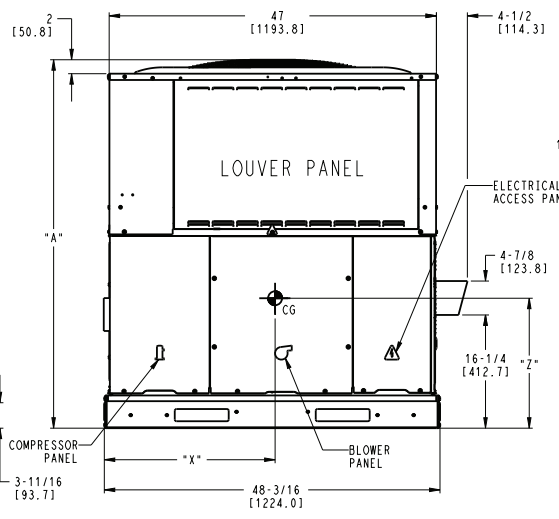
	INCHES [MM]
EVAP. COIL ACCESS SIDE	36 [914.0]
POWER ENTRY SIDE	42 [1066.8]
(EXCEPT FOR NEC REQUIREMENTS)	
UNIT TOP	48 [1219.2]
SIDE OPPOSITE DUCTS	36 [914.0]
DUCT PANEL	12 [304.8]*

*MINIMUM DISTANCES: IF UNIT IS PLACED LESS THAN 12 [304.8] FROM WALL SYSTEM, THEN SYSTEM PERFORMANCE MAYBE COMPROMISED.

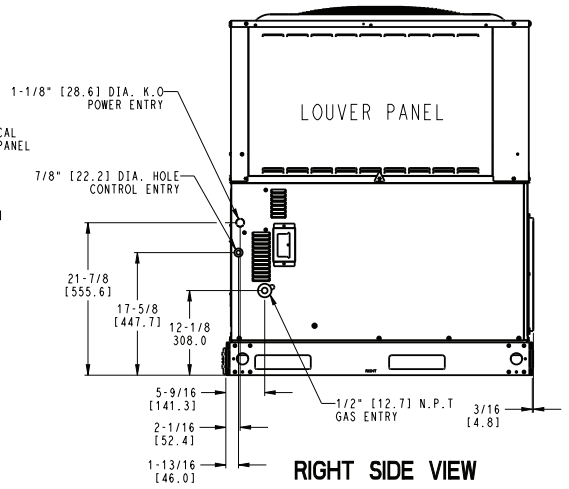
DIMENSIONS IN [] ARE IN MM



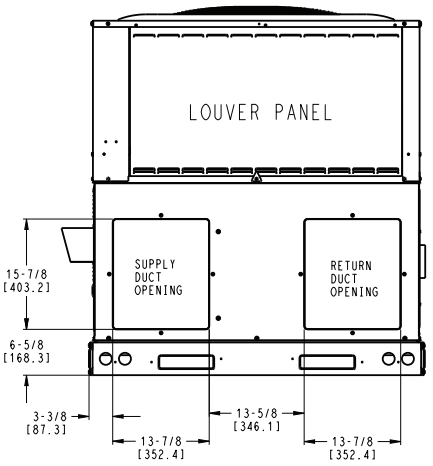
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

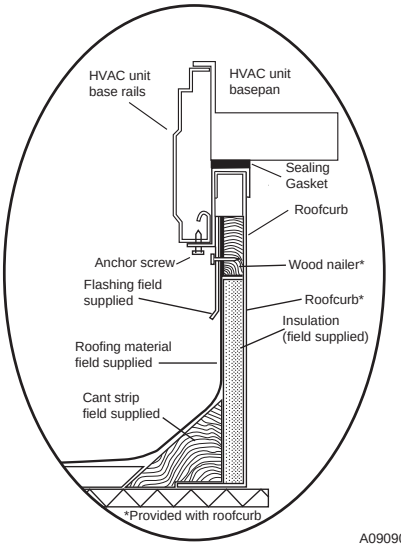


REAR VIEW

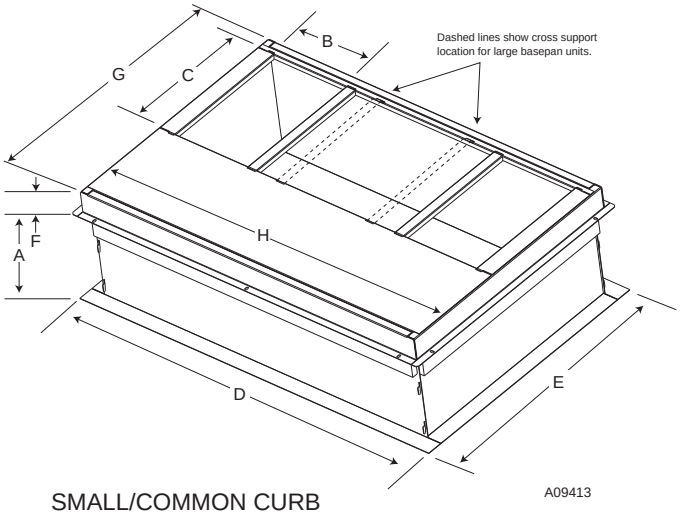
48VG500116	REV -

A14592

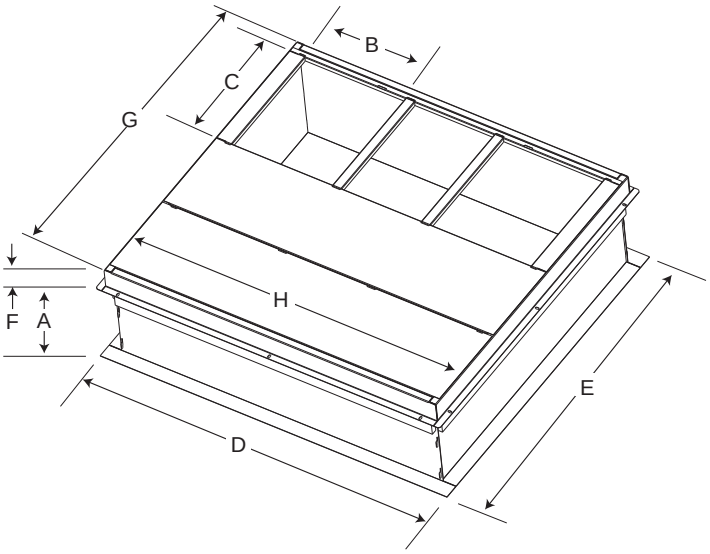
ACCESSORY DIMENSIONS



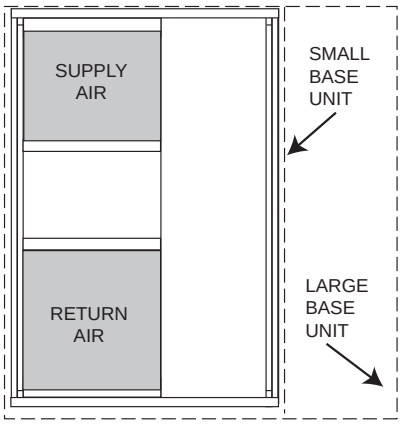
ROOF CURB DETAIL



SMALL/COMMON CURB



LARGE CURB



UNIT PLACEMENT ON COMMON CURB

SMALL OR LARGE BASE UNIT

A09414

UNIT SIZE	CATALOG NUMBER	A IN. (mm)	B (small / common base) IN. (mm)*	B (large base) IN. (mm)*	C IN. (mm)	D IN. (mm)	E IN. (mm)	F IN. (mm)	G IN. (mm)	H IN. (mm)
Small or Large	CPRFCURB010A00	11 (279)	10 (254)	14 (356)	16 (406)	47.8 (1214)	32.4 (822)	2.7 (69)	30.6 (778)	46.1 (1170)
	CPRFCURB011A00	14 (356)								
Large	CPRFCURB012A00	11 (279)	14 (356)				43.9 (1116)		42.2 (1072)	
	CPRFCURB013A00	14 (356)								

***** Part Numbers CPRCURB010A00 and CPRCURB011A00 can be used on both small and large basepan units. The cross supports must be located based on whether the unit is a small basepan or a large basepan.

NOTES:

1. Roof curb must be set up for unit being installed.
2. Seal strip must be applied, as required, to unit being installed.
3. Roof curb is made of 16-gauge steel.
4. Attach ductwork to curb (flanges of duct rest on curb).
5. Insulated panels: 1-in. (25.4 mm) thick fiberglass 1 lb. density.

SELECTION PROCEDURE (WITH EXAMPLE)

1. Determine cooling and heating requirements at design conditions:

Given:

Required Cooling Capacity (TC) . . . . . 34,000 Btuh
Sensible Heat Capacity (SHC) . . . . . 25,000 Btuh
Required Heating Capacity . . . . . 60,000 Btuh
Condenser Entering Air Temperature . . . . . 95°F (35°C)
Indoor-Air Temperature . 80°F (26°C)edb 67°F (19°C)ewb
Evaporator Air Quantity . . . . . 1200 CFM
External Static Pressure . . . . . 0.100 IN. W.C.
Electrical Characteristics 208-1-60

2. Select unit based on required cooling capacity.

Enter Net Cooling Capacities table at condenser entering temperature of 95°F (35°C). Unit 036 at 1200 cfm and 67°F (19°C) ewb (entering wet bulb) will provide a total capacity of 34,200 Btuh and a SHC of 27,400 Btuh. Calculate SHC correction, if required, using Note 4 under Cooling Capacities tables.

3. Select heating capacity of unit to provide design condition requirement.

In the Heating Capacities and Efficiencies table, note that the unit 036090 (208/230 VAC) will provide 74,000 Btuh with an input of 90,000 Btuh in high stage and will provide 48,000 Btuh of heating in low stage.

4. Determine fan speed and power requirements at design conditions.

Before entering the air delivery tables, calculate the total static pressure required. From the given example, the Wet Coil Pressure Drop Table, and the Filter Pressure Drop Table:

External Static Pressure	0.100 IN. W.C
Filter	0.07 IN. W.C
Wet Coil Pressure Drop	0.180 IN. W.C
Total Static Pressure	0.287 IN. W.C

Enter the table for Dry Coil Air Delivery—Horizontal and Downflow Discharge. At .287 IN. W.C. ESP, the closest speed to 1200 CFM is Med-Hi (orange wire), which delivers 1267 CFM at .3 in ESP.

5. Select unit that corresponds to power source available.

The Electrical Data Table shows that the unit is designed to operate at 208-1-60.

PERFORMANCE DATA

024 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
525	57 (13.8)	17.82	17.82	1.08	16.44	16.44	1.24	15.06	15.06	1.41	13.67	13.67	1.60	12.27	12.27	1.81	10.86	10.86	2.04
	62 (16.6)	18.21	16.78	1.07	16.66	15.16	1.24	15.11	15.05	1.41	13.69	13.69	1.60	12.28	12.28	1.81	10.88	10.88	2.04
	63* (17.2)	18.58	13.61	1.07	16.98	12.24	1.23	15.39	10.90	1.41	13.80	9.59	1.60	12.20	8.32	1.82	10.62	7.10	2.05
	67 (19.4)	19.95	14.13	1.04	18.24	12.71	1.21	16.54	11.34	1.39	14.83	10.00	1.58	13.13	8.69	1.80	11.44	7.44	2.03
	72 (22.2)	21.87	11.42	1.01	20.00	10.22	1.18	18.14	9.05	1.36	16.28	7.92	1.56	14.42	6.82	1.78	12.59	5.78	2.01
600	57 (13.8)	18.60	18.60	1.08	17.14	17.14	1.24	15.68	15.68	1.42	14.21	14.21	1.61	12.73	12.73	1.82	11.25	11.25	2.05
	62 (16.6)	18.65	18.61	1.08	17.17	17.17	1.24	15.71	15.71	1.42	14.23	14.23	1.61	12.75	12.75	1.82	11.27	11.27	2.05
	63* (17.2)	18.96	14.57	1.08	17.31	13.11	1.24	15.67	11.69	1.42	14.03	10.31	1.61	12.39	8.97	1.83	10.77	7.67	2.06
	67 (19.4)	20.34	15.15	1.05	18.58	13.66	1.22	16.82	12.20	1.40	15.06	10.77	1.60	13.31	9.39	1.81	11.59	8.05	2.04
	72 (22.2)	22.29	12.08	1.02	20.35	10.81	1.19	18.43	9.59	1.37	16.52	8.40	1.57	14.61	7.26	1.79	12.73	6.17	2.02
675	57 (13.8)	19.26	19.26	1.09	17.73	17.73	1.25	16.20	16.20	1.42	14.66	14.66	1.62	13.11	13.11	1.83	11.57	11.57	2.06
	62 (16.6)	19.29	19.29	1.09	17.75	17.75	1.25	16.22	16.22	1.42	14.68	14.68	1.62	13.13	13.13	1.83	11.59	11.59	2.06
	63* (17.2)	19.25	15.50	1.09	17.56	13.97	1.25	15.88	12.47	1.43	14.21	11.01	1.63	12.53	9.59	1.84	10.89	8.21	2.07
	67 (19.4)	20.64	16.16	1.06	18.83	14.58	1.23	17.03	13.03	1.41	15.24	11.53	1.61	13.45	10.06	1.82	11.70	8.65	2.05
	72 (22.2)	22.59	12.71	1.03	20.61	11.39	1.20	18.64	10.12	1.39	16.69	8.88	1.58	14.74	7.68	1.80	12.83	6.55	2.03

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

024 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
700	57 (13.8)	23.89	23.89	1.55	22.22	22.22	1.70	20.54	20.54	1.87	18.86	18.86	2.05	17.17	17.17	2.26	15.50	15.50	2.48
	62 (16.6)	24.55	21.58	1.55	22.62	20.64	1.71	20.72	19.69	1.87	18.89	18.89	2.05	17.20	17.20	2.26	15.52	15.52	2.48
	63* (17.2)	25.02	17.56	1.56	23.05	16.72	1.71	21.08	15.86	1.87	19.13	15.01	2.06	17.19	14.15	2.26	15.30	13.30	2.48
	67 (19.4)	26.85	18.20	1.57	24.72	17.34	1.73	22.61	16.48	1.89	20.50	15.61	2.07	18.42	14.75	2.27	16.39	13.89	2.49
	72 (22.2)	29.38	14.76	1.60	27.04	13.97	1.75	24.71	13.17	1.92	22.42	12.38	2.10	20.14	11.59	2.30	17.91	10.81	2.52
800	57 (13.8)	24.94	24.94	1.57	23.16	23.16	1.73	21.38	21.38	1.90	19.59	19.59	2.08	17.81	17.81	2.28	16.04	16.04	2.51
	62 (16.6)	25.14	23.30	1.58	23.20	23.20	1.73	21.41	21.41	1.90	19.62	19.62	2.08	17.83	17.83	2.28	16.06	16.06	2.51
	63* (17.2)	25.56	18.77	1.58	23.51	17.89	1.73	21.48	17.00	1.90	19.46	16.11	2.08	17.46	15.22	2.28	15.51	14.34	2.50
	67 (19.4)	27.40	19.50	1.60	25.19	18.60	1.75	23.00	17.70	1.92	20.83	16.80	2.10	18.68	15.89	2.30	16.60	15.00	2.52
	72 (22.2)	29.94	15.58	1.62	27.52	14.76	1.78	25.12	13.94	1.95	22.74	13.12	2.13	20.40	12.31	2.33	18.12	11.50	2.54
900	57 (13.8)	25.82	25.82	1.60	23.95	23.95	1.76	22.08	22.08	1.92	20.20	20.20	2.11	18.33	18.33	2.31	16.48	16.48	2.53
	62 (16.6)	25.86	25.86	1.60	23.98	23.98	1.76	22.11	22.11	1.92	20.23	20.23	2.11	18.35	18.35	2.31	16.50	16.50	2.53
	63* (17.2)	25.97	19.95	1.60	23.86	19.03	1.75	21.77	18.11	1.92	19.70	17.18	2.10	17.66	16.25	2.30	15.68	15.32	2.52
	67 (19.4)	27.81	20.76	1.62	25.54	19.83	1.77	23.30	18.89	1.94	21.07	17.95	2.12	18.88	17.01	2.32	16.76	16.07	2.54
	72 (22.2)	30.37	16.37	1.64	27.89	15.53	1.80	25.42	14.69	1.97	22.99	13.85	2.15	20.59	13.01	2.35	18.26	12.18	2.56

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

030 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
655	57 (13.8)	22.30	22.30	1.43	20.19	20.19	1.49	18.10	18.10	1.53	16.02	16.02	1.57	13.97	13.97	1.59	11.95	11.95	1.60
	62 (16.6)	22.91	20.51	1.43	20.54	17.72	1.48	18.23	15.01	1.53	16.05	16.05	1.57	13.99	13.99	1.59	11.97	11.97	1.60
	63* (17.2)	23.36	16.69	1.43	20.94	14.35	1.48	18.55	12.09	1.53	16.21	9.92	1.56	13.91	7.86	1.59	11.68	5.91	1.60
	67 (19.4)	25.19	17.36	1.41	22.57	14.93	1.46	19.99	12.60	1.51	17.47	10.36	1.55	15.00	8.21	1.58	12.60	6.19	1.59
	72 (22.2)	27.74	14.14	1.38	24.84	12.08	1.44	22.00	10.11	1.49	19.22	8.24	1.54	16.51	6.47	1.57	13.88	4.82	1.58
750	57 (13.8)	23.33	23.33	1.45	21.08	21.08	1.50	18.87	18.87	1.54	16.68	16.68	1.58	14.51	14.51	1.60	12.38	12.38	1.61
	62 (16.6)	23.49	22.18	1.45	21.12	21.12	1.50	18.90	18.90	1.54	16.70	16.70	1.58	14.53	14.53	1.60	12.39	12.39	1.61
	63* (17.2)	23.87	17.87	1.45	21.36	15.38	1.50	18.90	12.98	1.55	16.48	10.67	1.58	14.12	8.46	1.61	11.84	6.38	1.61
	67 (19.4)	25.72	18.62	1.43	23.00	16.04	1.48	20.35	13.55	1.53	17.75	11.16	1.57	15.21	8.87	1.59	12.76	6.70	1.60
	72 (22.2)	28.29	14.94	1.40	25.30	12.78	1.46	22.37	10.72	1.51	19.51	8.75	1.55	16.72	6.88	1.58	14.03	5.14	1.59
840	57 (13.8)	24.14	24.14	1.47	21.79	21.79	1.52	19.48	19.48	1.56	17.18	17.18	1.59	14.92	14.92	1.61	12.71	12.71	1.62
	62 (16.6)	24.18	24.18	1.46	21.82	21.82	1.52	19.50	19.50	1.56	17.21	17.21	1.59	14.94	14.94	1.61	12.72	12.72	1.62
	63* (17.2)	24.24	18.95	1.47	21.66	16.32	1.52	19.15	13.79	1.56	16.68	11.35	1.60	14.28	9.02	1.62	11.96	6.80	1.63
	67 (19.4)	26.09	19.78	1.45	23.31	17.06	1.50	20.60	14.43	1.55	17.95	11.90	1.59	15.36	9.47	1.61	12.87	7.16	1.62
	72 (22.2)	28.69	15.67	1.42	25.62	13.42	1.48	22.63	11.27	1.53	19.71	9.21	1.57	16.86	7.26	1.60	14.12	5.44	1.61

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

030 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
875	57 (13.8)	30.54	30.54	1.97	28.11	28.11	2.15	25.68	25.68	2.35	23.24	23.24	2.57	20.78	20.78	2.83	18.33	18.33	3.12
	62 (16.6)	31.60	26.39	1.98	28.82	24.96	2.15	26.06	23.52	2.35	23.34	23.16	2.57	20.81	20.81	2.83	18.36	18.36	3.12
	63* (17.2)	32.20	21.56	1.98	29.34	20.29	2.16	26.51	19.02	2.36	23.69	17.75	2.58	20.88	16.46	2.83	18.12	15.18	3.11
	67 (19.4)	34.66	22.38	2.01	31.55	21.07	2.19	28.49	19.77	2.38	25.45	18.47	2.60	22.42	17.16	2.85	19.45	15.86	3.13
	72 (22.2)	38.04	18.28	2.05	34.61	17.09	2.22	31.23	15.91	2.42	27.87	14.73	2.64	24.55	13.55	2.89	21.31	12.39	3.16
1000	57 (13.8)	31.92	31.92	2.01	29.32	29.32	2.19	26.74	26.74	2.39	24.16	24.16	2.61	21.55	21.55	2.87	18.97	18.97	3.15
	62 (16.6)	32.39	28.44	2.01	29.52	26.89	2.19	26.78	26.78	2.39	24.19	24.19	2.61	21.58	21.58	2.87	18.99	18.99	3.15
	63* (17.2)	32.92	23.02	2.02	29.95	21.68	2.19	27.01	20.35	2.39	24.10	19.02	2.61	21.21	17.67	2.86	18.37	16.33	3.14
	67 (19.4)	35.39	23.93	2.04	32.18	22.57	2.22	29.00	21.20	2.42	25.86	19.84	2.64	22.74	18.46	2.88	19.70	17.10	3.16
	72 (22.2)	38.82	19.27	2.08	35.26	18.03	2.26	31.76	16.81	2.46	28.30	15.59	2.67	24.87	14.37	2.92	21.55	13.17	3.19
1125	57 (13.8)	33.07	33.07	2.05	30.34	30.34	2.23	27.63	27.63	2.43	24.91	24.91	2.65	22.18	22.18	2.90	19.49	19.49	3.19
	62 (16.6)	33.13	33.13	2.05	30.38	30.38	2.23	27.67	27.67	2.43	24.94	24.94	2.65	22.21	22.21	2.90	19.51	19.51	3.19
	63* (17.2)	33.47	24.42	2.05	30.41	23.02	2.23	27.40	21.64	2.42	24.41	20.24	2.64	21.46	18.84	2.89	18.57	17.42	3.17
	67 (19.4)	35.96	25.44	2.08	32.64	24.00	2.25	29.39	22.58	2.45	26.17	21.16	2.67	22.98	19.72	2.91	19.90	18.28	3.19
	72 (22.2)	39.41	20.21	2.12	35.75	18.94	2.29	32.16	17.68	2.49	28.60	16.42	2.71	25.11	15.17	2.95	21.72	13.93	3.22

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

036 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
785	57 (13.8)	25.86	25.86	1.54	23.52	23.52	1.64	21.19	21.19	1.74	18.89	18.89	1.84	16.59	16.59	1.93	14.33	14.33	2.02
	62 (16.6)	26.33	24.60	1.54	23.73	22.02	1.64	21.23	21.23	1.74	18.92	18.92	1.84	16.62	16.62	1.93	14.35	14.35	2.02
	63* (17.2)	26.84	19.92	1.53	24.16	17.75	1.64	21.53	15.63	1.74	18.93	13.59	1.84	16.37	11.61	1.94	13.88	9.71	2.03
	67 (19.4)	28.92	20.73	1.51	26.02	18.48	1.62	23.18	16.30	1.72	20.39	14.19	1.82	17.65	12.15	1.92	14.97	10.19	2.02
	72 (22.2)	31.81	16.77	1.48	28.62	14.85	1.59	25.50	13.00	1.70	22.43	11.22	1.80	19.42	9.51	1.90	16.49	7.89	2.00
900	57 (13.8)	27.03	27.03	1.55	24.55	24.55	1.65	22.09	22.09	1.75	19.65	19.65	1.85	17.23	17.23	1.94	14.84	14.84	2.03
	62 (16.6)	27.07	27.07	1.55	24.59	24.59	1.65	22.12	22.12	1.75	19.68	19.68	1.85	17.25	17.25	1.94	14.86	14.86	2.03
	63* (17.2)	27.41	21.37	1.55	24.64	19.06	1.65	21.93	16.82	1.75	19.25	14.64	1.85	16.63	12.53	1.95	14.08	10.51	2.04
	67 (19.4)	29.51	22.28	1.53	26.52	19.89	1.63	23.59	17.58	1.74	20.72	15.32	1.84	17.90	13.15	1.94	15.16	11.05	2.03
	72 (22.2)	32.43	17.75	1.50	29.14	15.74	1.61	25.92	13.80	1.71	22.76	11.93	1.82	19.67	10.14	1.92	16.67	8.43	2.01
1010	57 (13.8)	27.98	27.98	1.56	25.37	25.37	1.66	22.80	22.80	1.76	20.25	20.25	1.86	17.72	17.72	1.95	15.24	15.24	2.04
	62 (16.6)	28.02	28.02	1.56	25.41	25.41	1.66	22.83	22.83	1.76	20.28	20.28	1.86	17.75	17.75	1.95	15.25	15.25	2.04
	63* (17.2)	27.84	22.71	1.56	24.99	20.28	1.67	22.22	17.92	1.77	19.49	15.62	1.87	16.82	13.38	1.96	14.28	14.28	2.05
	67 (19.4)	29.94	23.73	1.54	26.88	21.21	1.65	23.89	18.76	1.75	20.96	16.38	1.85	18.09	14.07	1.95	15.32	11.82	2.04
	72 (22.2)	32.87	18.66	1.51	29.50	16.57	1.62	26.21	14.55	1.73	22.99	12.60	1.83	19.84	10.73	1.93	16.79	8.94	2.02

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

036 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1050	57 (13.8)	35.86	35.86	2.29	33.72	33.72	2.51	31.52	31.52	2.76	29.26	29.26	3.03	26.89	26.89	3.34	24.47	24.47	3.69
	62 (16.6)	36.94	33.14	2.30	34.42	31.53	2.52	31.86	29.88	2.76	29.31	29.31	3.03	26.93	26.93	3.34	24.51	24.51	3.69
	63* (17.2)	37.62	27.02	2.31	35.04	25.57	2.53	32.41	24.12	2.77	29.71	22.66	3.03	26.94	21.18	3.34	24.13	19.71	3.69
	67 (19.4)	40.43	28.03	2.34	37.63	26.55	2.56	34.79	25.07	2.80	31.86	23.58	3.07	28.87	22.07	3.37	25.86	20.58	3.71
	72 (22.2)	44.31	22.80	2.39	41.22	21.45	2.61	38.07	20.10	2.85	34.86	18.73	3.11	31.58	17.37	3.41	28.28	16.02	3.75
1200	57 (13.8)	37.44	37.44	2.33	35.15	35.15	2.55	32.81	32.81	2.80	30.39	30.39	3.07	27.88	27.88	3.38	25.31	25.31	3.73
	62 (16.6)	37.84	35.72	2.34	35.28	35.09	2.56	32.85	32.85	2.80	30.43	30.43	3.07	27.92	27.92	3.38	25.34	25.34	3.73
	63* (17.2)	38.44	28.86	2.34	35.75	27.35	2.56	33.01	25.83	2.80	30.22	24.30	3.07	27.35	22.75	3.37	24.48	21.21	3.71
	67 (19.4)	41.27	30.00	2.38	38.37	28.45	2.59	35.40	26.90	2.83	32.38	25.34	3.10	29.29	23.77	3.40	26.20	22.20	3.74
	72 (22.2)	45.20	24.05	2.43	41.98	22.65	2.64	38.71	21.25	2.88	35.39	19.85	3.15	32.00	18.44	3.45	28.62	17.05	3.79
1350	57 (13.8)	38.77	38.77	2.37	36.36	36.36	2.59	33.88	33.88	2.84	31.33	31.33	3.11	28.69	28.69	3.42	26.00	26.00	3.76
	62 (16.6)	38.82	38.82	2.37	36.40	36.40	2.59	33.92	33.92	2.84	31.37	31.37	3.11	28.72	28.72	3.42	26.03	26.03	3.76
	63* (17.2)	39.08	30.63	2.38	36.30	29.05	2.59	33.49	27.48	2.83	30.61	25.88	3.10	27.68	24.26	3.40	24.75	22.63	3.74
	67 (19.4)	41.92	31.90	2.41	38.92	30.29	2.63	35.87	28.67	2.86	32.77	27.04	3.13	29.62	25.40	3.43	26.47	23.74	3.77
	72 (22.2)	45.86	25.24	2.46	42.55	23.81	2.68	39.20	22.37	2.92	35.78	20.92	3.18	32.32	19.48	3.48	28.86	18.05	3.81

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

042 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
915	57 (13.8)	30.96	30.96	1.93	28.67	28.67	1.98	26.33	26.33	2.01	23.93	23.93	2.04	21.48	21.48	2.05	19.01	19.01	2.03
	62 (16.6)	31.67	29.10	1.93	29.07	26.30	1.97	26.44	26.27	2.01	23.97	23.97	2.04	21.51	21.51	2.05	19.03	19.03	2.03
	63* (17.2)	32.30	23.63	1.92	29.63	21.25	1.97	26.89	18.92	2.01	24.12	16.63	2.04	21.31	14.41	2.05	18.51	12.28	2.04
	67 (19.4)	34.88	24.60	1.90	31.98	22.15	1.94	29.02	19.73	1.98	26.03	17.38	2.01	23.01	15.09	2.03	20.00	12.89	2.02
	72 (22.2)	38.48	20.01	1.87	35.25	17.89	1.91	31.99	15.82	1.95	28.70	13.81	1.98	25.38	11.87	1.99	22.08	10.03	1.98
1050	57 (13.8)	32.40	32.40	1.95	29.96	29.96	2.00	27.47	27.47	2.03	24.92	24.92	2.05	22.32	22.32	2.06	19.70	19.70	2.04
	62 (16.6)	32.52	32.36	1.95	30.01	30.01	1.99	27.51	27.51	2.03	24.96	24.96	2.05	22.35	22.35	2.06	19.73	19.73	2.04
	63* (17.2)	33.02	25.34	1.95	30.24	22.82	1.99	27.41	20.34	2.03	24.54	17.91	2.06	21.65	15.55	2.07	18.77	13.28	2.06
	67 (19.4)	35.63	26.44	1.93	32.61	23.83	1.97	29.55	21.26	2.01	26.46	18.75	2.03	23.35	16.31	2.04	20.26	13.96	2.03
	72 (22.2)	39.26	21.17	1.89	35.92	18.95	1.93	32.54	16.78	1.97	29.14	14.67	2.00	25.72	12.64	2.01	22.33	10.70	1.99
1180	57 (13.8)	33.57	33.57	1.98	31.00	31.00	2.01	28.38	28.38	2.05	25.70	25.70	2.07	22.99	22.99	2.07	20.25	20.25	2.05
	62 (16.6)	33.62	33.62	1.98	31.04	31.04	2.01	28.42	28.42	2.05	25.74	25.74	2.07	23.02	23.02	2.07	20.27	20.27	2.05
	63* (17.2)	33.55	26.93	1.98	30.68	24.28	2.02	27.77	21.66	2.05	24.85	19.10	2.08	21.90	16.60	2.09	18.99	18.84	2.07
	67 (19.4)	36.17	28.15	1.95	33.07	25.40	1.99	29.92	22.69	2.03	26.76	20.04	2.05	23.60	17.46	2.06	20.46	14.94	2.05
	72 (22.2)	39.84	22.25	1.92	36.39	19.94	1.96	32.92	17.68	1.99	29.44	15.49	2.02	25.95	13.37	2.02	22.49	11.34	2.01

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

042 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1225	57 (13.8)	44.10	44.10	2.67	40.87	40.87	2.95	37.59	37.59	3.27	34.28	34.28	3.63	30.95	30.95	4.03	27.68	27.68	4.47
	62 (16.6)	45.47	38.57	2.68	41.76	36.75	2.96	38.02	34.87	3.28	34.34	34.34	3.63	31.00	31.00	4.03	27.72	27.72	4.47
	63* (17.2)	46.30	31.46	2.69	42.48	29.82	2.97	38.64	28.16	3.28	34.81	26.49	3.64	31.02	24.81	4.03	27.34	23.17	4.46
	67 (19.4)	49.63	32.58	2.71	45.48	30.90	3.00	41.33	29.20	3.32	37.21	27.50	3.67	33.12	25.80	4.06	29.18	24.14	4.49
	72 (22.2)	54.17	26.44	2.75	49.61	24.90	3.04	45.06	23.34	3.36	40.53	21.79	3.72	36.05	20.23	4.11	31.74	18.73	4.54
1400	57 (13.8)	45.98	45.98	2.72	42.52	42.52	3.01	39.03	39.03	3.33	35.52	35.52	3.69	32.01	32.01	4.08	28.56	28.56	4.52
	62 (16.6)	46.52	41.52	2.73	42.71	42.37	3.01	39.08	39.08	3.33	35.57	35.57	3.69	32.04	32.04	4.08	28.59	28.59	4.52
	63* (17.2)	47.25	33.56	2.73	43.28	31.84	3.01	39.30	30.11	3.33	35.35	28.36	3.68	31.44	26.61	4.07	27.67	24.89	4.50
	67 (19.4)	50.58	34.83	2.76	46.29	33.07	3.04	42.00	31.30	3.36	37.75	29.52	3.72	33.55	27.75	4.11	29.50	26.00	4.54
	72 (22.2)	55.17	27.86	2.79	50.45	26.26	3.08	45.74	24.65	3.41	41.08	23.05	3.76	36.47	21.45	4.16	32.06	19.90	4.59
1575	57 (13.8)	47.54	47.54	2.77	43.89	43.89	3.05	40.22	40.22	3.38	36.54	36.54	3.74	32.86	32.86	4.13	29.26	29.26	4.57
	62 (16.6)	47.60	47.60	2.77	43.95	43.95	3.05	40.27	40.27	3.38	36.59	36.59	3.74	32.90	32.90	4.14	29.29	29.29	4.57
	63* (17.2)	47.97	35.58	2.77	43.88	33.79	3.05	39.80	31.99	3.37	35.76	30.17	3.72	31.76	28.34	4.12	27.94	26.51	4.55
	67 (19.4)	51.31	37.00	2.80	46.89	35.17	3.08	42.50	33.33	3.40	38.15	31.48	3.76	33.86	29.62	4.15	29.75	27.77	4.58
	72 (22.2)	55.92	29.22	2.84	51.07	27.57	3.12	46.25	25.93	3.45	41.47	24.28	3.81	36.77	22.64	4.20	32.27	21.05	4.63

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

048 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1050	57 (13.8)	35.18	35.18	2.15	32.65	32.65	2.21	30.08	30.08	2.26	27.45	27.45	2.29	24.76	24.76	2.29	22.01	22.01	2.26
	62 (16.6)	35.89	33.38	2.14	32.99	30.42	2.21	30.13	30.13	2.26	27.49	27.49	2.29	24.80	24.80	2.29	22.04	22.04	2.25
	63* (17.2)	36.62	27.06	2.14	33.64	24.54	2.21	30.61	22.07	2.26	27.55	19.66	2.29	24.45	17.30	2.29	21.33	15.03	2.26
	67 (19.4)	39.58	28.19	2.11	36.35	25.60	2.19	33.07	23.05	2.24	29.78	20.56	2.28	26.42	18.13	2.28	23.06	15.78	2.25
	72 (22.2)	43.68	22.88	2.08	40.10	20.63	2.16	36.50	18.44	2.22	32.85	16.30	2.26	29.17	14.23	2.26	25.49	12.25	2.24
1200	57 (13.8)	36.76	36.76	2.18	34.07	34.07	2.25	31.32	31.32	2.29	28.53	28.53	2.32	25.68	25.68	2.32	22.77	22.77	2.28
	62 (16.6)	36.82	36.82	2.18	34.12	34.12	2.25	31.37	31.37	2.29	28.58	28.58	2.32	25.71	25.71	2.32	22.80	22.80	2.28
	63* (17.2)	37.37	28.96	2.18	34.28	26.30	2.25	31.15	23.69	2.30	27.99	21.13	2.32	24.79	18.64	2.32	21.59	16.21	2.29
	67 (19.4)	40.36	30.24	2.15	37.01	27.49	2.23	33.63	24.79	2.28	30.21	22.14	2.31	26.77	19.57	2.31	23.32	17.07	2.28
	72 (22.2)	44.51	24.17	2.12	40.80	21.82	2.20	37.07	19.52	2.26	33.30	17.29	2.29	29.52	15.13	2.29	25.74	13.06	2.26
1310	57 (13.8)	37.76	37.76	2.21	34.95	34.95	2.27	32.10	32.10	2.32	29.20	29.20	2.34	26.23	26.23	2.34	23.23	23.23	2.30
	62 (16.6)	37.81	37.81	2.21	35.00	35.00	2.27	32.15	32.15	2.32	29.24	29.24	2.34	26.27	26.27	2.34	23.26	23.26	2.30
	63* (17.2)	37.81	30.32	2.21	34.64	27.55	2.28	31.45	24.84	2.32	28.23	22.18	2.35	24.98	19.58	2.34	21.76	21.62	2.31
	67 (19.4)	40.80	31.70	2.19	37.39	28.84	2.26	33.93	26.03	2.31	30.46	23.28	2.33	26.96	20.59	2.33	23.47	17.97	2.29
	72 (22.2)	44.98	25.09	2.15	41.19	22.67	2.23	37.37	20.30	2.28	33.55	18.00	2.31	29.70	15.77	2.32	25.85	13.64	2.28

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

048 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1400	57 (13.8)	48.89	48.89	3.11	45.66	45.66	3.41	42.38	42.38	3.75	39.05	39.05	4.13	35.68	35.68	4.55	32.30	32.30	4.99
	62 (16.6)	50.28	43.47	3.12	46.51	41.71	3.42	42.75	39.90	3.76	39.11	39.11	4.13	35.73	35.73	4.55	32.34	32.34	4.99
	63* (17.2)	51.23	35.39	3.13	47.37	33.80	3.43	43.48	32.17	3.77	39.57	30.53	4.14	35.65	28.86	4.54	31.78	27.20	4.98
	67 (19.4)	55.12	36.75	3.16	50.93	35.12	3.46	46.72	33.47	3.80	42.50	31.80	4.17	38.27	30.11	4.58	34.10	28.42	5.02
	72 (22.2)	60.49	29.87	3.21	55.87	28.34	3.51	51.22	26.80	3.84	46.58	25.25	4.22	41.93	23.68	4.62	37.37	22.12	5.06
1600	57 (13.8)	51.01	51.01	3.18	47.56	47.56	3.48	44.07	44.07	3.83	40.53	40.53	4.20	36.95	36.95	4.62	33.37	33.37	5.06
	62 (16.6)	51.47	46.83	3.18	47.65	47.65	3.49	44.13	44.13	3.83	40.59	40.59	4.20	37.00	37.00	4.62	33.41	33.41	5.06
	63* (17.2)	52.30	37.79	3.19	48.28	36.13	3.49	44.24	34.44	3.83	40.20	32.73	4.20	36.15	30.99	4.60	32.18	29.26	5.04
	67 (19.4)	56.21	39.32	3.23	51.86	37.62	3.53	47.50	35.90	3.86	43.13	34.16	4.23	38.77	32.40	4.64	34.50	30.65	5.07
	72 (22.2)	61.65	31.49	3.27	56.85	29.91	3.57	52.04	28.32	3.91	47.24	26.72	4.28	42.45	25.11	4.68	37.76	23.52	5.11
1750	57 (13.8)	52.37	52.37	3.23	48.78	48.78	3.54	45.15	45.15	3.88	41.47	41.47	4.25	37.75	37.75	4.66	34.04	34.04	5.11
	62 (16.6)	52.45	52.45	3.23	48.85	48.85	3.54	45.21	45.21	3.88	41.52	41.52	4.26	37.79	37.79	4.66	34.08	34.08	5.11
	63* (17.2)	52.92	39.53	3.24	48.81	37.82	3.54	44.68	36.08	3.87	40.56	34.32	4.24	36.44	32.53	4.65	32.42	30.72	5.08
	67 (19.4)	56.86	41.19	3.27	52.41	39.44	3.57	47.95	37.67	3.91	43.50	35.88	4.28	39.06	34.07	4.68	34.73	32.25	5.12
	72 (22.2)	62.33	32.67	3.32	57.41	31.06	3.62	52.50	29.43	3.95	47.61	27.80	4.32	42.73	26.16	4.72	37.97	24.55	5.15

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

060 Low Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW	Capacity MBtuh		Total Syst KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1200	57 (13.8)	42.50	42.50	2.61	41.54	41.54	2.64	40.36	40.36	2.63	38.87	38.87	2.59	37.03	37.03	2.49	34.82	34.82	2.34
	62 (16.6)	43.53	40.01	2.61	42.15	38.49	2.64	40.55	40.24	2.63	38.94	38.94	2.59	37.09	37.09	2.49	34.87	34.87	2.34
	63* (17.2)	44.37	32.51	2.61	42.92	31.12	2.63	41.20	29.70	2.63	39.14	28.21	2.59	36.69	26.66	2.49	33.85	25.05	2.34
	67 (19.4)	47.96	33.87	2.59	46.38	32.46	2.62	44.50	31.00	2.62	42.28	29.49	2.58	39.65	27.93	2.49	36.60	26.30	2.33
	72 (22.2)	52.94	27.58	2.56	51.15	26.23	2.60	49.07	24.86	2.60	46.63	23.45	2.57	43.75	21.98	2.48	40.44	20.47	2.33
1370	57 (13.8)	44.36	44.36	2.67	43.29	43.29	2.69	41.98	41.98	2.68	40.36	40.36	2.63	38.36	38.36	2.53	35.98	35.98	2.37
	62 (16.6)	44.59	44.18	2.67	43.36	43.36	2.69	42.05	42.05	2.68	40.42	40.42	2.63	38.42	38.42	2.53	36.03	36.03	2.37
	63* (17.2)	45.25	34.73	2.67	43.69	33.28	2.69	41.88	31.80	2.68	39.71	30.26	2.63	37.17	28.64	2.53	34.23	26.95	2.37
	67 (19.4)	48.88	36.25	2.65	47.18	34.77	2.68	45.19	33.26	2.67	42.87	31.70	2.62	40.13	30.07	2.53	36.99	28.37	2.37
	72 (22.2)	53.90	29.08	2.62	52.00	27.69	2.65	49.80	26.28	2.65	47.23	24.83	2.61	44.23	23.32	2.52	40.79	21.77	2.36
1545	57 (13.8)	45.96	45.96	2.73	44.78	44.78	2.75	43.35	43.35	2.73	41.59	41.59	2.67	39.46	39.46	2.57	36.92	36.92	2.40
	62 (16.6)	46.03	46.03	2.73	44.84	44.84	2.75	43.41	43.41	2.73	41.65	41.65	2.67	39.51	39.51	2.57	36.97	36.97	2.40
	63* (17.2)	45.92	36.92	2.73	44.29	35.42	2.75	42.38	33.88	2.73	40.14	32.27	2.68	37.53	30.58	2.57	34.57	34.35	2.41
	67 (19.4)	49.57	38.62	2.71	47.78	37.08	2.73	45.71	35.51	2.72	43.29	33.88	2.67	40.48	32.18	2.57	37.28	30.36	2.40
	72 (22.2)	54.62	30.56	2.69	52.62	29.14	2.71	50.31	27.69	2.71	47.64	26.20	2.66	44.54	24.66	2.56	40.98	23.08	2.39

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

060 High Cool

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW	Capacity MBtuh		Total Sys KW
		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens		Total	Sens	
1750	57 (13.8)	58.66	58.66	3.81	55.57	55.57	4.17	52.33	52.33	4.58	48.92	48.92	5.04	45.32	45.32	5.57	41.58	41.58	6.16
	62 (16.6)	59.85	53.13	3.82	56.20	51.25	4.17	52.51	52.25	4.58	48.99	48.99	5.05	45.37	45.37	5.57	41.63	41.63	6.16
	63* (17.2)	60.83	43.11	3.82	57.05	41.43	4.18	53.16	39.70	4.58	49.10	37.91	5.04	44.88	36.06	5.56	40.58	34.17	6.13
	67 (19.4)	65.32	44.77	3.86	61.22	43.05	4.22	57.00	41.30	4.63	52.61	39.48	5.10	48.03	37.60	5.62	43.40	35.70	6.20
	72 (22.2)	71.52	36.12	3.90	67.01	34.50	4.27	62.34	32.84	4.69	57.48	31.12	5.17	52.44	29.35	5.70	47.35	27.57	6.29
2000	57 (13.8)	60.99	60.99	3.90	57.68	57.68	4.26	54.22	54.22	4.68	50.58	50.58	5.15	46.74	46.74	5.68	42.79	42.79	6.27
	62 (16.6)	61.23	60.84	3.90	57.75	57.75	4.26	54.29	54.29	4.68	50.64	50.64	5.15	46.80	46.80	5.68	42.83	42.83	6.27
	63* (17.2)	61.92	45.99	3.91	57.99	44.25	4.26	53.95	42.45	4.67	49.76	40.60	5.13	45.40	38.65	5.65	41.00	36.66	6.22
	67 (19.4)	66.43	47.87	3.94	62.19	46.10	4.30	57.80	44.27	4.72	53.27	42.39	5.19	48.55	40.42	5.71	43.81	38.42	6.29
	72 (22.2)	72.71	38.07	3.98	68.00	36.40	4.35	63.17	34.70	4.78	58.16	32.94	5.26	52.95	31.12	5.79	47.73	29.31	6.37
2250	57 (13.8)	62.91	62.91	3.99	59.42	59.42	4.35	55.76	55.76	4.77	51.93	51.93	5.25	47.89	47.89	5.78	43.74	43.74	6.37
	62 (16.6)	62.99	62.99	3.99	59.49	59.49	4.36	55.83	55.83	4.77	51.99	51.99	5.25	47.94	47.94	5.78	43.79	43.79	6.37
	63* (17.2)	62.73	48.75	3.99	58.69	46.95	4.35	54.54	45.08	4.76	50.24	43.14	5.22	45.80	41.08	5.73	41.35	38.84	6.30
	67 (19.4)	67.27	50.85	4.02	62.89	49.01	4.39	58.40	47.12	4.80	53.75	45.15	5.27	48.94	43.08	5.80	44.15	40.88	6.38
	72 (22.2)	73.56	39.95	4.06	68.73	38.24	4.43	63.76	36.50	4.86	58.61	34.70	5.34	53.29	32.85	5.87	47.96	31.01	6.46

See Legend and Notes on Page 26.

PERFORMANCE DATA (CONT)

* At 75°F (24°C) entering dry bulb–Tennessee Valley Authority (TVA) rating conditions; all others at 80°F (27°C) dry bulb.

LEGEND

BF— Bypass Factor
edb— Entering Dry–Bulb
Ewb— Entering Wet–Bulb
kW — Total Unit Power Input
SHC— Sensible Heat Capacity (1000 Btuh)
TC — Total Capacity (1000 Btuh) (net)
rh—Relative Humidity

COOLING NOTES:

1. Ratings are net; they account for the effects of the evaporator–fan motor power and heat.
2. Direct interpolation is permissible. Do not extrapolate.
3. The following formulas may be used:

$$^{t}ldb = {}^{t}edb - \frac{\text{Sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

$$^{t}lwb = \begin{matrix}\text{Wet–bulb temperature corresponding to enthalpy} \\ \text{air leaving evaporator coil } (^{h}lwb)\end{matrix}$$

$$^{h}lwb = {}^{h}ewb - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: ^{h}ewb = Enthalpy of air entering evaporator coil

4. The SHC is based on 805 F (26.6°C) edb temperature of air entering evaporator coil. Below 80°F (26.6°C) edb, subtract (corr factor x cfm) from SHC.
Above 80° F (26.6°C) edb, add (corr factor x cfm) to SHC.
Correction Factor = 1.10 x (1 + BF) x (edb – 80).
5. Integrated capacity is maximum (instantaneous) capacity less the effect of frost on the outdoor coil and the heat required to defrost it.

PERFORMANCE DATA (CONT)

GAS ADJUSTMENT

Natural Gas Orifice Sizes and Manifold Pressure 208/230VAC Models

Nameplate Input, High Stage (Btu/hr)		ALTITUDE OF INSTALLATION (FT. [m] ABOVE SEA LEVEL) U.S.A.*				
		0 to 2000 [0 to 610]	2001 to 3000* [610 to 914]	3001 to 4000 [915 to 1219]	4001 to 5000 [1220 to 1524]	5001 to 6000 [1524 to 1829]
40000	Orifice No. (Qty)	44 (2)	45 (2)†	48 (2)†	48 (2)†	48 (2)†
	Manifold Press. High / Low (in. W.C.)	3.2 /1.4	3.2 /1.4	3.8 /1.6	3.5 /1.5	3.2 /1.4
60000	Orifice No. (Qty)	44 (3)	45 (3)†	48 (3)†	48 (3)†	48 (3)†
	Manifold Press. High / Low (in. W.C.)	3.2 /1.4	3.2 /1.4	3.8 /1.6	3.5 /1.5	3.2 /1.4
90000	Orifice No. (Qty)	38 (3)	41 (3)†	41 (3)†	42 (3)†	42 (3)†
	Manifold Press. High / Low (in. W.C.)	3.6 /1.6	3.8 /1.6	3.4 /1.5	3.4 /1.5	3.2 /1.4
115000	Orifice No. (Qty)	33 (3)	36 (3)†	36 (3)†	36 (3)†	38 (3)†
	Manifold Press. High / Low (in. W.C.)	3.8 /1.7	3.8 /1.7	3.6 /1.6	3.3 /1.4	3.6 /1.5
127000 (1–Phase)	Orifice No. (Qty)	31 (3)	31 (3)	33 (3)†	33 (3)†	34 (3)†
	Manifold Press. High / Low (in. W.C.)	3.7 /1.7	3.2 /1.4	3.5 /1.6	3.2 /1.4	3.2 /1.4
130000 (3–Phase)	Orifice No. (Qty)	31 (3)	31 (3)	33 (3)†	33 (3)†	34 (3)†
	Manifold Press. High / Low (in. W.C.)	3.8 /1.7	3.2 /1.4	3.7 /1.6	3.4 /1.4	3.3 /1.4

Natural Gas Orifice Sizes and Manifold Pressure 460V

Nameplate Input (Btu/hr)		ALTITUDE OF INSTALLATION (FT. ABOVE SEA LEVEL) U.S.A.*				
		0 to 2000 (0–610 m)	2001 to 3000* (611 to 914 m)	3001 to 4000 (915 to 1219 m)	4001 to 5000 (1220 to 1524 m)	5001 to 6000 (1524 to 1829 m)
60000	Orifice No. (Qty)	38 (2)	41 (2)†	41 (2)†	42 (2)†	42 (2)†
	Manifold Press. (in. W.C.)	3.6	3.8	3.4	3.4	3.2
90000	Orifice No. (Qty)	38 (3)	41 (3)†	41 (3)†	42 (3)†	42 (3)†
	Manifold Press. (in. W.C.)	3.6	3.8	3.4	3.4	3.2
115000	Orifice No. (Qty)	33 (3)	36 (3)†	36 (3)†	36 (3)†	38 (3)†
	Manifold Press. (in. W.C.)	3.8	3.8	3.6	3.3	3.6
130000	Orifice No. (Qty)	31 (3)	31 (3)	33 (3)†	33 (3)†	34 (3)†
	Manifold Press. (in. W.C.)	3.8	3.2	3.7	3.4	3.3

*In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft, use U.S.A. column 2001 to 3000 ft (610 to 914 m).
† Orifices available through your distributor.
NOTE: Orifice sizes and manifold pressure settings are based on natural gas with a heating value of 1025 Btu/ft^3 and a specific gravity of .6.

Propane Gas Orifice Sizes and Manifold Pressure 208/230VAC Models

Nameplate Input, High Stage (Btu/hr)		ALTITUDE OF INSTALLATION (FT. ABOVE SEA LEVEL) U.S.A.*†				
		0 to 2000 [0 to 610]	2001 to 3000* [610 to 914]	3001 to 4000 [915 to 1219]	4001 to 5000 [1220 to 1524]	5001 to 6000 [1524 to 1829]
40000	Orifice No. (Qty)	55 (2)	56 (2)	56 (2)	56 (2)	56 (2)
	Manifold Press. High / Low (in. W.C.)	10.0/5.0	11.0/6.0	11.0/5.5	11.0/5.0	10.7/4.8
60000	Orifice No. (Qty)	55 (3)	56 (3)	56 (3)	56 (3)	56 (3)
	Manifold Press. High / Low (in. W.C.)	10.0/5.0	11.0/6.0	11.0/5.5	11.0/5.0	10.7/4.8
90000	Orifice No. (Qty)	53 (3)	54 (3)	54 (3)	54 (3)	54 (3)
	Manifold Press. High / Low (in. W.C.)	10.0/5.4	11.0/6.4	11.0/5.9	11.0/5.4	11.0/5.0
115000	Orifice No. (Qty)	51 (3)	52 (3)	52 (3)	53 (3)	53 (3)
	Manifold Press. High / Low (in. W.C.)	10.0/5.4	11.0/5.0	10.6/4.8	11.0/6.1	11.0/5.5
127000 (1–Phase) or 130000 (3–Phase)	Orifice No. (Qty)	49 (3)	50 (3)	51 (3)	52 (3)	52 (3)
	Manifold Press. High / Low (in. W.C.)	10.0/5.4	11.0/4.8	11.0/4.9	11.0/5.2	11.0/5.0

*In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft, use U.S.A. column 2001 to 3000 ft (610 to 914 m).
† Use Kit No. CPLPCONV013C00 (0–2000 ft [0–610 m] above sea level. Use Kit No. CPLPCONV014C00 (2001–6000 ft [611–1829 m] above sea level.

PERFORMANCE DATA (CONT)

Propane Gas Orifice Sizes and Manifold Pressure
460V

Nameplate Input (Btu/hr)		ALTITUDE OF INSTALLATION (FT. ABOVE SEA LEVEL) U.S.A.*				
		0 to 2000 (0–610 m)	2001 to 3000* (611 to 914 m)	3001 to 4000 (915 to 1219 m)	4001 to 5000 (1220 to 1524 m)	5001 to 6000 (1524 to 1829 m)
60000	Orifice No. (Qty)	53 (2)	54 (2)	54 (2)	54 (2)	54 (2)
	Manifold Press. (IN. W.C.)	10.0	11.0	11.0	11.0	11.0
90000	Orifice No. (Qty)	53 (3)	54 (3)	54 (3)	54 (3)	54 (3)
	Manifold Press. (IN. W.C.)	10.0	11.0	11.0	11.0	11.0
115000	Orifice No. (Qty)	51 (3)	52 (3)	52 (3)	53 (3)	53 (3)
	Manifold Press. (IN. W.C.)	10.0	11.0	10.6	11.0	11.0
130000	Orifice No. (Qty)	49 (3)	50 (3)	51 (3)	52 (3)	52 (3)
	Manifold Press. (IN. W.C.)	10.0	11.0	11.0	11.0	11.0

In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft (610–1372 m), use U.S.A. column 2001 to 3000 ft (611 to 914 m).
†Use Kit No. CPLPCONV013(B,C)00 (0–2000 ft [0–610 m] above sea level). Use Kit No. CPLPCONV014(B,C)00 (2001–6000 ft [611–1829 m] above sea level).

High Altitude Compensation: Natural Gas
208/230VAC Models

Nameplate Input, High Stage (Btu/hr)	Rated Heating Input (Btu/hr), Natural Gas at Installation Altitude Above Sea Level, U.S.A.*									
	0 to 2000 ft 0 to 610 m		2001 to 3000 ft* 610 to 914 m		3001 to 4000 ft 915 to 1219 m		4001 to 5000 ft 1220 to 1524 m		5001 to 6000 ft 1524 to 1829 m	
	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage
40000	40000	26000	36000	23400	34400	22300	32800	21300	31200	20300
60000	60000	39000	54000	35100	51600	33500	49200	32000	46800	30400
90000	90000	58500	81000	52700	77400	50300	73800	48000	70200	45600
115000	115000	75000	103500	67500	98900	64500	94300	61500	89700	58500
127000 (1–Phase)	127000	84500	114300	76100	109200	72700	104100	69300	99100	65900
130000 (3–Phase)	130000	84500	117000	76100	111800	72700	106600	69300	101400	65900

High Altitude Compensation, Natural Gas
460V

Nameplate Input (Btu/hr)	Rated Heating Input (Btu/hr), Natural Gas at Installation Altitude Above Sea Level, U.S.A.*				
	0 to 2000 ft (0–610 m)	2001 to 3000 ft* (611 to 914 m)	3001 to 4000 ft (915 to 1219 m)	4001 to 5000 ft (1220 to 1524 m)	5001 to 6000 ft (1524 to 1829 m)
60000	60000	54000	51600	49200	46800
90000	90000	81000	77400	73800	70200
115000	115000	103500	98900	94300	89700
130000	130000	117000	111800	106600	101400

*In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above Sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft (610–1372 m), use U.S.A. column 2001 to 3000 ft (611 to 914 m).

High Altitude Compensation: Propane Gas
208/230VAC Models

Nameplate Input, High Stage (Btu/hr)	Rated Heating Input (Btu/hr), LP Gas at Installation Altitude Above Sea Level, U.S.A.*									
	0 to 2000 ft 0 to 610 m		2001 to 3000 ft* 610 to 914 m		3001 to 4000 ft 915 to 1219 m		4001 to 5000 ft 1220 to 1524 m		5001 to 6000 ft 1524 to 1829 m	
	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage	High Stage	Low Stage
40000	38000	26000	31700	23400	31700	22300	31700	21300	31200	20300
60000	57000	39000	47500	35100	47500	33500	47500	32000	46800	30400
90000	79000	58500	68900	52700	68900	50300	68600	48000	68600	45600
115000	103000	75000	100400	67500	98900	64500	83000	61500	83000	58500
127000 (1–Phase) or 130000 (3–Phase)	116000	84500	115500	76100	111800	72700	101300	69300	100400	65900

*In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft (610–1372 m), use U.S.A. column 2001 to 3000 ft (611 to 914 m).

High Altitude Compensation, Propane Gas
460V

Nameplate Input (Btu/hr)	Rated Heating Input (Btu/hr), Propane Gas at Installation Altitude Above Sea Level, U.S.A.*				
	0 to 2000 ft (0–610 m)	2001 to 3000 ft* (611 to 914 m)	3001 to 4000 ft (915 to 1219 m)	4001 to 5000 ft (1220 to 1524 m)	5001 to 6000 ft (1524 to 1829 m)
60000	53000	45900	45900	45800	45800
90000	79000	68900	68900	68600	68600
115000	103000	100400	98900	83000	83000
130000	116000	115500	111800	101300	100400

*In the U.S.A., the input rating for altitudes above 2000 ft (610m) must be reduced by 4% for each 1000 ft (305 m) above sea level.
In Canada, the input rating for altitudes from 2001 to 4500 ft (611 to 1372 m) above sea level must be derated by 10% by an authorized gas conversion station or dealer.
For Canadian Installations from 2000 to 4500 ft (610–1372 m), use U.S.A. column 2001 to 3000 ft (611 to 914 m).

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
24040	25 - 55ºF Low Stage, 25 - 55ºF High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	27 (15)	37 (21)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	42 (23)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	689	597	489	352	---	---	---	---	---	---
				BHP	0.08	0.06	0.06	0.05	---	---	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	28 (16)	33 (18)	40 (22)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	43 (24)	50 (28)	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	743	694	628	563	497	426	300	---	---	---
				BHP	0.12	0.13	0.13	0.13	0.14	0.15	0.15	---	---	---
				Low Stage Heat Rise ºF (ºC)	26 (15)	28 (16)	31 (17)	35 (19)	39 (22)	46 (25)	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	40 (22)	43 (24)	48 (26)	53 (30)	NA	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	921	829	754	663	582	485	371	---	---	---
				BHP	0.14	0.14	0.15	0.16	0.17	0.17	0.18	---	---	---
				Low Stage Heat Rise ºF (ºC)	NA	NA	26 (14)	29 (16)	34 (19)	40 (22)	53 (29)	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	33 (18)	36 (20)	40 (22)	45 (25)	51 (29)	NA	NA	NA	NA	NA
		High	Black	CFM	1291	1206	1142	1081	1017	951	888	823	753	668
				BHP	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.36	0.37	0.37
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	26 (14)	29 (16)
				High Stage Heat Rise ºF (ºC)	NA	25 (14)	26 (15)	28 (15)	29 (16)	31 (17)	34 (19)	36 (20)	40 (22)	45 (25)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
24060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	41 (23)	55 (31)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	689	597	489	352	---	---	---	---	---	---
				BHP	0.08	0.06	0.06	0.05	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	43 (24)	49 (27)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	921	829	754	663	582	485	371	---	---	---
				BHP	0.14	0.14	0.15	0.16	0.17	0.17	0.18	---	---	---
				Low Stage Heat Rise °F (°C)	32 (18)	36 (20)	39 (22)	44 (25)	51 (28)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	49 (27)	55 (30)	NA	NA	NA	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1229	1171	1105	1049	980	913	838	775	679	516
				BHP	0.28	0.30	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.33
				Low Stage Heat Rise °F (°C)	NA	25 (14)	27 (15)	28 (16)	30 (17)	32 (18)	35 (20)	38 (21)	43 (24)	NA
				High Stage Heat Rise °F (°C)	37 (20)	39 (21)	41 (23)	43 (24)	46 (26)	50 (28)	54 (30)	NA	NA	NA
		High	Black	CFM	1291	1206	1142	1081	1017	951	888	823	753	668
				BHP	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.36	0.37	0.37
				Low Stage Heat Rise °F (°C)	NA	NA	26 (14)	27 (15)	29 (16)	31 (17)	33 (18)	36 (20)	39 (22)	44 (24)
				High Stage Heat Rise °F (°C)	35 (19)	37 (21)	40 (22)	42 (23)	44 (25)	48 (26)	51 (28)	55 (31)	NA	NA

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
30040	25 - 55ºF Low Stage, 25 - 55ºF High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	27 (15)	37 (21)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	831	765	670	586	466	299	---	---	---	---
				BHP	0.11	0.12	0.12	0.13	0.13	0.14	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	NA	26 (14)	29 (16)	33 (19)	42 (23)	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	36 (20)	39 (22)	45 (25)	51 (28)	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	831	765	670	586	466	299	---	---	---	---
				BHP	0.11	0.12	0.12	0.13	0.13	0.14	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	NA	26 (14)	29 (16)	33 (19)	42 (23)	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	36 (20)	39 (22)	45 (25)	51 (28)	NA	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	1139	1069	1012	937	870	786	724	626	512	381
				BHP	0.22	0.23	0.24	0.24	0.25	0.26	0.26	0.27	0.27	0.28
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	25 (14)	27 (15)	31 (17)	38 21)	51 (28)
				High Stage Heat Rise ºF (ºC)	26 (15)	28 (16)	30 (16)	32 (18)	34 (19)	38 (21)	41 (23)	48 (27)	NA	NA
		High	Black	CFM	1531	1460	1382	1301	1209	1114	1003	890	764	629
				BHP	0.53	0.52	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.35
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	26 (14)	31 (17)
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	25 (14)	27 (15)	30 (17)	34 (19)	39 (22)	48 (26)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
30060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	41 (23)	55 (31)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	831	765	670	586	466	299	---	---	---	---
				BHP	0.11	0.12	0.12	0.13	0.13	0.14	---	---	---	---
				Low Stage Heat Rise °F (°C)	35 (20)	38 (21)	44 (24)	50 (28)	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	54 (30)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1139	1069	1012	937	870	786	724	626	512	381
				BHP	0.22	0.23	0.24	0.24	0.25	0.26	0.26	0.27	0.27	0.28
				Low Stage Heat Rise °F (°C)	26 (14)	28 (15)	29 (16)	31 (17)	34 (19)	37 (21)	41 (23)	47 (26)	NA	NA
				High Stage Heat Rise °F (°C)	40 (22)	42 (23)	45 (25)	48 (27)	52 (29)	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1229	1171	1105	1049	980	913	838	775	679	516
				BHP	0.28	0.30	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.33
				Low Stage Heat Rise °F (°C)	NA	25 (14)	27 (15)	28 (16)	30 (17)	32 (18)	35 (20)	38 (21)	43 (24)	NA
				High Stage Heat Rise °F (°C)	37 (20)	39 (21)	41 (23)	43 (24)	46 (26)	50 (28)	54 (30)	NA	NA	NA
		High	Black	CFM	1531	1460	1382	1301	1209	1114	1003	890	764	629
				BHP	0.53	0.52	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.35
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	26 (15)	29 (16)	33 (18)	39 (21)	47 (26)
				High Stage Heat Rise °F (°C)	30 (17)	31 (17)	33 (18)	35 (19)	37 (21)	41 (23)	45 (25)	51 (28)	NA	NA

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
36060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	694	624	533	460	383	328	---	---	---	---
				BHP	0.05	0.05	0.06	0.07	0.07	0.08	---	---	---	---
				Low Stage Heat Rise °F (°C)	42 (24)	47 (26)	55 (31)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise °F (°C)	32 (18)	34 (19)	36 (20)	39 (22)	42 (23)	45 (25)	52 (29)	NA	NA	NA
				High Stage Heat Rise °F (°C)	48 (27)	52 (29)	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Low Stage Heat Rise °F (°C)	NA	25 (14)	27 (15)	28 (15)	29 (16)	31 (17)	32 (18)	34 (19)	36 (20)	38 (21)
				High Stage Heat Rise °F (°C)	37 (21)	39 (21)	41 (23)	42 (24)	45 (25)	47 (26)	49 (27)	51 (29)	55 (31)	NA
		Med-High[2]	Orange	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	25 (14)	26 (14)	27 (15)	28 (15)	29 (16)	30 (17)	32 (18)	33 (18)	35 (19)
				High Stage Heat Rise °F (°C)	36 (20)	38 (21)	39 (22)	41 (23)	42 (24)	44 (25)	47 (26)	49 (27)	51 (28)	54 (30)
		High	Black	CFM	1466	1423	1384	1343	1308	1263	1219	1183	1145	1106
				BHP	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.41
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	25 (14)	26 (14)	27 (15)
				High Stage Heat Rise °F (°C)	31 (17)	32 (18)	33 (18)	34 (19)	35 (19)	36 (20)	37 (21)	38 (21)	39 (22)	41 (23)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
36090	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[3]	Blue	CFM	882	737	665	608	542	496	437	395	339	288
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise ºF (ºC)	50 (28)	60 (33)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise ºF (ºC)	47 (26)	51 (29)	55 (30)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise ºF (ºC)	35 (20)	37 (21)	39 (21)	40 (22)	42 (23)	44 (24)	46 (25)	48 (26)	50 (28)	53 (29)
				High Stage Heat Rise ºF (ºC)	54 (30)	57 (31)	59 (33)	61 (34)	64 (35)	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1359	1311	1267	1224	1187	1140	1095	1058	1019	973
				BHP	0.25	0.26	0.27	0.28	0.29	0.31	0.31	0.33	0.34	0.35
				Low Stage Heat Rise ºF (ºC)	NA	NA	35 (19)	36 (20)	37 (21)	39 (22)	41 (23)	42 (23)	44 (24)	46 (25)
				High Stage Heat Rise ºF (ºC)	50 (28)	52 (29)	54 (30)	55 (31)	57 (32)	60 (33)	62 (34)	64 (36)	NA	NA
		High	Black	CFM	1466	1423	1384	1343	1308	1263	1219	1183	1145	1106
				BHP	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.41
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	35 (20)	36 (20)	38 (21)	39 (22)	40 (22)
				High Stage Heat Rise ºF (ºC)	46 (26)	48 (26)	49 (27)	51 (28)	52 (29)	54 (30)	56 (31)	57 (32)	59 (33)	61 (34)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
42060	25 - 55ºF Low Stage, 25 - 55ºF High Stage	Low[3]	Blue	CFM	694	624	533	460	383	328	---	---	---	---
				BHP	0.05	0.05	0.06	0.07	0.07	0.08	---	---	---	---
				Low Stage Heat Rise ºF (ºC)	42 (24)	47 (26)	55 (31)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Low Stage Heat Rise ºF (ºC)	27 (15)	29 (16)	30 (17)	32 (18)	34 (19)	36 (20)	38 (21)	41 (23)	44 (25)	48 (27)
				High Stage Heat Rise ºF (ºC)	42 (23)	44 (24)	47 (26)	49 (27)	52 (29)	55 (30)	NA	NA	NA	NA
		Medium[4]	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Low Stage Heat Rise ºF (ºC)	NA	25 (14)	27 (15)	28 (15)	29 (16)	31 (17)	32 (18)	34 (19)	36 (20)	38 (21)
				High Stage Heat Rise ºF (ºC)	37 (21)	39 (21)	41 (23)	42 (24)	45 (25)	47 (26)	49 (27)	51 (29)	55 (31)	NA
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	25 (14)	26 (14)	27 (15)
				High Stage Heat Rise ºF (ºC)	31 (17)	32 (18)	33 (18)	34 (19)	35 (20)	36 (20)	37 (21)	39 (22)	40 (22)	41 (23)
		High	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	28 (15)	28 (16)	29 (16)	30 (17)	30 (17)	31 (17)	32 (18)	33 (18)	34 (19)	35 (19)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
42090	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[3]	Blue	CFM	882	737	665	608	542	496	437	395	339	288
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise ºF (ºC)	50 (28)	60 (33)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Low Stage Heat Rise ºF (ºC)	41 (23)	43 (24)	46 (25)	48 (27)	51 (28)	54 (30)	58 (32)	62 (35)	NA	NA
				High Stage Heat Rise ºF (ºC)	62 (35)	65 (36)	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	1359	1311	1267	1224	1187	1140	1095	1058	1019	973
				BHP	0.25	0.26	0.27	0.28	0.29	0.31	0.31	0.33	0.34	0.35
				Low Stage Heat Rise ºF (ºC)	NA	NA	35 (19)	36 (20)	37 (21)	39 (22)	41 (23)	42 (23)	44 (24)	46 (25)
				High Stage Heat Rise ºF (ºC)	50 (28)	52 (29)	54 (30)	55 (31)	57 (32)	60 (33)	62 (34)	64 (36)	NA	NA
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	36 (20)	37 (20)	38 (21)	39 (22)	41 (23)
				High Stage Heat Rise ºF (ºC)	46 (26)	47 (26)	49 (27)	51 (28)	52 (29)	54 (30)	55 (31)	57 (32)	59 (33)	61 (34)
		High	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	41 (23)	42 (23)	43 (24)	44 (25)	45 (25)	46 (26)	48 (27)	49 (27)	50 (28)	51 (29)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48090	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[3]	Blue	CFM	903	820	749	702	645	581	534	468	432	382
				BHP	0.11	0.12	0.12	0.13	0.14	0.14	0.16	0.16	0.17	0.18
				Low Stage Heat Rise ºF (ºC)	49 (27)	54 (30)	59 (33)	63 (35)	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise ºF (ºC)	35 (19)	36 (20)	38 (21)	40 (22)	42 (23)	43 (24)	46 (25)	47 (26)	50 (28)	53 (29)
				High Stage Heat Rise ºF (ºC)	53 (30)	55 (31)	58 (32)	61 (34)	63 (35)	64 (35)	NA	NA	NA	NA
		Medium[4]	Red	CFM	1386	1336	1304	1259	1230	1186	1147	1102	1052	1022
				BHP	0.32	0.33	0.34	0.35	0.36	0.37	0.39	0.39	0.40	0.42
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	35 (20)	36 (20)	37 (21)	39 (21)	40 (22)	42 (23)	43 (24)
				High Stage Heat Rise ºF (ºC)	49 (27)	51 (28)	52 (29)	54 (30)	55 (31)	57 (32)	59 (33)	62 (34)	64 (36)	NA
		Med-High[2]	Orange	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (26)	47 (26)	49 (27)	50 (28)
		High	Black	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	37 (20)	37 (21)	38 (21)	38 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (25)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48115	30 - 60°F Low Stage, 30 - 60°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	45 (25)	46 (26)	48 (27)	51 (28)	53 (30)	55 (31)	58 (32)	60 (33)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	42 (24)	44 (24)	46 (25)	48 (26)	50 (28)	52 (29)	54 (30)	57 (31)	60 (33)	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	34 (19)	34 (19)	35 (19)	36 (20)	37 (20)	38 (21)	39 (21)	40 (22)	41 (23)	42 (23)
				High Stage Heat Rise °F (°C)	51 (29)	52 (29)	54 (30)	55 (31)	56 (31)	58 (32)	59 (33)	60 (34)	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise °F (°C)	31 (17)	31 (17)	32 (18)	32 (18)	33 (18)	33 (19)	34 (19)	35 (19)	36 (20)	37 (21)
				High Stage Heat Rise °F (°C)	47 (26)	47 (26)	49 (27)	49 (27)	50 (28)	51 (28)	52 (29)	53 (30)	55 (30)	57 (31)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	33 (19)	34 (19)	35 (20)	37 (21)
				High Stage Heat Rise °F (°C)	45 (25)	46 (25)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	57 (31)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48130	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise ºF (ºC)	50 (28)	52 (29)	54 (30)	57 (32)	60 (33)	62 (34)	65 (36)	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise ºF (ºC)	48 (26)	49 (27)	51 (29)	54 (30)	56 (31)	58 (32)	61 (34)	64 (35)	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise ºF (ºC)	38 (21)	39 (21)	39 22)	40 (22)	41 (23)	42 (24)	43 (24)	44 (25)	46 (25)	47 (26)
				High Stage Heat Rise ºF (ºC)	57 (32)	58 (32)	59 (33)	61 (34)	62 (34)	64 (35)	65 (36)	NA	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise ºF (ºC)	NA	35 (19)	36 (20)	36 (20)	37 (21)	38 (21)	39 (21)	39 (22)	40 (22)	42 (23)
				High Stage Heat Rise ºF (ºC)	52 (29)	52 (29)	54 (30)	54 (30)	56 (31)	56 (31)	58 (32)	59 (33)	61 (34)	63 (35)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	35 (20)	36 (20)	37 (20)	38 (21)	38 (21)	40 (22)	42 (23)
				High Stage Heat Rise ºF (ºC)	50 (28)	50 (28)	52 (29)	53 (29)	54 (30)	55 (31)	57 (31)	58 (32)	60 (33)	63 (35)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60090	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[3]	Blue	CFM	903	820	749	702	645	581	534	468	432	382
				BHP	0.11	0.12	0.12	0.13	0.14	0.14	0.16	0.16	0.17	0.18
				Low Stage Heat Rise ºF (ºC)	49 (27)	54 (30)	59 (33)	63 (35)	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise ºF (ºC)	35 (19)	36 (20)	38 (21)	40 (22)	42 (23)	43 (24)	46 (25)	47 (26)	50 (28)	53 (29)
				High Stage Heat Rise ºF (ºC)	53 (30)	55 (31)	58 (32)	61 (34)	63 (35)	64 (35)	NA	NA	NA	NA
		Medium[4]	Red	CFM	1386	1336	1304	1259	1230	1186	1147	1102	1052	1022
				BHP	0.32	0.33	0.34	0.35	0.36	0.37	0.39	0.39	0.40	0.42
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	35 (20)	36 (20)	37 (21)	39 (21)	40 (22)	42 (23)	43 (24)
				High Stage Heat Rise ºF (ºC)	49 (27)	51 (28)	52 (29)	54 (30)	55 (31)	57 (32)	59 (33)	62 (34)	64 (36)	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	36 (20)	37 (20)	38 (21)	38 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (25)
		High	Black	CFM	2020	1990	1956	1912	1872	1842	1802	1760	1719	1643
				BHP	0.62	0.63	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.72
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	35 (19)	35 (20)	36 (20)	37 (20)	38 (21)	39 (21)	39 (22)	41 (23)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60115	30 - 60°F Low Stage 30 - 60°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	45 (25)	46 (26)	48 (27)	51 (28)	53 (30)	55 (31)	58 (32)	60 (33)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	42 (24)	44 (24)	46 (25)	48 (26)	50 (28)	52 (29)	54 (30)	57 (31)	60 (33)	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	34 (19)	34 (19)	35 (19)	36 (20)	37 (20)	38 (21)	39 (21)	40 (22)	41 (23)	42 (23)
				High Stage Heat Rise °F (°C)	51 (29)	52 (29)	54 (30)	55 (31)	56 (31)	58 (32)	59 (33)	60 (34)	NA	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise °F (°C)	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	33 (19)	34 (19)	35 (19)	36 (20)	37 (21)
				High Stage Heat Rise °F (°C)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	55 (31)	57 (31)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	33 (19)	34 (19)	35 (20)	37 (21)
				High Stage Heat Rise °F (°C)	45 (25)	46 (25)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	57 (31)

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC SINGLE PHASE MODELS (CONT)

UNIT SIZE	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60130	35 - 65ºF Low Stage, 35 - 65ºF High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise ºF (ºC)	50 (28)	52 (29)	54 (30)	57 (32)	60 (33)	62 (34)	65 (36)	NA	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise ºF (ºC)	48 (26)	49 (27)	51 (29)	54 (30)	56 (31)	58 (32)	61 (34)	64 (35)	NA	NA
				High Stage Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise ºF (ºC)	38 (21)	39 (21)	39 (22)	40 (22)	41 (23)	42 (24)	43 (24)	44 (25)	46 (25)	47 (26)
				High Stage Heat Rise ºF (ºC)	57 (32)	58 (32)	59 (33)	61 (34)	62 (34)	64 (35)	65 (36)	NA	NA	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise ºF (ºC)	NA	35 (19)	35 (20)	36 (20)	37 (20)	38 (21)	39 (21)	39 (22)	41 (23)	42 (23)
				High Stage Heat Rise ºF (ºC)	51 (28)	52 (29)	53 (29)	54 (30)	55 (31)	57 (31)	58 (32)	59 (33)	61 (34)	63 (35)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise ºF (ºC)	NA	NA	NA	35 (20)	36 (20)	37 (20)	38 (21)	38 (21)	40 (22)	42 (23)
				High Stage Heat Rise ºF (ºC)	50 (28)	50 (28)	52 (29)	53 (29)	54 (30)	55 (31)	57 (31)	58 (32)	60 (33)	63 (35)

Notes:

[1] Factory-shipped low stage cooling speed

[2] Factory-shipped high stage cooling speed

[3] Factory-shipped low stage gas heating speed

[4] Factory-shipped high stage gas heating speed

Allowable High Stage Enhanced Dehumidification Cooling Speed

"NA" = Not allowed for particular heating speed

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
24040	15 - 45°F Low Stage, 20 - 50°F High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	26 (15)	36 (20)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	41 (23)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	689	597	489	352	---	---	---	---	---	---
				BHP	0.08	0.06	0.06	0.05	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	27 (15)	31 (17)	38 (21)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	42 (23)	49 (27)	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	877	779	698	598	519	410	---	---	---	---
				BHP	0.12	0.12	0.13	0.14	0.15	0.15	---	---	---	---
				Low Stage Heat Rise °F (°C)	21 (12)	24 (13)	27 (15)	31 (17)	36 (20)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	33 (18)	37 (21)	42 (23)	49 (27)	NA	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	921	829	754	663	582	485	371	---	---	---
				BHP	0.14	0.14	0.15	0.16	0.17	0.17	0.18	---	---	---
				Low Stage Heat Rise °F (°C)	20 (11)	23 (13)	25 (14)	28 (16)	32 (18)	39 (22)	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	32 (18)	35 (20)	39 (21)	44 (24)	50 (28)	NA	NA	NA	NA	NA
		High	Black	CFM	1291	1206	1142	1081	1017	951	888	823	753	668
				BHP	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.36	0.37	0.37
				Low Stage Heat Rise °F (°C)	15 (8)	16 (9)	16 (9)	17 (10)	18 (10)	20 (11)	21 (12)	23 (13)	25 (14)	28 (16)
				High Stage Heat Rise °F (°C)	23 (13)	24 (13)	25 (14)	27 (15)	29 (16)	31 (17)	33 (18)	35 (20)	39 (21)	44 (24)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
24060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[1]	Blue	CFM	689	597	489	352	---	---	---	---	---	---
				BHP	0.08	0.06	0.06	0.05	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	41 (23)	48 (27)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	777	692	583	465	318	---	---	---	---	---
				BHP	0.09	0.10	0.10	0.11	0.12	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	37 (20)	41 (23)	49 (27)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	921	829	754	663	582	485	371	---	---	---
				BHP	0.14	0.14	0.15	0.16	0.17	0.17	0.18	---	---	---
				Low Stage Heat Rise °F (°C)	31 (17)	34 (19)	38 (21)	43 (24)	49 (27)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	48 (27)	54 (30)	NA	NA	NA	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1229	1171	1105	1049	980	913	838	775	679	516
				BHP	0.28	0.30	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.33
				Low Stage Heat Rise °F (°C)	NA	NA	26 (14)	27 (15)	29 (16)	31 (17)	34 (19)	37 (20)	42 (23)	55 (31)
				High Stage Heat Rise °F (°C)	36 (20)	38 (21)	40 (22)	42 (24)	45 (25)	49 (27)	53 (29)	NA	NA	NA
		High	Black	CFM	1291	1206	1142	1081	1017	951	888	823	753	668
				BHP	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.36	0.37	0.37
				Low Stage Heat Rise °F (°C)	NA	NA	25 (14)	26 (15)	28 (16)	30 (17)	32 (18)	35 (19)	38 (21)	43 (24)
				High Stage Heat Rise °F (°C)	34 (19)	37 (20)	39 (22)	41 (23)	44 (24)	47 (26)	50 (28)	54 (30)	NA	NA

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
30040	15 - 45°F Low Stage, 20 - 50°F High Stage	Low[3]	Blue	CFM	714	525	---	---	---	---	---	---	---	---
				BHP	0.08	0.07	---	---	---	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	26 (15)	36 (20)	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	41 (23)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	831	765	670	586	466	299	---	---	---	---
				BHP	0.11	0.12	0.12	0.13	0.13	0.14	---	---	---	---
				Low Stage Heat Rise °F (°C)	23 (13)	25 (14)	28 (16)	32 (18)	40 (22)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	35 (19)	38 (21)	43 (24)	50 (28)	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	877	779	698	598	519	410	---	---	---	---
				BHP	0.12	0.12	0.13	0.14	0.15	0.15	---	---	---	---
				Low Stage Heat Rise °F (°C)	21 (12)	24 (13)	27 (15)	31 (17)	36 (20)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	33 (18)	37 (21)	42 (23)	49 (27)	NA	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	1139	1069	1012	937	870	786	724	626	512	381
				BHP	0.22	0.23	0.24	0.24	0.25	0.26	0.26	0.27	0.27	0.28
				Low Stage Heat Rise °F (°C)	17 (9)	18 (10)	19 (10)	20 (11)	22 (12)	24 (13)	26 (14)	30 (17)	37 (20)	NA
				High Stage Heat Rise °F (°C)	26 (14)	27 (15)	29 (16)	31 (17)	33 (19)	37 (21)	40 (22)	47 (26)	NA	NA
		High	Black	CFM	1531	1460	1382	1301	1209	1114	1003	890	764	629
				BHP	0.53	0.52	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.35
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	16 (9)	17 (9)	19 (10)	21 (12)	25 (14)	30 (17)
				High Stage Heat Rise °F (°C)	NA	20 (11)	21 (12)	22 (12)	24 (13)	26 (15)	29 (16)	33 (18)	38 (21)	46 (26)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
30060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	777	692	583	465	318	---	---	---	---	---
				BHP	0.09	0.10	0.10	0.11	0.12	---	---	---	---	---
				Low Stage Heat Rise °F (°C)	37 (21)	41 (23)	49 (27)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	831	765	670	586	466	299	---	---	---	---
				BHP	0.11	0.12	0.12	0.13	0.13	0.14	---	---	---	---
				Low Stage Heat Rise °F (°C)	34 (19)	37 (21)	43 (24)	49 (27)	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	54 (30)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1139	1069	1012	937	870	786	724	626	512	381
				BHP	0.22	0.23	0.24	0.24	0.25	0.26	0.26	0.27	0.27	0.28
				Low Stage Heat Rise °F (°C)	25 (14)	27 (15)	28 (16)	30 (17)	33 (18)	36 (20)	39 (22)	46 (26)	NA	NA
				High Stage Heat Rise °F (°C)	39 (22)	42 (23)	44 (24)	47 (26)	51 (28)	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1229	1171	1105	1049	980	913	838	775	679	516
				BHP	0.28	0.30	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.33
				Low Stage Heat Rise °F (°C)	NA	NA	26 (14)	27 (15)	29 (16)	31 (17)	34 (19)	37 (21)	42 (23)	55 (31)
				High Stage Heat Rise °F (°C)	36 (20)	38 (21)	40 (22)	42 (23)	45 (25)	49 (27)	53 (29)	NA	NA	NA
		High	Black	CFM	1531	1460	1382	1301	1209	1114	1003	890	764	629
				BHP	0.53	0.52	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.35
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	26 (14)	28 (16)	32 (18)	37 (21)	45 (25)
				High Stage Heat Rise °F (°C)	29 (16)	30 (17)	32 (18)	34 (19)	37 (21)	40 (22)	44 (24)	50 (28)	NA	NA

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
36060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	694	624	533	460	383	328	---	---	---	---
				BHP	0.05	0.05	0.06	0.07	0.07	0.08	---	---	---	---
				Low Stage Heat Rise °F (°C)	41 (23)	46 (25)	54 (30)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise °F (°C)	31 (17)	33 (18)	35 (20)	38 (21)	41 (23)	44 (24)	50 (28)	54 (30)	NA	NA
				High Stage Heat Rise °F (°C)	48 (26)	52 (29)	55 (31)	NA	NA	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Low Stage Heat Rise °F (°C)	NA	NA	26 (14)	27 (15)	28 (16)	30 (16)	31 (17)	33 (18)	35 (19)	37 (20)
				High Stage Heat Rise °F (°C)	37 (20)	38 (21)	40 (22)	42 (23)	44 (24)	46 (26)	48 (27)	51 (28)	54 (30)	NA
		Med-High[2]	Orange	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	NA	25 (14)	26 (14)	27 (15)	28 (16)	29 (16)	31 (17)	32 (18)	34 (19)
				High Stage Heat Rise °F (°C)	36 (20)	37 (21)	39 (22)	40 (22)	42 (23)	44 (24)	46 (25)	48 (27)	50 (28)	53 (29)
		High	Black	CFM	1466	1423	1384	1343	1308	1263	1219	1183	1145	1106
				BHP	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.41
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	25 (14)	26 (14)
				High Stage Heat Rise °F (°C)	30 (17)	31 (17)	32 (18)	33 (18)	34 (19)	35 (20)	37 (20)	38 (21)	39 (22)	40 (22)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
36090	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[3]	Blue	CFM	1097	971	823	747	669	636	558	513	456	412
				BHP	0.12	0.11	0.10	0.11	0.12	0.13	0.13	0.14	0.15	0.16
				Low Stage Heat Rise °F (°C)	39 (22)	44 (25)	52 (29)	58 (32)	64 (36)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	61 (34)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Low Stage Heat Rise °F (°C)	46 (26)	50 (28)	53 (29)	58 (32)	62 (34)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	36 (20)	37 (21)	39 (22)	40 (22)	42 (23)	44 (25)	46 (26)	48 (27)	51 (28)
				High Stage Heat Rise °F (°C)	54 (30)	56 (31)	59 (33)	61 (34)	63 (35)	NA	NA	NA	NA	NA
		Med-High[4]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248. 59	0.35	0.36	0.37	0.38	0.39
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	35 (20)	37 (20)	38 (21)	39 (22)
				High Stage Heat Rise °F (°C)	46 (26)	48 (26)	49 (27)	51 (28)	52 (29)	54 (30)	56 (31)	58 (32)	60 (33)	62 (34)
		High	Black	CFM	1466	1423	1384	1343	1308	1263	1219	1183	1145	1106
				BHP	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.41
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	35 (20)	36 (20)	38 (21)	39 (22)
				High Stage Heat Rise °F (°C)	46 (26)	47 (26)	49 (27)	50 (28)	52 (29)	53 (30)	55 (31)	57 (32)	59 (33)	61 (34)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
42060	25 - 55°F Low Stage, 25 - 55°F High Stage	Low[3]	Blue	CFM	694	624	533	460	383	328	---	---	---	---
				BHP	0.05	0.05	0.06	0.07	0.07	0.08	---	---	---	---
				Low Stage Heat Rise °F (°C)	41 (23)	46 (25)	54 (30)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Low Stage Heat Rise °F (°C)	27 (15)	28 (15)	29 (16)	31 (17)	33 (18)	35 (19)	37 (21)	40 (22)	43 (24)	47 (26)
				High Stage Heat Rise °F (°C)	41 (23)	43 (24)	46 (25)	48 (27)	51 (28)	54 (30)	NA	NA	NA	NA
		Medium[4]	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Low Stage Heat Rise °F (°C)	NA	NA	26 (14)	27 (15)	28 (16)	30 (16)	31 (17)	33 (18)	35 (19)	37 (20)
				High Stage Heat Rise °F (°C)	37 (20)	38 (21)	40 (22)	42 (23)	44 (24)	46 (26)	48 (27)	51 (28)	54 (30)	NA
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248. 59	0.35	0.36	0.37	0.38	0.39
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	25 (14)	26 (15)
				High Stage Heat Rise °F (°C)	31 (17)	31 (17)	32 (18)	34 (18)	35 (19)	36 (20)	37 (20)	38 (21)	39 (22)	41 (23)
		High	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	27 (15)	28 (16)	29 (16)	29 (16)	30 (17)	31 (17)	32 (18)	32 (18)	33 (18)	34 (19)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
42090	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[3]	Blue	CFM	1097	971	823	747	669	636	558	513	456	412
				BHP	0.12	0.11	0.10	0.11	0.12	0.13	0.13	0.14	0.15	0.16
				Low Stage Heat Rise °F (°C)	39 (22)	44 (25)	52 (29)	58 (32)	64 (36)	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	61 (34)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Low Stage Heat Rise °F (°C)	40 (22)	42 (23)	44 (25)	47 (26)	49 (27)	52 (29)	56 (31)	60 (33)	64 (36)	NA
				High Stage Heat Rise °F (°C)	63 (35)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	36 (20)	37 (21)	39 (22)	40 (22)	42 (23)	44 (25)	46 (26)	48 (27)	51 (28)
				High Stage Heat Rise °F (°C)	54 (30)	56 (31)	59 (33)	61 (34)	63 (35)	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248. 59	0.35	0.36	0.37	0.38	0.39
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	35 (20)	37 (20)	38 (21)	39 (22)
				High Stage Heat Rise °F (°C)	46 (26)	48 (26)	49 (27)	51 (28)	52 (29)	54 (30)	56 (31)	58 (32)	60 (33)	62 (34)
		High[4]	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	41 (23)	42 (24)	43 (24)	44 (25)	45 (25)	47 (26)	48 (27)	49 (27)	50 (28)	52 (29)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48090	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[3]	Blue	CFM	1067	904	703	587	501	449	380	340	---	---
				BHP	0.12	0.10	0.09	0.09	0.09	0.10	0.11	0.12	---	---
				Low Stage Heat Rise °F (°C)	40 (22)	48 (26)	61 (34)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	63 (35)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	35 (19)	36 (20)	38 (21)	40 (22)	42 (23)	44 (25)	46 (25)	48 (27)	51 (28)
				High Stage Heat Rise °F (°C)	53 (29)	55 (30)	57 (32)	60 (33)	63 (35)	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	NA	NA	35 (19)	36 (20)	38 (21)	39 (22)	41 (23)	43 (24)	45 (25)	48 (27)
				High Stage Heat Rise °F (°C)	50 (28)	52 (29)	54 (30)	57 (31)	59 (33)	62 (34)	64 (36)	NA	NA	NA
		Med-High[2]	Orange	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (26)	47 (26)	48 (27)	50 (28)
		High	Black	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	36 (20)	37 (20)	38 (21)	38 (21)	39 (22)	40 (22)	41 (23)	41 (23)	43 (24)	44 (24)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48115	30 - 60°F Low Stage, 30 - 60°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	44 (24)	45 (25)	47 (26)	50 (28)	52 (29)	54 (30)	57 (32)	59 (33)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	42 (23)	43 (24)	45 (25)	47 (26)	49 (27)	51 (28)	53 (30)	56 (31)	59 (33)	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	33 (18)	34 (19)	35 (19)	35 (20)	36 (20)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)
				High Stage Heat Rise °F (°C)	52 (29)	53 (29)	54 (30)	55 (31)	56 (31)	58 (32)	59 (33)	NA	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise °F (°C)	30 (17)	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	34 (19)	34 (19)	35 (20)	36 (20)
				High Stage Heat Rise °F (°C)	47 (26)	47 (26)	49 (27)	49 (27)	51 (28)	51 (28)	53 (29)	53 (30)	55 (31)	57 (32)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	NA	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	34 (19)	35 (19)	37 (20)
				High Stage Heat Rise °F (°C)	45 (25)	46 (25)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	57 (32)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48130	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	49 (27)	51 (28)	53 (30)	56 (31)	59 (33)	61 (34)	64 (36)	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	47 (26)	48 (27)	51 (28)	53 (29)	55 (31)	57 (32)	60 (33)	63 (35)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (26)
				High Stage Heat Rise °F (°C)	57 (32)	58 (32)	59 (33)	61 (34)	62 (35)	64 (35)	65(36)	NA	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Low Stage Heat Rise °F (°C)	NA	NA	35 (20)	35 (20)	36 (20)	37 (20)	38 (21)	39 (21)	40 (22)	41 (23)
				High Stage Heat Rise °F (°C)	52 (29)	52 (29)	54 (30)	54 (30)	56 (31)	56 (31)	58 (32)	59 (33)	61 (34)	63 (35)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	NA	NA	35 (19)	35 (20)	36 (20)	37 (21)	38 (21)	39 (22)	41 (23)
				High Stage Heat Rise °F (°C)	50 (28)	50 (28)	52 (29)	53 (29)	54 (30)	55 (31)	57 (31)	58 (32)	60 (33)	63 (35)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60090	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[3]	Blue	CFM	1067	904	703	587	501	449	380	340	---	---
				BHP	0.12	0.10	0.09	0.09	0.09	0.10	0.11	0.12	---	---
				Low Stage Heat Rise °F (°C)	40 (22)	48 (26)	61 (34)	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	63 (35)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[1]	Pink	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	NA	35 (19)	36 (20)	38 (21)	40 (22)	42 (23)	44 (25)	46 (25)	48 (27)	51 (28)
				High Stage Heat Rise °F (°C)	53 (29)	55 (30)	57 (32)	60 (33)	63 (35)	NA	NA	NA	NA	NA
		Medium[4]	Red	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	NA	NA	35 (19)	36 (20)	38 (21)	39 (22)	41 (23)	43 (24)	45 (25)	48 (27)
				High Stage Heat Rise °F (°C)	50 (28)	52 (29)	54 (30)	57 (31)	59 (33)	62 (34)	64 (36)	NA	NA	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	36 (20)	37 (20)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)
		High	Black	CFM	2020	1990	1956	1912	1872	1842	1802	1760	1719	1643
				BHP	0.62	0.63	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.72
				Low Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	35 (20)	36 (20)	37 (20)	37 (21)	38 (21)	39 (22)	41 (23)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60115	30 - 60°F Low Stage, 30 - 60°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	44 (24)	45 (25)	47 (26)	50 (28)	52 (29)	54 (30)	57 (32)	59 (33)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	42 (23)	43 (24)	45 (25)	47 (26)	49 (27)	51 (28)	53 (30)	56 (31)	59 (33)	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	33 (18)	34 (19)	35 (19)	35 (20)	36 (20)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)
				High Stage Heat Rise °F (°C)	52 (29)	53 (29)	54 (30)	55 (31)	56 (31)	58 (32)	59 (33)	NA	NA	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise °F (°C)	30 (17)	30 (17)	31 (17)	32 (18)	32 (18)	33 (18)	34 (19)	35 (19)	36 (20)	36 (20)
				High Stage Heat Rise °F (°C)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	51 (29)	53 (29)	54 (30)	55 (31)	57 (32)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	NA	30 (17)	31 (17)	31 (17)	32 (18)	33 (18)	34 (19)	35 (19)	37 (20)
				High Stage Heat Rise °F (°C)	45 (25)	46 (25)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	57 (32)

See notes on page 57.

DRY COIL AIR DELIVERY* – HORIZONTAL AND DOWNFLOW DISCHARGE – 208/230 VAC 3-PHASE MODELS (CONT)

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60130	35 - 65°F Low Stage, 35 - 65°F High Stage	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Low Stage Heat Rise °F (°C)	49 (27)	51 (28)	53 (30)	56 (31)	59 (33)	61 (34)	64 (36)	NA	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1340	1299	1240	1191	1139	1091	1050	1001	952	895
				BHP	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.32
				Low Stage Heat Rise °F (°C)	47 (26)	48 (27)	51 (28)	53 (29)	55 (31)	57 (32)	60 (33)	63 (35)	NA	NA
				High Stage Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Low Stage Heat Rise °F (°C)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (26)
				High Stage Heat Rise °F (°C)	57 (32)	58 (32)	59 (33)	61 (34)	62 (35)	64 (35)	65 (36)	NA	NA	NA
		Med-High[2]	Orange	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Low Stage Heat Rise °F (°C)	NA	NA	35 (19)	36 (20)	36 (20)	37 (21)	38 (21)	39 (22)	40 (22)	41 (23)
				High Stage Heat Rise °F (°C)	51 (28)	52 (29)	53 (30)	54 (30)	55 (31)	57 (31)	58 (32)	59 (33)	61 (34)	63 (35)
		High[4]	Black	CFM	1934	1900	1855	1815	1778	1737	1695	1656	1606	1528
				BHP	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.70	0.68
				Low Stage Heat Rise °F (°C)	NA	NA	NA	35 (19)	35 (20)	36 (20)	37 (21)	38 (21)	39 (22)	41 (23)
				High Stage Heat Rise °F (°C)	50 (28)	50 (28)	52 (29)	53 (29)	54 (30)	55 (31)	57 (31)	58 (32)	60 (33)	63 (35)

Notes:

[1] Factory-shipped low stage cooling speed

[2] Factory-shipped high stage cooling speed

[3] Factory-shipped low stage gas heating speed

[4] Factory-shipped high stage gas heating speed

Allowable High Stage Enhanced Dehumidification Cooling Speed

"NA" = Not allowed for particular heating speed

DRY COIL AIR DELIVERY - HORIZONTAL AND DOWNFLOW DISCHARGE - 460 VAC MODELS

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
36060	25 - 55ºF	Low[1]	Blue	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Heat Rise ºF (ºC)	48 (26)	51 (29)	55 (30)	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Heat Rise ºF (ºC)	41 (23)	43 (24)	46 (25)	48 (27)	51 (28)	54 (30)	NA	NA	NA	NA
		Medium[3]	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Heat Rise ºF (ºC)	37 (20)	38 (21)	40 (22)	42 (23)	44 (24)	46 (26)	48 (27)	51 (28)	54 (30)	NA
		Med-High[2]	Orange	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise ºF (ºC)	36 (20)	37 (21)	39 (21)	40 (22)	42 (23)	44 (24)	46 (25)	48 (26)	50 (28)	53 (29)
		High	Black	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				Heat Rise ºF (ºC)	31 (17)	31 (17)	32 (18)	33 (19)	35 (19)	36 (20)	37 (20)	38 (21)	39 (22)	41 (23)
36090	35 - 65ºF	Low[1]	Blue	CFM	934	864	810	745	698	649	571	525	486	428
				BHP	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17
				Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Heat Rise ºF (ºC)	63 (35)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Heat Rise ºF (ºC)	56 (31)	58 (32)	61 (34)	64 (35)	NA	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise ºF (ºC)	54 (30)	57 (32)	59 (33)	62 (34)	64 (35)	NA	NA	NA	NA	NA
		High[3]	Black	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				Heat Rise ºF (ºC)	47 (26)	48 (27)	50 (28)	51 (28)	53 (29)	54 (30)	56 (31)	58 (32)	60 (33)	62 (35)

See notes on page 62.

DRY COIL AIR DELIVERY - HORIZONTAL AND DOWNFLOW DISCHARGE - 460 VAC MODELS

42060	25 - 55°F	Low[1]	Blue	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Heat Rise °F (°C)	41 (23)	43 (24)	46 (25)	48 (27)	51 (28)	54 (30)	NA	NA	NA	NA
		Med-Low	Pink	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Heat Rise °F (°C)	37 (20)	38 (21)	40 (22)	42 (23)	44 (24)	46 (26)	48 (27)	51 (28)	54 (30)	NA
		Medium[3]	Red	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	36 (20)	37 (21)	39 (21)	40 (22)	42 (23)	44 (24)	46 (25)	48 (26)	50 (28)	53 (29)
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				High Stage Heat Rise °F (°C)	31 (17)	31 (17)	32 (18)	33 (19)	35 (19)	36 (20)	37 (20)	38 (21)	39 (22)	41 (23)
		High	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Heat Rise °F (°C)	27 (15)	28 (16)	29 (16)	29 (16)	30 (17)	31 (17)	32 (18)	32(18)	33 (18)	34 (19)
42090	35 - 65°F	Low[1]	Blue	CFM	1076	1026	972	918	872	827	771	714	666	611
				BHP	0.13	0.14	0.15	0.15	0.17	0.18	0.18	0.20	0.21	0.22
				Heat Rise °F (°C)	63 (35)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1213	1169	1110	1065	1016	964	923	878	820	777
				BHP	0.16	0.17	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25
				Heat Rise °F(°C)	56 (31)	58 (32)	61 (34)	64 (35)	NA	NA	NA	NA	NA	NA
		Medium	Red	CFM	1251	1198	1149	1104	1066	1017	970	932	892	839
				BHP	0.19	0.21	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	54 (30)	57 (32)	59 (33)	62 (34)	64 (35)	NA	NA	NA	NA	NA
		Med-High[2]	Orange	CFM	1451	1415	1372	1327	1287	1249	1212	1168	1130	1094
				BHP	0.29	0.30	0.31	0.32	248.59	0.35	0.36	0.37	0.38	0.39
				Heat Rise °F (°C)	47 (26)	48 (27)	50 (28)	51 (28)	53 (29)	54 (30)	56 (31)	58 (32)	60 (33)	62 (35)
		High[3]	Black	CFM	1633	1590	1552	1518	1483	1444	1406	1372	1340	1303
				BHP	0.41	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.53
				Heat Rise °F (°C)	42 (23)	43 (24)	44 (24)	45 (25)	46 (25)	47 (26)	48 (27)	50 (28)	51 (28)	52 (29)

See notes on page 62.

DRY COIL AIR DELIVERY - HORIZONTAL AND DOWNFLOW DISCHARGE - 460 VAC MODELS

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48090	35 - 65°F	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	54 (30)	55 (31)	58 (32)	61 (34)	64 (35)	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise °F (°C)	47 (26)	49 (27)	51 (28)	53 (29)	55 (31)	57 (32)	60 (33)	63 (35)	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Heat Rise °F (°C)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (26)	47 (26)	49 (27)	50 (28)
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Heat Rise °F (°C)	37 (20)	37 (21)	38 (21)	38 (21)	40 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (25)
		High	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise °F (°C)	NA	NA	NA	NA	NA	35 (19)	36 (20)	37 (20)	38 (21)	39 (22)
48115	30 - 60°F	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise °F (°C)	60 (33)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Heat Rise °F (°C)	51 (28)	52 (29)	53 (30)	55 (30)	56 (31)	57 (32)	59 (33)	60 (33)	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Heat Rise °F (°C)	47 (26)	47 (26)	48 (27)	48 (27)	50 (28)	51 (28)	52 (29)	53 (29)	55 (30)	56 (31)
		High[3]	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise °F (°C)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	45 (25)	46 (25)	46 (26)	48 (27)	49 (27)

See notes on page 62.

DRY COIL AIR DELIVERY - HORIZONTAL AND DOWNFLOW DISCHARGE - 460 VAC MODELS

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
48130	35 - 65°F	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise °F (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1686	1650	1617	1576	1544	1503	1468	1433	1393	1356
				BHP	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52	0.53	0.55
				Heat Rise °F (°C)	57 (32)	58 (32)	60 (33)	61 (34)	62 (35)	64 (36)	NA	NA	NA	NA
		Med-High	Orange	CFM	1854	1837	1781	1784	1720	1698	1655	1625	1578	1532
				BHP	0.56	0.57	0.60	0.59	0.62	0.63	0.64	0.66	0.67	0.67
				Heat Rise °F (°C)	52 (29)	52 (29)	54 (30)	54 (30)	56 (31)	57 (32)	58 (32)	59 (33)	61 (34)	63 (35)
		High[3]	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise °F (°C)	45 (25)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	55 (31)
60090	35 - 65°F	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise °F (°C)	54 (30)	55 (31)	58 (32)	61 (34)	64 (35)	NA	NA	NA	NA	NA
		Med-Low[3]	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise °F (°C)	47 (26)	49 (27)	51 (28)	53 (29)	55 (31)	57 (32)	60 (33)	63 (35)	NA	NA
		Medium[2]	Red	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Heat Rise °F (°C)	36 (20)	37 (20)	38 (21)	39 (21)	39 (22)	40 (22)	41 (23)	42 (23)	43 (24)	44 (25)
		Med-High	Orange	CFM	2020	1990	1956	1912	1872	1842	1802	1760	1719	1643
				BHP	0.62	0.63	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.72
				Heat Rise °F (°C)	NA	NA	35 (19)	36 (20)	36 (20)	37 (21)	38 (21)	39 (21)	40 (22)	41 (23)
		High	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise °F (°C)	NA	NA	NA	NA	NA	35 (19)	36 (20)	37 (20)	38 (21)	39 (22)

See notes on page 62.

DRY COIL AIR DELIVERY - HORIZONTAL AND DOWNFLOW DISCHARGE - 460 VAC MODELS

UNIT	HEATING RISE RANGE	MOTOR SPEED	WIRE COLOR		EXTERNAL STATIC PRESSURE (IN. W.C.)									
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
60115	30 - 60ºF	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise ºF (ºC)	60 (33)	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Heat Rise ºF (ºC)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	53 (30)	55 (31)	56 (31)
		Med-High	Orange	CFM	2020	1990	1956	1912	1872	1842	1802	1760	1719	1643
				BHP	0.62	0.63	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.72
				Heat Rise ºF (ºC)	43 (24)	43 (24)	44 (24)	45 (25)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	52 (29)
		High[3]	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise ºF (ºC)	40 (22)	41 (23)	42 (23)	43 (24)	44 (24)	44 (25)	46 (25)	46 (26)	48 (27)	49 (27)
60130	35 - 65ºF	Low[1]	Blue	CFM	1271	1229	1177	1121	1066	1027	974	942	887	839
				BHP	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.28	0.29
				Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Med-Low	Pink	CFM	1445	1389	1341	1281	1236	1189	1139	1072	1027	982
				BHP	0.24	0.26	0.26	0.28	0.29	0.3	0.32	0.33	0.34	0.35
				Heat Rise ºF (ºC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Medium[2]	Red	CFM	1878	1844	1805	1762	1731	1693	1655	1616	1570	1532
				BHP	0.50	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.64	0.63
				Heat Rise ºF (ºC)	51 (28)	52 (29)	53 (30)	55 (30)	56 (31)	57 (32)	58 (32)	60 (33)	61 (34)	63 (35)
		Med-High	Orange	CFM	2020	1990	1956	1912	1872	1842	1802	1760	1719	1643
				BHP	0.62	0.63	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.72
				Heat Rise ºF (ºC)	48 (26)	48 (27)	49 (27)	50 (28)	51 (29)	52 (29)	53 (30)	55 (30)	56 (31)	59 (33)
		High[3]	Black	CFM	2131	2088	2065	2013	1982	1941	1888	1860	1785	1751
				BHP	0.72	0.74	0.75	0.77	0.79	0.8	0.81	0.81	0.79	0.75
				Heat Rise ºF (ºC)	45 (25)	46 (26)	47 (26)	48 (27)	49 (27)	50 (28)	51 (28)	52 (29)	54 (30)	55 (31)

Notes:
[1] Factory-shipped low stage cooling speed
[2] Factory-shipped high stage cooling speed
[3] Factory-shipped low gas heating speed
"NA" = Not allowed for particular heating speed

Filter Pressure Drop Table (IN. W.C.)

FILTER SIZE IN. (MM)	COOLING TONS	STANDARD CFM (SCFM)																
		600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200
600-1400 CFM 12x20x1+12x20x1 (305x508x25+305x508x25)	**2.0, 2.5,**	0.03	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.08	-	-	-	-	-	-	-	-
1200-1800 CFM 16x24x1+14x24x1 (406x610x25+356x610x25)	**3.0 3.5, 4.0**	-	-	-	-	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.12	-	-
1500-2200 CFM 16x24x1+18x24x1 (406x610x25+457x356x25)	**5.0**	-	-	-	-	-	-	-	-	-	0.04	0.06	0.08	0.10	0.11	0.13	0.14	0.15

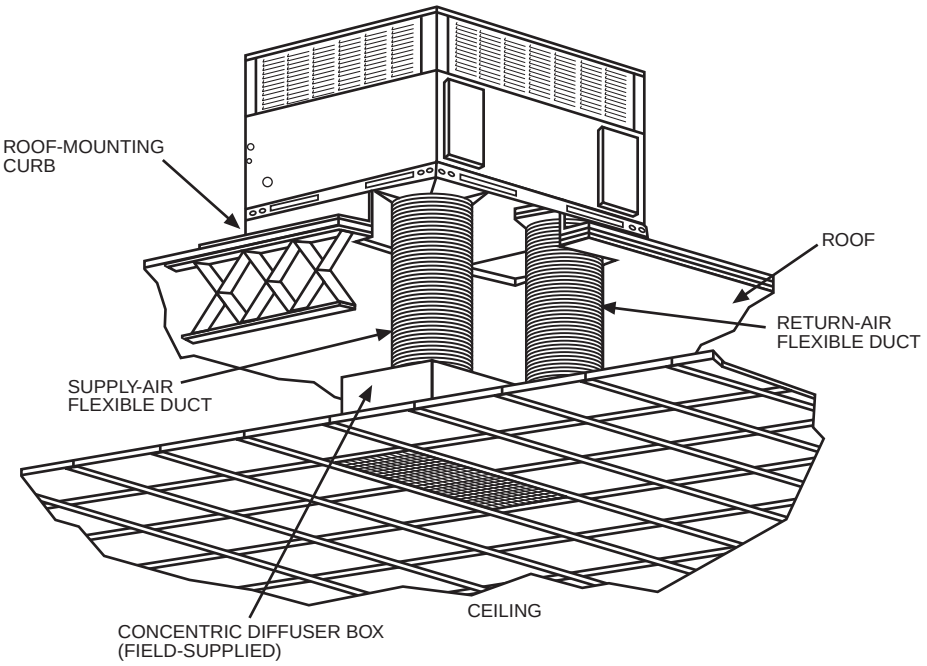
Wet Coil Pressure Drop (IN. W.C.)

UNIT SIZE	STANDARD CFM (SCFM)																
	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200
24	0.03	0.04	0.04	0.05	0.06												
30				0.05	0.06	0.07	0.08	0.11									
36				0.06	0.06	0.09	0.10	0.11	0.14								
42					0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.09	0.11				
48							0.04	0.06	0.09	0.10	0.10	0.11	0.12	0.13	0.14		
60										0.06	0.07	0.01	0.08	0.09	0.10	0.12	0.13

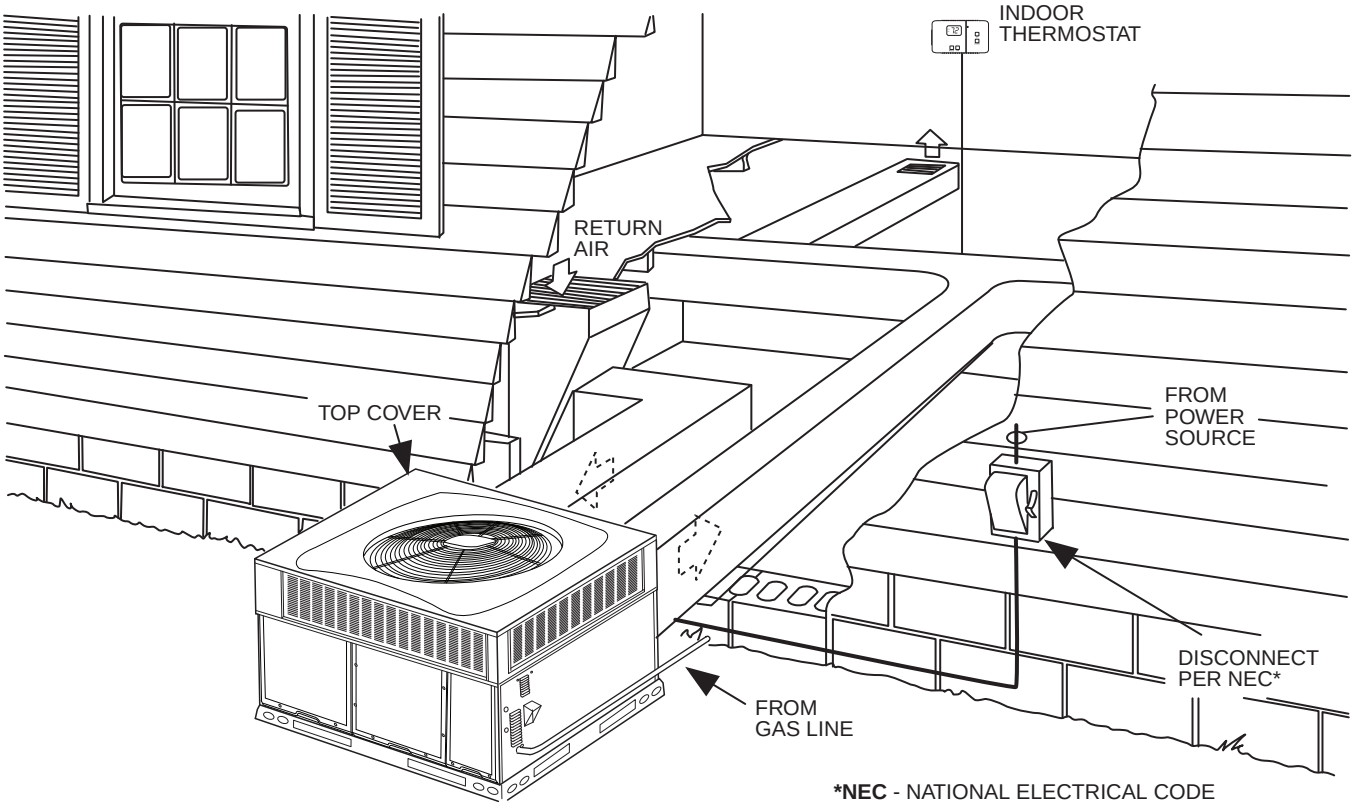
Economizer with 1-in. Filter Pressure Drop (IN. W.C.)

FILTER SIZE IN. (MM)	COOLING TONS	STANDARD CFM (SCFM)																
		600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200
600-1400 CFM 12x20x1+12x20x1 (305x508x25+305x508x25)	**2.0, 2.5,**	-	-	0.08	0.09	0.10	0.11	0.11	0.13	0.14	-	-	-	-	-	-	-	-
1200-1800 CFM 16x24x1+14x24x1 (406x610x25+356x610x25)	**3.0 3.5, 4.0**	-	-	-	-	-	0.09	0.09	0.10	0.12	0.13	0.15	0.17	0.17	0.19	0.21	-	-
1500-2200 CFM 16x24x1+18x24x1 (406x610x25+457x356x25)	**5.0**	-	-	-	-	-	-	-	-	-	0.15	0.17	0.18	0.20	0.21	0.22	0.23	0.23

TYPICAL PIPING AND WIRING



A09233



A09234

APPLICATION DATA

Condensate trap — A 2-in. (50.8 mm) condensate trap must be field supplied.

Ductwork — Secure downflow discharge ductwork to roof curb. For horizontal discharge applications, attach ductwork to unit with flanges.

To convert a unit to downflow discharge — Units are equipped with factory-installed inserts in the down-flow openings. Removal of the inserts is similar to removing an electrical knock-out. Use the duct cover to seal the horizontal discharge openings in the unit. Units installed in horizontal discharge orientation do not require duct covers.

Airflow — Units are draw-thru in the cooling mode and blow-thru in the heating mode.

Maximum cooling airflow — To minimize the possibility of condensate blow-off from the evaporator, airflow through the units should not exceed 450 cfm per ton.

Minimum cooling airflow — Minimum cooling airflow is 350 cfm per ton.

Minimum ambient cooling operation temperature — All standard units have a minimum ambient operating temperature of 40°F (4°C). With accessory low ambient temperature kit, units can operate at temperatures down to 0°F (-17°C).

Minimum temperature — Air entering the heat exchanger in heating mode must be a minimum of 55°F (13°C) continuous and a maximum of 80°F (27°C) continuous.

ELECTRICAL DATA

UNIT	NOMINAL	VOLTAGE RANGE		COMPRESSOR		OFM	IFM	IDM	POWER SUPPLY	
		MIN	MAX	RLA	LRA	FLA	FLA	FLA	MCA	MOCP
2404030 2406030	208/230-1-60	197	253	11.7	58.3	0.7	4.1	1.5	19.4	30
3004030 3006030	208/230-1-60	197	253	13.1	73.0	1.2	4.1	1.5	21.7	30
3004050 3006050	208/230-3-60	197	253	8.7	58.0	1.2	4.1	.21	16.2	20
3606030 3609030	208/230-1-60	197	253	15.3	83.0	1.2	6.0	1.5	26.3	40
3606050 3609050	208/230-3-60	197	253	11.6	73.0	1.2	6.0	.21	21.7	30
3606060	460-3-60	414	506	5.7	38.0	0.53	3.2	.65	10.8	15
3609060								.33		
4206030 4209030	208/230-1-60	197	253	17.9	96.0	1.2	6.0	1.5	29.6	45
4206050 4209050	208/230-3-60	197	253	14.2	88.0	1.2	6.0	.21	25.0	35
4206060	460-3-60	414	506	6.2	44.0	0.53	3.2	.65	11.5	15
4209060								.33		
4809030	208/230-1-60	197	253	21.2	104.0	1.2	7.6	1.5	35.3	50
4811530										
4813030										
4809050	208/230-3-60	197	253	14.0	83.1	1.2	7.6	.21	26.3	40
4811550								.50		
4813050								.50		
4809060	460-3-60	414	506	6.4	41.0	0.53	4.0	.33	12.5	15
4811560								.65		
4813060								.30		
6009030	208/230-1-60	197	253	28.8	152.9	1.2	7.6	1.5	44.8	60
6011530										
6013030										
6009050	208/230-3-60	197	253	16.2	110.0	1.2	7.6	.21	29.1	40
6011550								.50		
6013050								.50		
6009060	460-3-60	414	506	7.6	52.0	.053	4.0	.33	14.0	20
6011560								.65		
6013060								.30		

ELECTRICAL DATA (CONT)

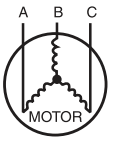
LEGEND

FLA - Full Load Amps
IDM - Inducer Motor
IFM - Indoor Fan Motor
LRA -Locked Rotor Amps
MCA - Minimum Circuit Amps
MOCP - Maximum Over Current Protection
OFM - Outdoor Fan Motor
RLA - Rated Load Amps

NOTES:
1. In compliance with NEC (National Electrical Code) requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be Power Supply fuse or circuit breaker.
2. Minimum wire size is based on 60 C copper wire. If other than 60 C wire is used, or if length exceeds wire length in table, determine size from NEC.
3. Unbalanced 3-Phase Supply Voltage
   Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance

$$\% \text{ Voltage imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

EXAMPLE: Supply voltage is 230-3-60.



AB = 228 v
BC = 231 v
AC = 227 v

$$\text{Average Voltage} = \frac{228 + 231 + 227}{3} = \frac{686}{3} = 229$$

Determine maximum deviation from average voltage.
(AB) 229 - 228 = 1 v
(BC) 231 - 229 = 2 v
(AC) 229 - 227 = 2 v

Maximum deviation is 2 v.

Determine percent of voltage imbalance

$$\% \text{ Voltage Imbalance} = 100 \times \frac{2}{229} = 0.8\%$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.

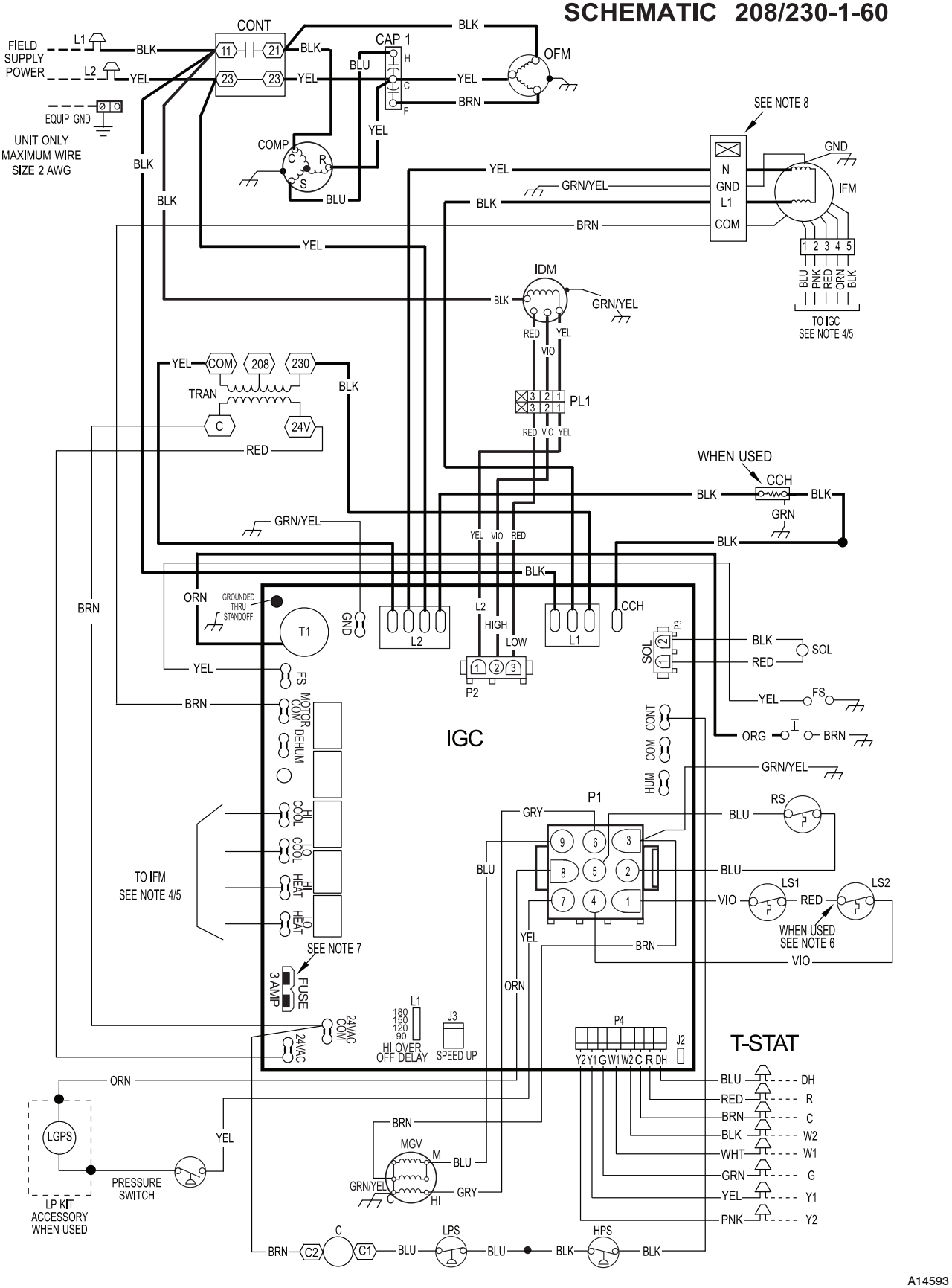
IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

CONNECTION WIRING SCHEMATIC 208/230–1–60

CONNECTION WIRING DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING

SCHEMATIC 208/230-1-60



A14593

LADDER WIRING SCHEMATIC 208/230-1-60

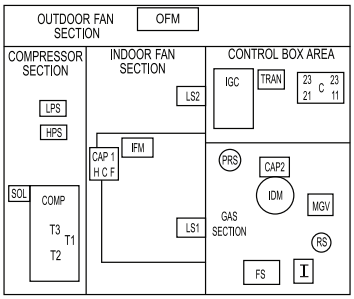
LADDER WIRING DIAGRAM

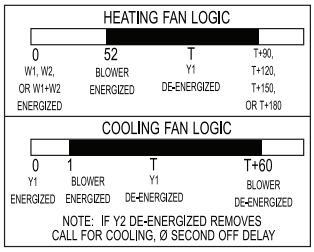
DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING

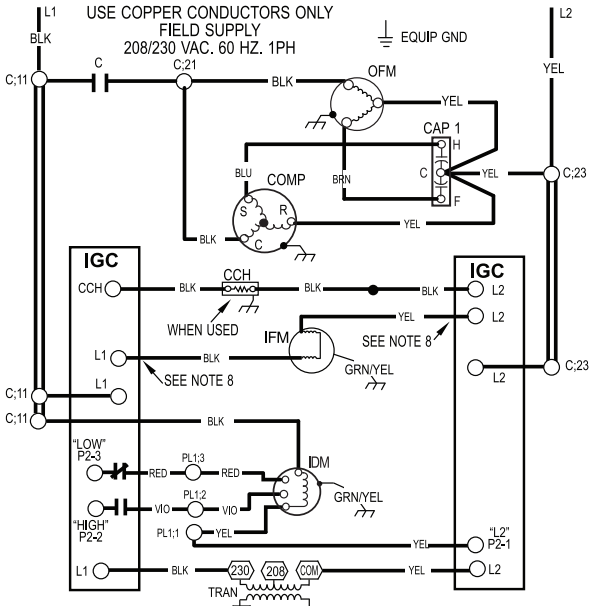
LEGEND

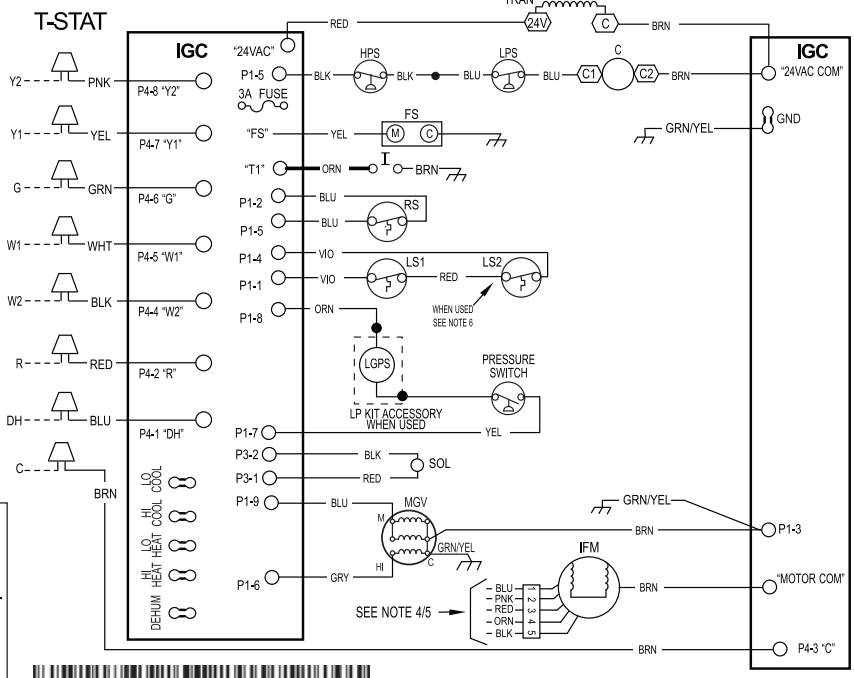
	FIELD SPLICE	EQUIP	EQUIPMENT
	TERMINAL (MARKED)	FS	FLAME SENSOR
	TERMINAL (UNMARKED)	GND	GROUND
	SPLICE	HPS	HIGH PRESSURE SWITCH
	SPLICE (MARKED)	I	IGNITOR
	FACTORY LO VOLTAGE	IDM	INDUCED DRAFT MOTOR
	FIELD CONTROL WIRING	IFM	INDOOR FAN MOTOR
	FIELD POWER WIRING	IGC	INTERGRATED GAS UNIT CONTROLLER
	ACCESSORY OR OPTIONAL WIRING	LGPS	LOW GAS PRESSURE SWITCH (WHEN USED)
	FACTORY HI VOLTAGE	LPS	LOW PRESSURE SWITCH
C	CONTACTOR	LS1	PRIMARY LIMIT SWITCH
CAP1	CAPACITOR, COMP	LS2	SECONDARY LIMIT SWITCH
CAP2	CAPACITOR, INDUCER	MGV	MAIN GAS VALVE
CCH	CRANKCASE HEATER	OFM	OUTDOOR FAN MOTOR
COMP	COMPRESSOR MOTOR	OT	QUADRUPLE TERMINAL
		PL1	IGC TO INDUCER MOTOR PLUG
		PL2	INDUCER MOTOR PLUG
		RS	ROLLOUT SWITCH
		SOL	COMPRESSOR SOLENOID
		TRAN	TRANSFORMER
		T-STAT	THERMOSTAT

1Ø UNIT COMPONENT ARRANGEMENT









NOTES:

1. IF ANY OF THE ORIGINAL WIRES FURNISHED ARE REPLACED THEY MUST BE REPLACED WITH THE SAME WIRE OR IT'S EQUIVALENT.
2. SEE PRE-SALE LITERATURE FOR THERMOSTATS.
3. USE 75 DEGREES C COPPER CONDUCTORS FOR FIELD INSTALLATION.
4. REFER TO INSTALLATION INSTRUCTIONS FOR CORRECT SPEED SELECTION FOR IFM.
5. SEE INSTALLATION INSTRUCTIONS FOR PROPER HEATING AND COOLING CONNECTIONS FOR YOUR UNIT.
6. ON SOME MODELS LS1 AND LS2 ARE WIRED IN SERIES. ON OTHER MODELS ONLY LS1 IS USED.
7. THIS FUSE IS MANUFACTURED BY LITTLE FUSE, P/N 257003.
8. DO NOT DISCONNECT PLUG UNDER LOAD.
9. N.E.C. CLASS 2, 24V.

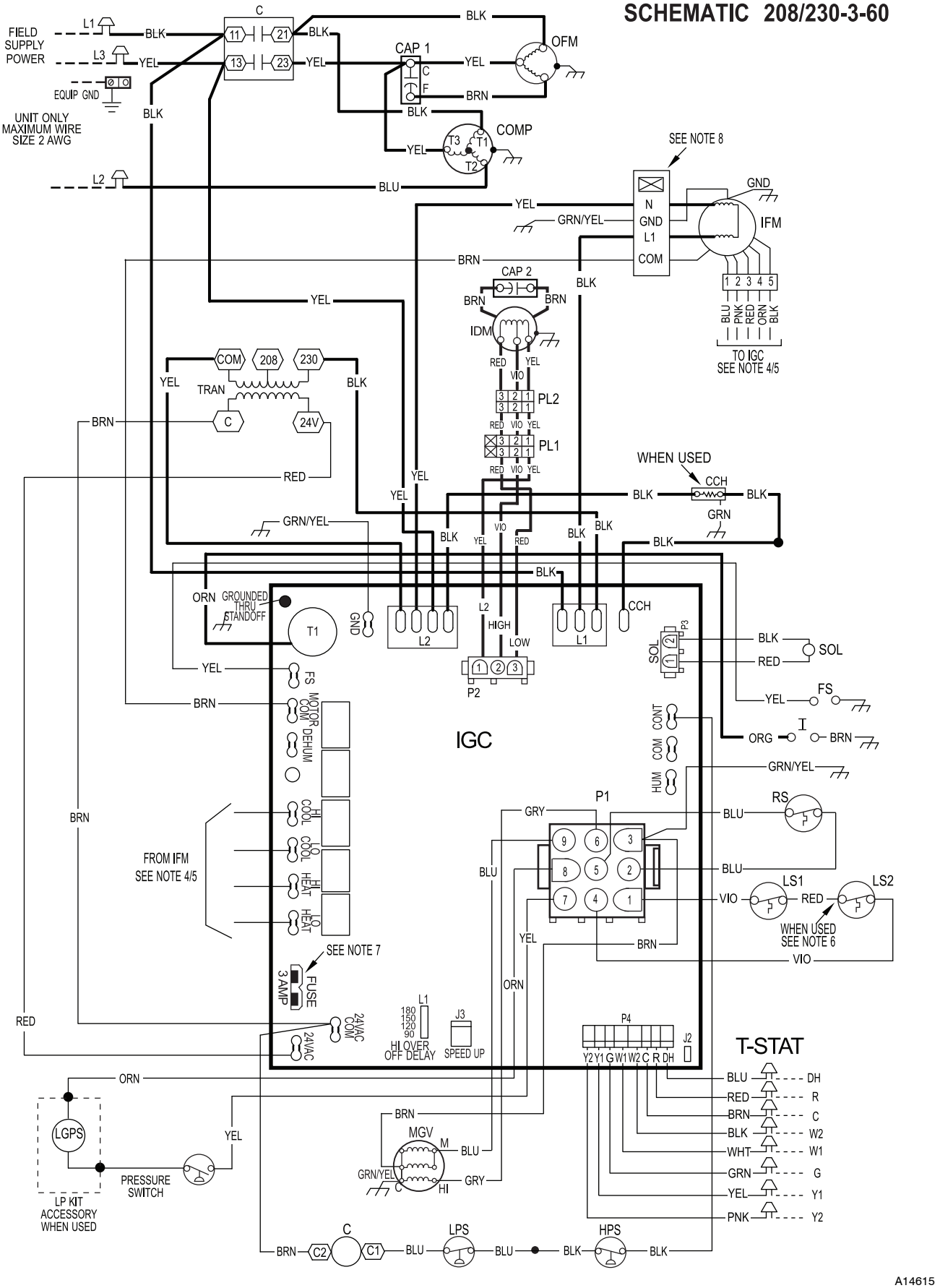
48VG500093 REV. A

A14594

CONNECTION WIRING SCHEMATIC GAS INPUTS 40, 60, 90 KBTU/HR 208/230-3-60

CONNECTION WIRING DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING



A14615

LADDER WIRING SCHEMATIC GAS INPUTS 40, 60, 90 KBTU/HR 208/230-3-60

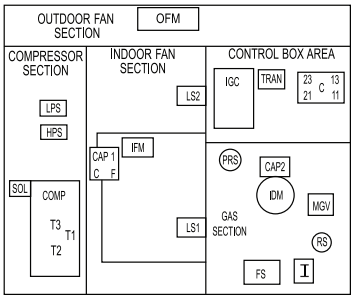
LADDER WIRING DIAGRAM

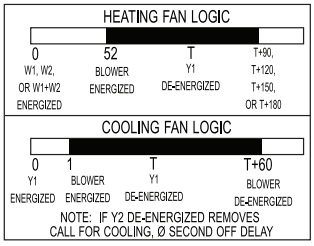
DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING

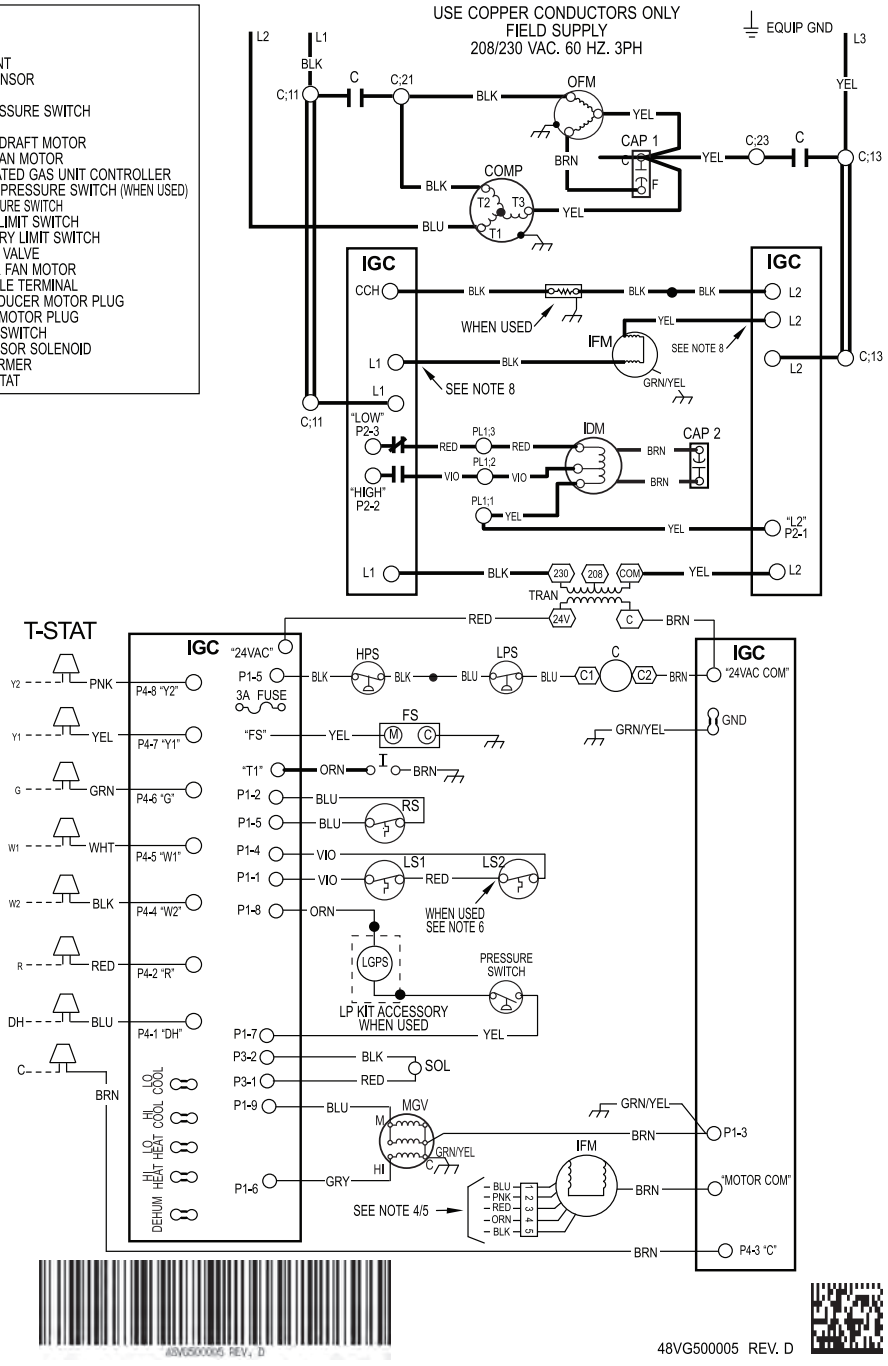
LEGEND

	FIELD SPLICE	EQUIP	EQUIPMENT
	TERMINAL (MARKED)	FS	FLAME SENSOR
	TERMINAL (UNMARKED)	GND	GROUND
	SPLICE	HPS	HIGH PRESSURE SWITCH
	SPLICE (MARKED)	I	IGNITOR
	FACTORY LO VOLTAGE	IDM	INDUCED DRAFT MOTOR
	FIELD CONTROL WIRING	IFM	INDOOR FAN MOTOR
	FIELD POWER WIRING	IGC	INTERGRATED GAS UNIT CONTROLLER
	ACCESSORY OR OPTIONAL WIRING	LGPS	LOW GAS PRESSURE SWITCH (WHEN USED)
	FACTORY HI VOLTAGE	LPS	LOW PRESSURE SWITCH
C	CONTACTOR	LS1	PRIMARY LIMIT SWITCH
CAP1	CAPACITOR, COMP	LS2	SECONDARY LIMIT SWITCH
CAP2	CAPACITOR, INDUCER	MGV	MAIN GAS VALVE
CCH	CRANKCASE HEATER	OFM	OUTDOOR FAN MOTOR
COMP	COMPRESSOR MOTOR	OT	QUADRUPLE TERMINAL
		PL1	IGC TO INDUCER MOTOR PLUG
		PL2	INDUCER MOTOR PLUG
		RS	ROLLOUT SWITCH
		SOL	COMPRESSOR SOLENOID
		TRAN	TRANSFORMER
		T-STAT	THERMOSTAT

3Ø UNIT COMPONENT ARRANGEMENT







NOTES:

1. IF ANY OF THE ORIGINAL WIRES FURNISHED ARE REPLACED THEY MUST BE REPLACED WITH THE SAME WIRE OR IT'S EQUIVALENT.
2. SEE PRE-SALE LITERATURE FOR THERMOSTATS.
3. USE 75 DEGREES C COPPER CONDUCTORS FOR FIELD INSTALLATION.
4. REFER TO INSTALLATION INSTRUCTIONS FOR CORRECT SPEED SELECTION FOR IFM.
5. SEE INSTALLATION INSTRUCTIONS FOR PROPER HEATING AND COOLING CONNECTIONS FOR YOUR UNIT.
6. ON SOME MODELS LS1 AND LS2 ARE WIRED IN SERIES. ON OTHER MODELS ONLY LS1 IS USED.
7. THIS FUSE IS MANUFACTURED BY LITTLE FUSE, P/N 257003.
8. DO NOT DISCONNECT PLUG UNDER LOAD.
9. N.E.C. CLASS 2, 24V.

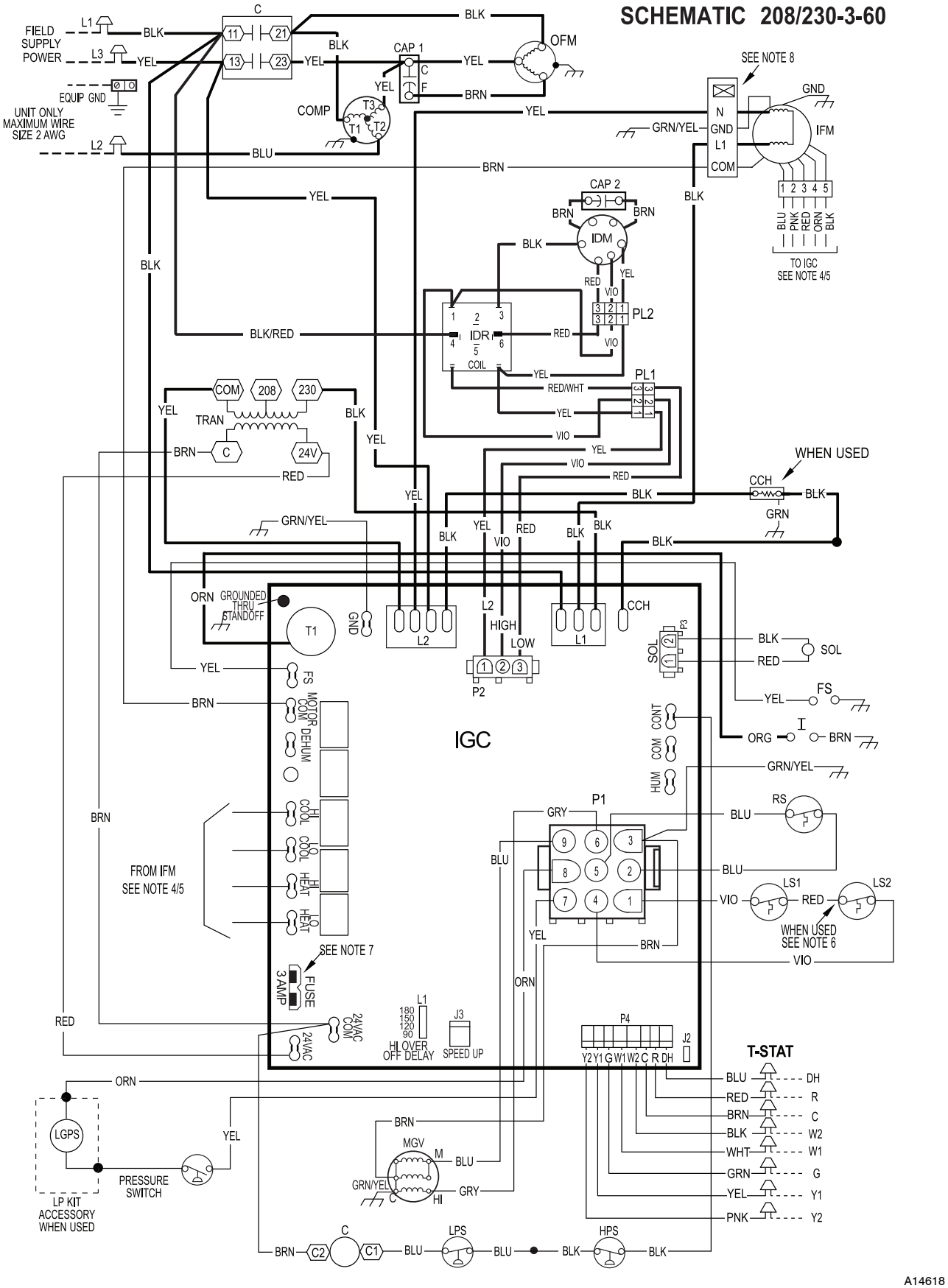
48VG500005 REV. D

A14616

CONNECTION WIRING SCHEMATIC GAS INPUTS 115, 130 208/230–3–60

CONNECTION WIRING DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING



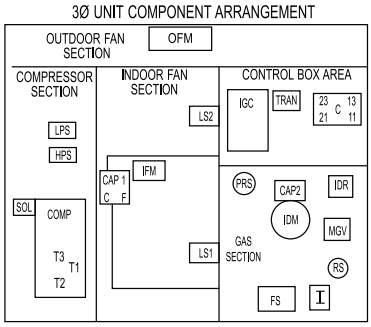
LADDER WIRING SCHEMATIC GAS INPUTS 115, 130 208/230-3-60

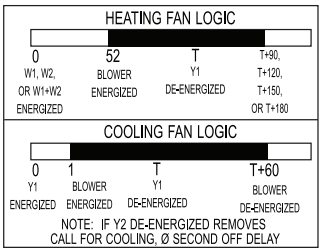
LADDER WIRING DIAGRAM

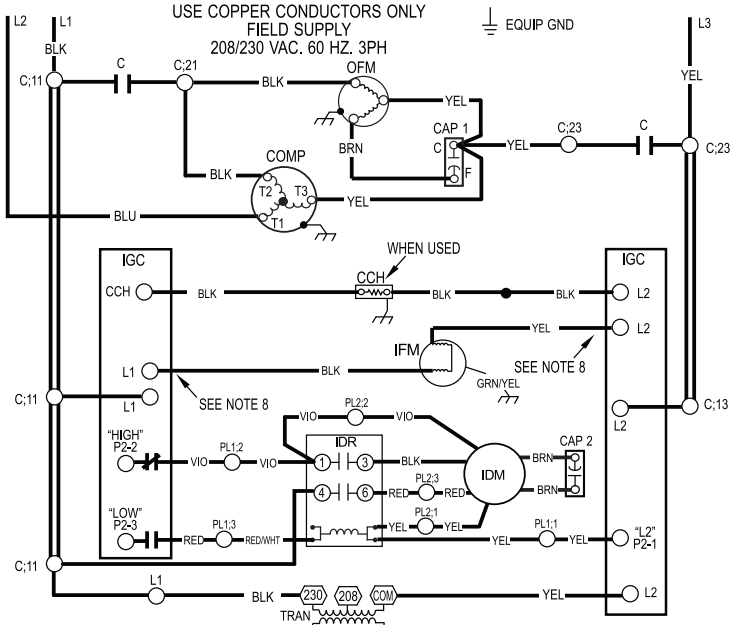
DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING

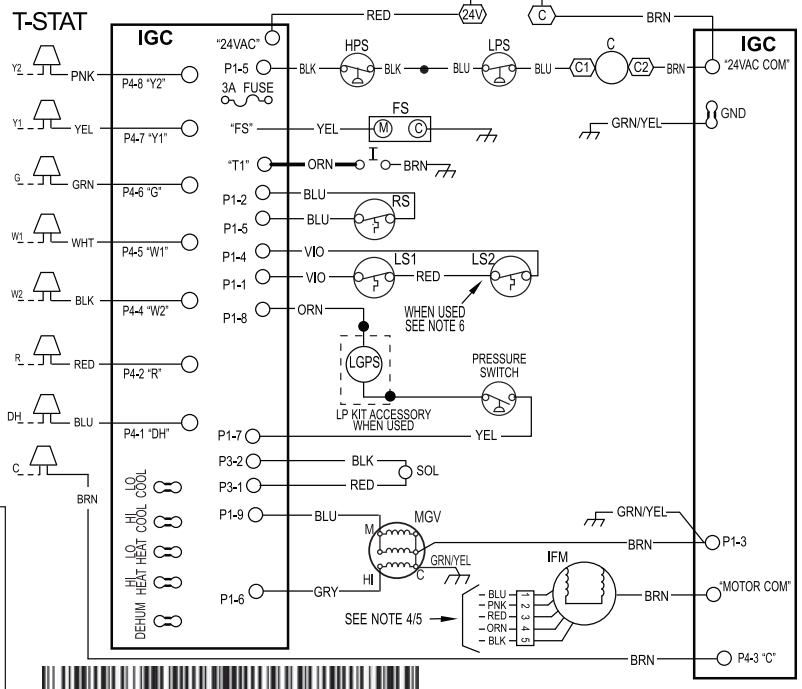
LEGEND

	FIELD SPLICE	EQUIP	EQUIPMENT
	TERMINAL (MARKED)	FS	FLAME SENSOR
	TERMINAL (UNMARKED)	GND	GROUND
	SPLICE	HPS	HIGH PRESSURE SWITCH
	SPLICE (MARKED)	I	IGNITOR
	FACTORY LO VOLTAGE	IDM	INDUCED DRAFT MOTOR
	FIELD CONTROL WIRING	IDR	INDUCER RELAY
	FIELD POWER WIRING	IFM	INDOOR FAN MOTOR
	ACCESSORY OR OPTIONAL WIRING	IGC	INTERGRATED GAS UNIT CONTROLLER
	FACTORY HI VOLTAGE	LGPS	LOW PRESSURE SWITCH (WHEN USED)
C	CONTACTOR	LPS	LOW PRESSURE SWITCH
CAP1	CAPACITOR, COMP	LS1	PRIMARY LIMIT SWITCH
CAP2	CAPACITOR, INDUCER	LS2	SECONDARY LIMIT SWITCH
CCH	CRANKCASE HEATER	MGV	MAIN GAS VALVE
COMP	COMPRESSOR MOTOR	OFM	OUTDOOR FAN MOTOR
		OT	QUADRUPLE TERMINAL
		PL1	IGC TO INDUCER MOTOR PLUG
		PL2	INDUCER MOTOR PLUG
		RS	ROLLOUT SWITCH
		SOL	COMPRESSOR SOLENOID
		TRAN	TRANSFORMER
		T-STAT	THERMOSTAT









NOTES:

1. IF ANY OF THE ORIGINAL WIRES FURNISHED ARE REPLACED THEY MUST BE REPLACED WITH THE SAME WIRE OR IT'S EQUIVALENT.
2. SEE PRE-SALE LITERATURE FOR THERMOSTATS.
3. USE 75 DEGREES C COPPER CONDUCTORS FOR FIELD INSTALLATION.
4. REFER TO INSTALLATION INSTRUCTIONS FOR CORRECT SPEED SELECTION FOR IFM.
5. SEE INSTALLATION INSTRUCTIONS FOR PROPER HEATING AND COOLING CONNECTIONS FOR YOUR UNIT.
6. ON SOME MODELS LS1 AND LS2 ARE WIRED IN SERIES. ON OTHER MODELS ONLY LS1 IS USED.
7. THIS FUSE IS MANUFACTURED BY LITTLE FUSE, P/N 257003.
8. DO NOT DISCONNECT PLUG UNDER LOAD.
9. N.E.C. CLASS 2, 24V.

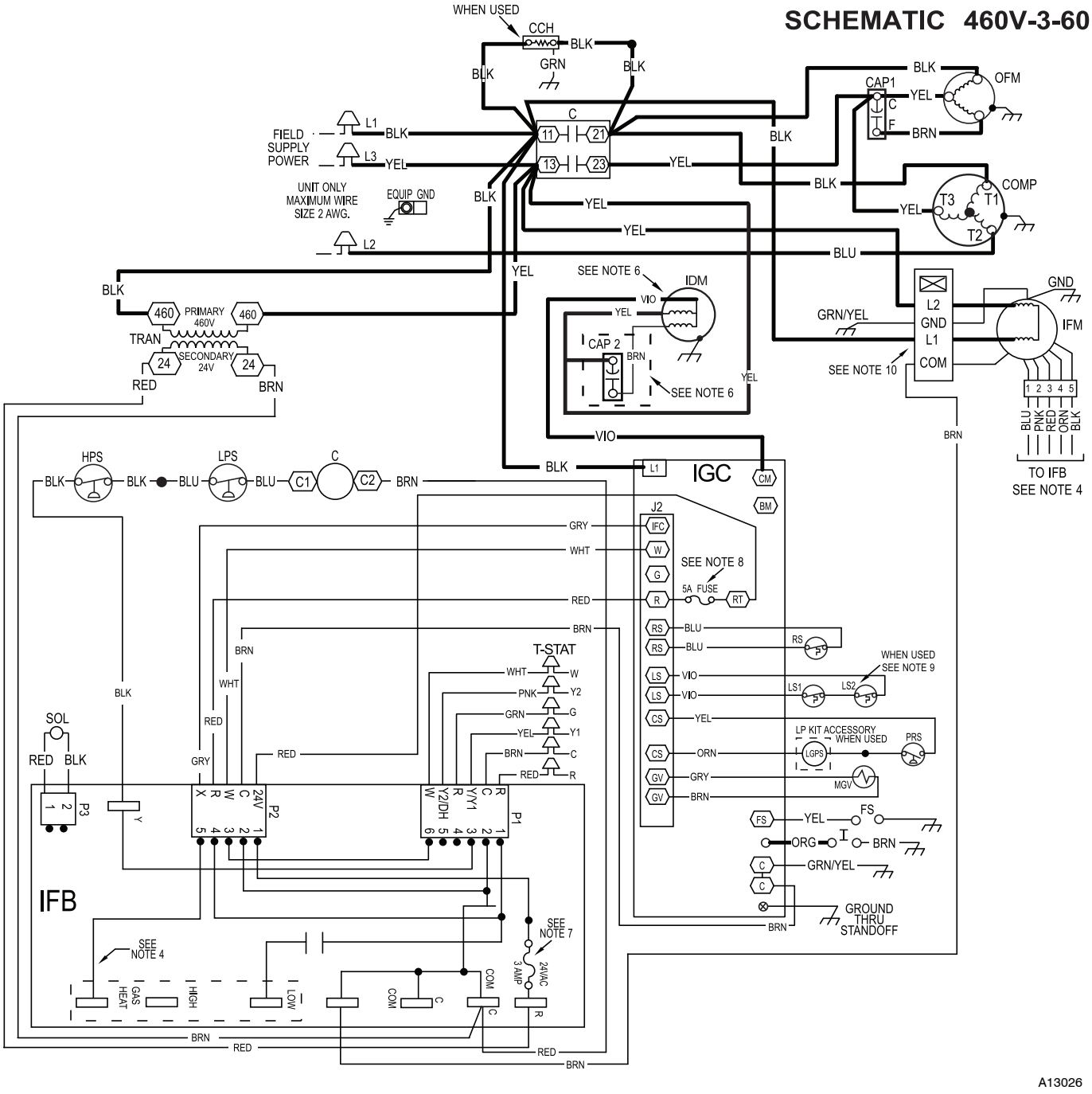
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A14617

CONNECTION WIRING SCHEMATIC 460-3-60

CONNECTION WIRING DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING



A13026

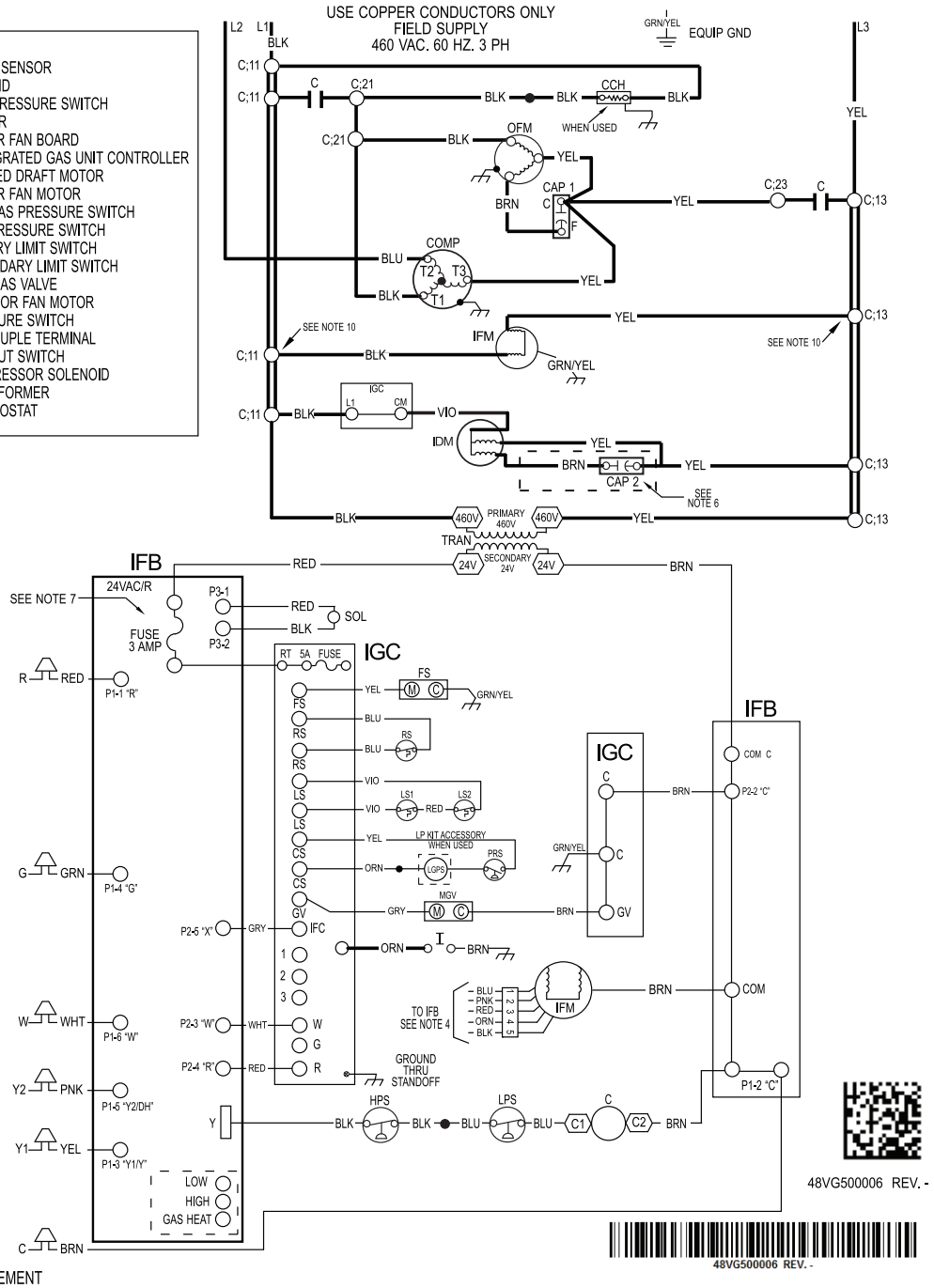
LADDER WIRING DIAGRAM 460-3-60

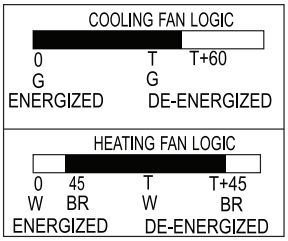
LADDER WIRING DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING

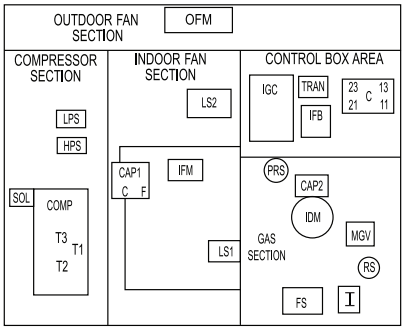
LEGEND

	FIELD SPLICE	FS	FLAME SENSOR
	TERMINAL (MARKED)	GND	GROUND
	TERMINAL (UNMARKED)	HPS	HIGH PRESSURE SWITCH
	SPLICE	I	IGNITOR
	SPLICE (MARKED)	IFB	INDOOR FAN BOARD
	FACTORY LO VOLTAGE	IGC	INTERGRATED GAS UNIT CONTROLLER
	FIELD CONTROL WIRING	IDM	INDUCED DRAFT MOTOR
	FIELD POWER WIRING	IFM	INDOOR FAN MOTOR
	ACCESSORY OR OPTIONAL WIRING	LGPS	LOW GAS PRESSURE SWITCH
	FACTORY HI VOLTAGE	LPS	LOW PRESSURE SWITCH
C	CONTACTOR	LS1	PRIMARY LIMIT SWITCH
CAP 1	CAPACITOR, COMP	LS2	SECONDARY LIMIT SWITCH
CAP 2	CAPACITOR, INDUCER	MGV	MAIN GAS VALVE
COMP	COMPRESSOR MOTOR	OFM	OUTDOOR FAN MOTOR
CCH	CRANK CASE HEATER	PRS	PRESSURE SWITCH
EQUIP	EQUIPMENT	QT	QUADRUPLE TERMINAL
		RS	ROLLOUT SWITCH
		SOL	COMPRESSOR SOLENOID
		TRAN	TRANSFORMER
		T-STAT	THERMOSTAT





3Ø UNIT COMPONENT ARRANGEMENT



NOTES:

1. IF ANY OF THE ORIGINAL WIRES FURNISHED ARE REPLACED, THEY MUST BE REPLACED WITH THE SAME WIRE OR IT'S EQUIVALENT.
2. SEE PRE SALE LITERATURE FOR THERMOSTAT.
3. USE 75 DEGREE COPPER CONDUCTORS FOR FIELD INSTALLATION.
4. SEE INSTALLATION INSTRUCTIONS FOR PROPER HEATING AND COOLING CONNECTIONS FOR YOUR UNIT.
5. LS2 USED ON SMALL CHASSIS ONLY.
6. INDUCER CAPACITOR AND WIRING ON CERTAIN MODELS ONLY. IF CAP2 IS PRESENT, YELLOW WIRES FROM CONTACTOR AND IDM CONNECT ON SAME SIDE OF CAP2.
7. THIS FUSE IS MANUFACTURED BY LITTLE FUSE, P/N 287003.
8. THIS FUSE IS MANUFACTURED BY LITTLEFUSE, P/N 257005.
9. ON SOME MODELS LS1 AND LS2 ARE WIRED IN SERIES. ON OTHER MODELS ONLY LS1 IS USED.
10. DO NOT DISCONNECT PLUG UNDER LOAD.

A13027

CONTROLS

Operating sequence

208/230 VAC Models:

On a call for low stage heating, terminal W1 on the thermostat is energized. On a call for high stage heating both terminals W1 and W2 are energized. Regardless of the stage of the heating call, the induced-draft motor is turned on to high speed for a 15 sec pre-purge time. After the pre-purge, when the pressure switch senses that sufficient combustion air is being moved by the induced-draft motor, the ignition sequence begins. The IGC will energize the sparker and the low stage gas valve solenoid. Upon sensing flame, the IGC will check the heating call. If W2 is not energized, the IGC will drop the induced-draft motor to low speed and maintain the gas valve on low stage. If W2 is energized, the IGC will maintain the induced-draft motor on high speed and energize the high stage gas valve solenoid. Thirty sec after flame is sensed the IGC will turn on the evaporator fan motor. If W2 is not energized, the evaporator fan motor will run on low heat speed. If W2 is energized, the evaporator fan motor will run on high heat speed. After the call for heat is satisfied, the IGC will run the evaporator fan motor an additional field-selectable time of 90, 120, 150, or 180 sec before shutting the evaporator fan motor off.

460 VAC Models:

On a call for heating, terminal W of the thermostat is energized, starting the induced-draft motor. When the pressure switch senses that the induced-draft motor is moving sufficient combustion air, the ignition sequence begins. This function is performed by the integrated gas unit controller (IGC). The indoor (evaporator)-fan motor is energized 45 sec after flame is established. When the thermostat is satisfied and W is de-energized, the burners stop firing and the indoor (evaporator) fan motor shuts off after a 45-sec time-off delay. Please note that the IGC has the capability to automatically reduce the indoor fan motor on delay and increase the indoor fan motor off delay in the event of high duct static and/or partially-clogged filter.

Cooling — When the system thermostat calls for cooling, 24 V is supplied to the "Y1/Y" and "G" terminals of the thermostat. This completes the circuit to the contactor coil (C) and indoor (evaporator) fan relay (IFR). The normally open contacts of energized C close and complete the circuit through compressor motor (COMP) to outdoor (condenser) fan motor (OFM). Both motors start instantly. The set of normally open contacts of energized IFR close and complete the circuit through IFM. The IFM starts instantly.

On the loss of the thermostat call for cooling, 24 V is removed from both the "Y1/Y" and "G" terminals (provided the fan switch is in the "AUTO" position) de-energizing the compressor contactor and opening the contacts supplying power to compressor/OFM. After a 60-second delay, the IFM shuts off. If the thermostat fan selector switch is in the "ON" position, the IFM will run continuously.

NOTE: On units with a Time Guard® II device: Once the compressor has started and then stopped, it cannot be restarted again until 5 minutes have elapsed.

GUIDE SPECIFICATIONS

Packaged Gas Heating/Electric Cooling Units Constant Volume Application

HVAC Guide Specifications

Size Range: **2 to 5 Tons, Nominal Cooling**
40,000 to 130,000 Btuh,
Nominal Heating Input

SYSTEM DESCRIPTION

Outdoor rooftop or ground mounted air conditioner and gas furnace system utilizing a two-stage scroll compressor for cooling duty. Unit shall discharge supply air vertically or horizontally as shown on contract drawings. Outdoor fan/coil section shall have a draw-thru design with vertical discharge for minimum sound levels.

QUALITY ASSURANCE

A. Unit shall be rated in accordance with AHRI Standards 210/240 and 270-1995.

B. Unit shall be designed in accordance with UL Standard 1995 and ANSI Z 21.47.

C. Unit shall be manufactured in a facility registered to ISO 9001 manufacturing quality standard.

D. Unit shall be UL listed and c-UL certified as a total package for safety requirements.

E. Roof curb shall be designed to conform to NRCA Standards.

F. Insulation and adhesives shall meet NFPA 90.1 requirements for flame spread and smoke generation.

G. Cabinet insulation shall meet ASHRAE Standard 62.2.

DELIVERY, STORAGE AND HANDLING

Unit shall be stored and handled per manufacturer's recommendations.

Part 2 — Products

EQUIPMENT

A. General:

Factory-assembled, single-piece, heating and cooling unit. Contained within the enclosure shall be all factory wiring, piping, controls, refrigerant charge with R-410A refrigerant, and special features required prior to field start-up.

B. Unit Cabinet:

1. Unit cabinet shall be constructed of phosphated, zinc-coated, pre-painted steel capable of with-standing 500 hours in salt spray.
2. Normal service shall be through 3 removable cabinet panels.
3. The unit shall be constructed on a rust proof unit base that has an externally trapped, integrated sloped drain.
4. Evaporator fan compartment top surface shall be insulated with a minimum 1/2-in. (12.7 mm) thick, flexible fiberglass insulation, coated on the air side and retained by adhesive and mechanical means. The evaporator wall sections will be insulated with a minimum semi-rigid foil-faced board capable of being wiped clean. Aluminum foil-faced fiberglass insulation shall be used in the entire indoor air cavity section.
5. Unit shall have a field-supplied condensate trap.

C. Fans:

1. The evaporator fan shall be a multi-speed, direct-drive, as shown on equipment drawings.
2. Fan wheel shall be made from steel, be double-inlet type with forward curved blades with corrosion resistant finish. Fan wheel shall be dynamically balanced.
3. Condenser fan shall be direct drive propeller type with aluminum blades riveted to corrosion resistant steel spiders, be dynamically balanced, and discharge air vertically.

D. Compressor:

1. Fully hermetic compressors with factory-installed vibration isolation.
2. Two-stage scroll compressors shall be standard on all units.

E. Coils:

Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Tube sheet openings shall be belled to prevent tube wear.

F. Heating Section:

1. Induced-draft combustion type with energy saving direct spark ignition system and redundant main gas valve.
2. Induced-draft motors shall provide adequate airflow for combustion.
3. The heat exchangers shall be constructed of aluminized steel for corrosion resistance.
4. Burners shall be of the in-shot type constructed of aluminum coated steel.
5. All gas piping and electric power shall enter the unit cabinet at a single location.

G. Refrigerant Components:

Refrigerant expansion device shall be of the TXV (thermostatic expansion valve) type.

H. Filters:

Filter section shall consist of field-installed, throwaway, 1-in. (25 mm) thick fiberglass filters of commercially available sizes.

I. Controls and Safeties:

1. Unit controls shall be complete with a self-contained low voltage control circuit.
2. Compressors shall incorporate a solid-state compressor protector that provides reset capability.

J. Operating Characteristics:

1. Unit shall be capable of starting and running at 125°F (51°C) ambient outdoor temperature per maximum load criteria of AHRI Standard 210.
2. Compressor with standard controls shall be capable of operation down to 40°F (4°C) ambient outdoor temperature.
3. Units shall be provided with fan time delay to prevent cold air delivery before the heat exchanger warms up.
4. Unit shall be provided with fan time delay after the thermostat is satisfied.

K. Electrical Requirements:

All unit power wiring shall enter the unit cabinet at a single location.

L. Motors:

1. Compressor motors shall be of the refrigerant-cooled type with line-break thermal and current overload protection.
2. All fan motors shall have permanently lubricated bearings, and inherent, automatic reset, thermal overload protection.
3. Condenser fan motor shall be totally enclosed.
4. Evaporator Fan Motor to be multi-speed ECM blower motor.

M. Compressor Protection:

Solid-state control shall protect compressor by preventing "short cycling."

GUIDE SPECIFICATIONS (CONT)

N. Low NOx:
Shall provide NOx reduction to values below 40 nanograms/joule to meet California's and other localities' emission requirements as shipped from factory.

O. Special Option/Kits Available:

1. Coil Options
Base unit with tin plated indoor coil hairpins available as a factory installed option.
2. Compressor Start Kit (single phase units only):
Shall provide additional starting torque for single-phase compressors.
3. Corporate Thermostat:
To provide for one-stage heating and cooling in addition manual or automatic changeover and indoor fan control.
4. Crankcase Heater Kit:
Shall provide anti-floodback protection for low-load cooling applications.
5. Economizer for two-stage operation:
(Horizontal and Vertical with Jade Honeywell W7220 controller, Honeywell communicating actuator, and dry bulb sensor. (Contact MicroMetl Customer Service at 1-800-662-4822 to order.)
NOTE: The enhanced dehumidification feature on high stage cooling does not support use of an economizer.
   a. Economizer controls capable of providing free cooling using outside air.
   b. Equipped with low leakage dampers not to exceed 3% leakage, at 1.0 IN. W.C. pressure differential.
   c. Spring return motor shuts off outdoor damper on power failure.
6. Filter Rack Option or Kit:
Shall provide filter mounting for downflow applications. Offered as an accessory or as a factory installed option.
7. Flat Roof Curb Kit:
Curbs shall have seal strip and a wood nailer for flashing and shall be installed per manufacturer's instructions.
8. Flue Discharge Deflector Kit
Directs flue gas exhaust; 90 degrees upward from current discharge.
9. Heat Exchanger Option
Stainless Steel Heat Exchanger available as a factory installed option.
10. High Altitude Propane Conversion Kit:
Shall consist of all required hardware to convert to propane gas heat operation at 2001 to 6000 ft (611 to 1829 m) above sea level.
11. Low Ambient Package Kit:
Shall consist of a solid-state control and condenser coil temperature sensor for controlling condenser-fan motor operation, which shall allow unit to operate down to 0°F (-18°C) outdoor ambient temperature when properly installed.
12. Manual Outdoor Air Damper Kit:
Package shall consist of damper, birdscreen, and rainhood which can be preset to admit outdoor air for year-round ventilation.
13. Natural-to-Propane Conversion Kit:
Shall be complete with all required hardware to convert to propane gas operation at 10.0 IN. W.C. manifold pressure.
14. Propane-to-Natural Conversion Kit
Shall be complete with all hardware to convert to natural gas at standard altitude (0 to 2000 ft [0 to 610 m] above sea level).
15. Square-To-Round Duct Transitions Kit (24-48 models):
Shall have the ability to convert the supply and return openings from rectangular to round.

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Edition Date: 12/14

Catalog No: 48VG–02PD

Manufacturer reserves the right to change, at any time, specifications and designs without notice and without obligations.

Replaces: 48VG–01PD

48HC
High Efficiency
Gas Heat/Electric Cooling Packaged Rooftop
3 to 12.5 Nominal Tons

Carrier
turn to the experts

Product Data

WeatherMaster®



C10222

Puron™
the environmentally sound refrigerant

ENERGY STAR

ASHRAE 90.1 COMPLIANT

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Carrier
turn to the experts

The Carrier rooftop unit (RTU) was designed by customers for customers. With “no-strip” screw collars, handled access panels, and more we’ve made your unit easy to install, easy to maintain and easy to use.

Easy to install:

All WeatherMaster® units are field-convertible to horizontal air flow, which makes it easy to adjust to unexpected job-site complications. Lighter units make easy replacement. Most of Carrier’s 3-12.5 ton 48HC rooftops fit on existing Carrier curbs dating back to 1989. Also, our large control box gives you room to work and room to mount Carrier accessory controls.

Easy to maintain:

Easy access handles by Carrier provide quick and easy access to all normally serviced components. Our “no-strip” screw system has superior holding power and guides screws into position while preventing the screw from stripping the unit’s metal. Take accurate pressure readings by reading condenser pressure with panels on. Simply remove the black, composite plug, route your gauge line(s) through the hole, and connect them to the refrigeration service valve(s). Now, you can take refrigeration system pressure readings without affecting the condenser airflow.

Easy to use:

The newly designed, central terminal board by Carrier puts all your connections and troubleshooting points in one convenient place, standard. Most low voltage connections are made to the same board and make it easy to find what you’re looking for and easy to access it. Carrier rooftops have high and low pressure switches, a filter drier, and 2-in (51mm) filters standard.

FEATURES AND BENEFITS

- Single-stage cooling capacity control on 04 to 07 models, 2-stage cooling capacity control on 08 to 14 models
- SEER up to 15.6, EER up to 13.0
- IEER's up to 13.0 with single speed indoor fan motor, and up to 14.3 with SAV™ (Staged Air Volume) 2-speed/VFD indoor fan motor system
- Exclusive non-corrosive composite condensate pan in accordance with ASHRAE 62 Standard, sloping design; side or center drain
- Gas efficiencies up to 82%
- Induced draft combustion design
- Redundant gas valve, with up to 2 stages of heating
- Pre-painted exterior panels and primer-coated interior panels tested to 500 hours salt spray protection
- TXV refrigerant metering system on each circuit
- Fully insulated cabinet
- Exclusive IGC solid-state control for on-board diagnostics with LED error code designation, burner control logic and energy saving indoor fan motor delay
- Dedicated 3-5 ton "Low NOx" models available that meet California Air Quality Management NOx requirement of 40 nangram/joule or less. Low NOx models include stainless steel heat exchangers
- Cooling operating range up to 125°F (52°C), and down to 35°F (2°C), 0°F (-18°C) on 11 size standard
- Access panels with easy grip handles
- Innovative , easy starting, no-strip screw feature on unit access panels
- Two-inch disposable return air filters
- Tool-less filter access door
- Belt drive evaporator-fan motor and pulley combinations available on all three phase models
- Electric Drive X13 (5 speed/torque) motor on 04 to 06 models
- New terminal board facilitating simple safety circuit troubleshooting and simplified control box arrangement
- Field Convertible airflow (3-12.5 ton). Being able to convert a unit from vertical airflow to horizontal makes it easy to overcome job site complications. 12.5 ton models require a simple supply air duct cover to field convert from factory vertical to horizontal.
- Provisions for thru-the-bottom power entry capability as standard
- Single point gas and electric connections
- Full perimeter base rail with built-in rigging adapters and fork truck slots
- Scroll compressors with internal line-break overload protection
- 24-volt control circuit protected with resettable circuit breaker
- Permanently lubricated evaporator-fan motor
- Totally enclosed condenser motors with permanently lubricated bearings
- Low Pressure switch and high-pressure switch protection
- Exclusive IGC anti-cycle protection for gas heat operation
- Solid-state electronic direct spark ignition system
- Flame roll-out safety protector
- Liquid line filter drier on each circuit
- Factory-installed Humidi-MiZer® Adaptive Dehumidification System on all sizes, includes MotorMaster I controller.
- Standard Warranty: 10 yr. aluminized heat exchanger, 15 yr. stainless steel heat exchanger, 5 yr. compressor, 1 yr. parts.
- Optional SAV system utilizes a Variable Frequency Drive (VFD) to automatically adjust the indoor fan motor speed between cooling stages. Available on 2-stage cooling models 08-14 with electromechanical, ComfortLink or RTU Open controls.

MODEL NUMBER NOMENCLATURE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	8	H	C	–	D	0	8	A	3	A	5	–	D	A	0	A	0

Product Type
48 = Gas Heat Pkg. Rooftop

Model Series – WeatherMaster
HC = High Efficiency

Heat Size
D = Low Gas Heat
E = Medium Gas Heat
F = High Gas Heat
L = Low No_x – Low gas heat
M = Low No_x – Med gas heat
N = Low No_x – High gas heat
S = Low Heat w/Stainless Steel Exchanger
R = Med Heat w/Stainless Steel Exchanger
T = High Heat w/Stainless Steel Exchanger
(Low No_x models incl. Stainless Steel HX)

Refrigerant System Options
A = Single stage cooling models
B – Single stage cooling w/Humidi–Mizer
D = 2 stage Cooling
E = 2 stg cooling w/Humidi–MiZer
F = Single stg cool w/MotorMaster low amb cntl
G = 2 stg cool w/Motormaster low amb cntl

Cooling Tons
04 = 3 ton
05 = 4 ton
06 = 5 ton
07 = 6 ton
08 = 7.5 ton
09 = 8.5 ton
11 = 10 ton (12.0 EER)
12 = 10 ton (11.5 EER)
14 = 12.5 ton

Sensor Options
A = None
B = RA Smoke Detector
C = SA Smoke Detector
D = RA + SA Smoke Detector
E = CO_2 Sensor
F = RA Smoke Detector + CO_2
G = SA Smoke Detector + CO_2
H = RA + SA Smoke Detector + CO_2

Indoor Fan Options 3, 4, 5 Ton Models Only*
0 = Electric (Direct) Drive x13 motor
2 = Medium Static Option – Belt Drive
3 = High Static Option – Belt Drive
Indoor Fan Options 66–12.5 Ton Models Only
1 = Standard Static Option – Belt Drive
2 = Medium Static Option – Belt Drive
3 = High Static Option – Belt Drive
C = High Static Option w/High Eff Motor – Belt Drive

*See Price page details for specific Humidi–MiZer models

Note: On single phase (–3 voltage code models, the Following are not available as a factory installed option:
– Humidi–MiZer
– Coated coils or Cu fin coils
– Louvered hail guard
– Economizer or 2 position damper
– Powered 115 volt convenience outlet

Coil Options (Outdoor–Indoor–Hail Guard)
A = Al/Cu – Al/Cu
B = Pre–coat Al/Cu – Al/Cu
C = E–coat Al/Cu – Al/Cu
D = E–coat AL/Cu – E–coat AL/Cu
E = Cu/Cu – Al/Cu
F = Cu/Cu – Cu/Cu
M = Al/Cu – Al/Cu – Louvered Hail Guard
N = Pre–Coat Al/Cu – Al/Cu – Louvered Hail Guard
P = E–Coat Al/Cu – Al/Cu Louvered Hail Guard
Q = E–Coat Al/Cu – E–coat Al/Cu – Louvered Hail Guard
R – Cu/Cu – Al/Cu – Louvered Hail Guard
S – Cu/Cu – Cu/Cu – Louvered Hail Guard

Voltage
1 = 575/3/60
5 = 208–230/3/60
6 = 460/3/60

Design Revision
– = Factory Design Revision

Base Unit Controls
0 = Base Electromechanical Controls
1 = PremierLink Controller
2 = RTU Open Multi–Protocol Controller
6 = Electromechanical w/2 spd fan and W7220 Econo controller
D = ComfortLink Controls

Intake / Exhaust Options
A = None
B = Temperature Economizer w/Barometric Relief
F = Enthalpy Economizer w/Barometric Relief
K = 2 position Damper
U = Temp Ultra Low Leak Economizer w/Baro Relief
W = Enthalpy Ultra Low Leak Econo w/Baro Relief

Service Options
0 = None
1 = Un–powered Convenience Outlet
2 = Powered Convenience Outlet
3 = Hinged Panels
4 = Hinged Panels, un–powered C.O.
5 = Hinged Panels, powered C.O.
C = Foil faced insulation

Electrical Options
A = None
B = HACR breaker
C = Non–fused disconnect
D = Thru–the–base Connections
F = Non–fused Disconn & thru–the–base
G = 2–speed indoor fan (VFD) controller
J = 2–spd contr (VFD) & non–fused disc.
K = 2 spd contr & thru–the–base
L = 2spd fan contr (VFD) &non–fused disc
N = 2 spd contr w/non–fused disc & thru–the–base conn.

Packaging
0 = Standard
1 = LTL

Not all possible options can be displayed above – see price pages or contact your Carrier Expert for more details.

Table 1 – FACTORY-INSTALLED OPTIONS AND FIELD-INSTALLED ACCESSORIES

CATEGORY	ITEM	FACTORY INSTALLED OPTION	FIELD INSTALLED ACCESSORY
Cabinet	Thru–the–base electrical or gas–line connections	X	X
	Hinged access panels	X	
	Supply duct cover – 14 size only		X
	Foil faced insulation throughout entire cabinet	X	
Coil Options	Cu/Cu indoor and/or outdoor coils[1]	X	
	Pre–coated outdoor coils[1]	X	
	Premium, E–coated outdoor coils[1]	X	
Humidity Control	Humidi–MiZer Adaptive Dehumidification System[1]	X	
Condenser Protection	Condenser coil hail guard (louvered design)[1]	X	X
Controls	Thermostats, temperature sensors, and subbases		X
	PremierLink™ DDC communicating controller	X	X
	ComfortLink Controls	X	
	RTU Open Multi–Protocol Controller	X	
	Smoke detector (supply and/or return air)	X	
	Time Guard II compressor delay control circuit		X
	Phase Monitor		X
Economizers & Outdoor Air Dampers	EconoMi$er™ IV (for electro–mechanical controlled RTUs)[1]	X	X
	EconoMi$er™2 (for DDC controlled RTUs)[1]	X	X
	Motorized 2 position outdoor–air damper[1]	X	X
	Manual outdoor–air damper (25% and 50%)	X	X
	Barometric relief[2]	X	X
	Power exhaust (prop design)		X
	Ultra Low Leak EconoMi$er X (for 2–speed SAV system only, 08–14 sizes with 2 stages of cooling), vertical supply and return air only.	X	X
Economizer Sensors & IAQ Devices	Single dry bulb temperature sensors[3]	X	X
	Differential dry bulb temperature sensors[3]		X
	Single enthalpy sensors[3]	X	X
	Differential enthalpy sensors[3]		X
	Wall or duct mounted CO_2 sensor[3]		X
	Unit mounted CO_2 sensor[3]	X	
Gas Heat	Propane conversion kit		X
	Stainless steel heat exchanger	X	
	High altitude conversion kit		X
	Flue Shield (04–12 models only)		X
	Flue Discharge Deflector (04–12 models only)		X
Indoor Motor & Drive	Multiple motor and drive packages	X	
	Staged Air Vol (SAV) system w/VFD controller (2–stage cool only with electrical mechanical and RTU Open controls)	X	
	Display Kit for SAV system with VFD		X
Low Ambient Control	Winter start kit[4]		X
	Motormaster head pressure controller to –20°F[4]		X
	Cooling Low Ambient Controller to 0°F (except 11 size)[4]	X	
Power Options	Convenience outlet (powered)[1,5]	X	
	Convenience outlet (unpowered)	X	
	HACR circuit breaker[6]	X	
	Non–fused disconnect[7]	X	
Roof Curbs	Roof curb 14–in (356mm)		X
	Roof curb 24–in (610mm)		X

NOTES:

1. Not available as factory installed option on single phase (208/230/1/60) models. Use field installed accessory where available.
2. Included with economizer.
3. Sensors used to optimize economizer performance.
4. See application data for assistance.
5. Powered convenience outlet is not available on 11 size with ComfortLink or RTU Open controls
6. HACR circuit breaker cannot be used when rooftop MOCP electrical rating exceeds:
   04–12 sizes – 208/230/1/60 and 208/230/3/60 = 100 amps, 460/3/60 = 90 amps, 575/3/60 = 70 amps.
   14 size – 208/230/3/60 = 200 amps, 460/3/60 = 90 amps, 575/3/60 = 80 amps.
   HACR circuit breaker on 575 volt can only be used on Wye power supply. Delta power supply is prohibited. Carrier RTUBuilder automatically selects the amp limitations.
7. Non–fused disconnect switch (04–12 sizes) cannot be used when unit FLA electrical rating exceeds:
   208/230/1/60 and 208/230/3/60 = 80 amps, 460/3/60 and 575/3/60 = 80 amps.
   Non–fused disconnect switch (14 size) cannot be used when unit FLA electrical rating exceeds:
   208/230/3/60 = 100 amps, 460/3/60 and 575/3/60 = 100 amps.
   Carrier RTUBuilder automatically selects the amp limitations.

FACTORY OPTIONS AND/OR ACCESSORIES

Economizer (dry-bulb or enthalpy)

Economizers save money. They bring in fresh, outside air for ventilation; and provide cool, outside air to cool your building. This is the preferred method of low-ambient cooling. When coupled to CO_2 sensors, economizers can provide even more savings by coupling the ventilation air to only that amount required.

Economizers are available, installed and tested by the factory, with either enthalpy or dry-bulb temperature inputs. There are also models for electromechanical as well as direct digital controllers. Additional sensors are available as accessories to optimize the economizers.

Economizers include gravity controlled, barometric relief equalizes building pressure and ambient air pressures. This can be a cast effective solution to prevent building pressurization.

CO_2 Sensor

Improves productivity and saves money by working with the economizer to intake only the correct amount of outside air for ventilation. As occupants fill your building, the CO_2 sensor detects their presence through increasing CO_2 levels, and opens the economizer appropriately.

When the occupants leave, the CO_2 levels decrease, and the sensor appropriately closes the economizer. This intelligent control of the ventilation air, called Demand Control Ventilation (DCV) reduces the overall load on the rooftop, saving money.

Smoke Detectors

Trust the experts. Smoke detectors make your application safer and your job easier. Carrier smoke detectors immediately shut down the rooftop unit when smoke is detected. They are available, installed by the factory, for supply air, return air, or both.

Louvered Hail Guards

Sleek, louvered panels protect the condenser coil from hail damage, foreign objects, and incidental contact.

Convenience Outlet (powered or un-powered)

Reduce service and/or installation costs by including a convenience outlet in your specification. Carrier will install this service feature at our factory. Provides a convenient, 15 amp, 115v GFCI receptacle with “Wet in Use” cover. The “powered” option allows the installer to power the outlet from the line side of the disconnect or load side as required by code. The “unpowered” option is to be powered from a separate 115/120v power source.

Non-fused Disconnect

This OSHA-compliant, factory-installed, safety switch allows a service technician to locally secure power to the rooftop.

Power Exhaust with Barometric Relief

Superior internal building pressure control. This field-installed accessory may eliminate the need for costly, external pressure control fans.

PremierLink™, DDC Controller

This CCN controller regulates your rooftop’s performance to tighter tolerances and expanded limits, as well as facilitates zoning systems and digital accessories. It also unites your Carrier HVAC equipment together on one, coherent CCN network. The PremierLink can be factory-installed, or easily field-installed.

RTU Open, Multi-Protocol Controller

Connect the rooftop to an existing BAS without needing complicated translators or adapter modules using the RTU Open controller. This new controller speaks the 4 most common building automation system languages (Bacnet, Modbus, N2, and Lonworks). Use this controller when you have an existing BAS. Besides the 4 protocols, it also communicates with a Carrier Open system (I-Vu and VVT).

Time Guard II Control Circuit

This accessory protects your compressor by preventing short-cycling in the event of some other failure, prevents the compressor from restarting for 30 seconds after stopping. Not required with PremierLink, RTU Open, or authorized commercial thermostats.

Motorized 2-Position Damper

The new Carrier 2-position, motorized outdoor air damper admits up to 100% outside air. Using reliable, gear-driven technology, the 2-position damper opens to allow ventilation air and closes when the rooftop stops, stopping unwanted infiltration.

Manual OA Damper

Manual outdoor air dampers are an economical way to bring in ventilation air. The dampers are available in 25% and 50% versions.

Optional Humidi-MiZer Adaptive Dehumidification System

Carrier’s Humidi-MiZer adaptive dehumidification system is an all-inclusive factory installed option that can be ordered with any WeatherMaster 48HC04-14 rooftop unit.

This system expands the envelope of operation of Carrier’s WeatherMaster rooftop products to provide unprecedented flexibility to meet year round comfort conditions.

The Humidi-MiZer adaptive dehumidification system has the industry’s only dual dehumidification mode setting. The Humidi-MiZer system includes two new modes of operation.

FACTORY OPTIONS AND/OR ACCESSORIES (cont.)

Optional Humidi-MiZer Adaptive Dehumidification System (cont.)

The WeatherMaster 48HC04-14 rooftop coupled with the Humidi-MiZer system is capable of operating in normal design cooling mode, subcooling mode, and hot gas reheat mode. Normal design cooling mode is when the unit will operate under its normal sequence of operation by cycling compressors to maintain comfort conditions.

Subcooling mode will operate to satisfy part load type conditions when the space requires combined sensible and a higher proportion of latent load control. Hot Gas Reheat mode will operate when outdoor temperatures diminish and the need for latent capacity is required for sole humidity control. Hot Gas Reheat mode will provide neutral air for maximum dehumidification operation.

Staged Air Volume (SAV) Indoor Fan Speed System

Carrier's Staged Air Volume (SAV) system saves energy and installation time by utilizing a Variable Frequency Drive (VFD) to automatically adjust the indoor fan motor speed in sequence with the units cooling operation. Per ASHRAE 90.1 2010 standard section 6.4.3.10.b, during the first stage of cooling operation the VFD will adjust the fan motor to provide 2/3rd of the total cfm established for the unit. When a call for the second stage of cooling is required, the VFD will allow the total cfm for the unit established (100%). During the heating mode the VFD will allow total design cfm (100%) operation and during the ventilation mode the VFD will allow operation to 2/3rd of total cfm.

Compared to single speed indoor fan motor systems, Carrier's SAV system can save substantial energy, 25%+*, versus single speed indoor fan motor systems.

The VFD used in Carrier's SAV system has soft start capabilities to slowly ramp up the speeds, thus eliminating any high inrush air volume during initial start-up. It also has internal over current protection for the fan motor and a field installed display kit that allows adjustment and in depth diagnostics of the VFD.

This SAV system is available on models with 2-stage cooling operation with electrical mechanical or RTU Open, Multi Protocol controls. Both space sensor and conventional thermostats controls can be used to provide accurate control in any application.

The SAV system is very flexible for initial fan performance set up and adjustment. The standard factory shipped VFD is pre-programmed to automatically stage the fan speed between the first and second stage of cooling. The unit fan performance static pressure and cfm can be easily adjusted using the traditional means of pulley adjustments. The other means to adjust the unit static and cfm performance is to utilize the field installed Display Kit and adjust the frequency and voltage in the VFD to required performance requirements. In either case, once set up, the VFD will automatically adjust the speed between the cooling stage operations.

*Data based on .10 ($/kWh) in an office application utilizing Carrier's HAP 4.6 simulation software program

Hinged Access Panels

Allows access to unit's major components with specifically designed hinged access panels. Panels are: filter, control box, fan motor and compressor.

MotorMaster Head Pressure Controller

The MotorMaster motor controller is a low ambient, head pressure controller kit that is designed to maintain the unit's condenser head pressure during periods of low ambient cooling operation. This device should be used as an alternative to economizer free cooling not when economizer usage is either not appropriate or desired. The MotorMaster will either cycle the outdoor-fan motors or operate them at reduced speed to maintain the unit operation, depending on the model.

MotorMaster allows cooling operation down to -20°F (-29°C) ambient conditions.

Winter Start Kit

The winter start kit by Carrier extends the low ambient limit of your rooftop to 25°F (-4°C). The kit bypasses the low pressure switch, preventing nuisance tripping of the low pressure switch. Other low ambient precautions may still be prudent.

Propane Heating

Convert your gas heat rooftop from standard natural gas operation to Propane using this field-installed kit.

High Altitude Heating

High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion at altitudes above 2000 ft (610m). Kits may not be required in all areas.

Flue Discharge Deflector

The flue discharge deflector is a useful accessory when flue gas recirculation is a concern. By venting the flue discharge upwards, the deflector minimizes the chance for a neighboring unit to intake the flue exhaust (04-12 models only).

FACTORY OPTIONS AND/OR ACCESSORIES (cont.)

Optional Stainless Steel Heat Exchanger

The stainless steel heat exchanger option provides the tubular heat exchanger be made out of a minimum 20 gauge type 409 stainless steel for applications where the mixed air to the heat exchanger is expected to drop below 45°F (7°C). Stainless steel may be specified on applications where the presence of airborne contaminants require its use (applications such as paper mills) or in area with very high outdoor humidity that may result in severe condensation in the heat exchanger during cooling operation.

Flue Discharge Heat Shield

The flue discharge heat shield keeps people from touching the rooftop unit's potentially hot flue discharge. This is especially useful for ground level applications, where more, untrained people could have access to the unit's exterior (04-12 models only).

Alternate Motors and Drives

Some applications need larger horsepower motors, some need more airflow, and some need both. Regardless of the case, your Carrier expert has a factory installed combination to meet your application. A wide selection of motors and pulleys (drives) are available, factory installed, to handle nearly any application.

Thru-the-Base Connections

Thru-the-base connections, available as either an accessory or as a factory option, are necessary to ensure proper connection and seal when routing wire and piping through the rooftop's basepan and curb. These couplings eliminate roof penetration and should be considered for gas lines, main power lines, as well as control power.

ComfortLink Controls

Models with the optional Carrier ComfortLink Controls allow added unit diagnostics and operation setup capabilities, as well as controlling logic for single zone Variable Air Volume (VAV) applications.

The ComfortLink control is your link to a world of simple and easy to use rooftop units that offer outstanding performance and value. It optimizes the performance of the refrigeration circuits as conditions change, resulting in the following features:

- Better control of temperature and humidity
- Superior reliability
- Automatic redundancy
- Low ambient cooling operation to 0°F (-18°C)
- More accurate diagnostics, at unit or remote

The ComfortLink Scrolling Marquee is very easy to use. The messages are displayed in easy to understand English, no decoding is required. A scrolling readout provides detailed explanations of control information. Only four, large, easy-to-use buttons are required to maneuver through the entire menu. The readout is designed to be visible even in the brightest sunlight. A handheld Navigator accessory or wall-mounted System Pilot™ accessory can be used for added service flexibility.

The ComfortLink control provides unparalleled service diagnostic information. Temperature and pressure can be read directly from the display with no need for separate gauges. Other data, such as compressor cycles, unit run time hours, current alarms, can also be accessed. A history of alarms is also available for viewing.

The service run test can be very helpful when troubleshooting. The user can run test major components to determine the root cause of a problem. The unit can be run-tested before an installation is complete to ensure satisfactory start-up. To ensure reliability, the ComfortLink control prevents reverse compressor rotation. No laptop computers are required for start-up.

Time schedules are built in and the Scrolling Marquee display provides easy access to setpoints. The ComfortLink control accepts input from a CO_2 sensor and a smoke detector. Both are available as factory installed options or as field installed accessories.

HACR Breaker

These manual reset devices provide overload and short circuit protection for the unit. Factory wired and mounted with the units with access cover to help provide environment protection.

On 575V applications, HACR breaker can only be used with WYE power distribution systems. Use on Delta power distribution systems is prohibited.

Foil Faced Insulated Cabinet

Cabinet is fully insulated with non-fibrous, foil faced cleanable insulation that is secured and encapsulated in unit design.

Low Ambient Controller

The low ambient controller is a head pressure controller kit that is designed to maintain the unit's condenser head pressure during periods of low ambient cooling operation. This device should be used as an alternative to economizer free cooling not when economizer usage is either not appropriate or desired. The low ambient controller will either cycle the outdoor fan motors or operate them at reduced speed to maintain the unit operation, depending on the model. This controller allows cooling operation down to 0°F (-18°C) ambient conditions. (Not available on 11 size models as standard unit cooling operation down to 0°F /-18°C.)

Table 2 – AHRI COOLING RATING TABLE 1-STAGE COOLING

UNIT	COOLING STAGES	NOM. CAPACITY (TONS)	NET COOLING CAPACITY (MBH)	TOTAL POWER (kW)	SEER	EER	IEER
A04	1	3	36.0	2.9	15.00	12.50	–
A05	1	4	48.5	3.7	15.60	13.00	–
A06	1	5	57.5	4.6	15.20	12.45	–
A07	1	6	73.0	6.0	–	12.00	13.00

Table 3 – AHRI COOLING RATING TABLE 2-STAGE COOLING

UNIT	COOLING STAGES	NOM. CAPACITY (TONS)	NET COOLING CAPACITY (MBH)	TOTAL POWER (kW)	EER	IEER WITH SINGLE SPEED INDOOR MOTOR	IEER WITH 2–SPEED INDOOR MOTOR
D08	2	7.5	89.0	7.4	12.0	13.0	13.8
D09	2	8.5	97.0	8.1	12.0	13.0	13.8
D11	2	10.0	111.0	9.3	12.0	12.6	14.3
D12	2	10.0	115.0	10.0	11.5	12.0	12.4
D14	2	12.5	146.0	11.9	12.2	13.0	13.9

LEGEND

–	–	Not Applicable
AHRI	–	Air Conditioning, Heating and Refrigeration Institute Test Standard
ASHRAE	–	American Society of Heating, Refrigerating and Air Conditioning, Inc.
EER	–	Energy Efficiency Ratio
IEER	–	Integrated Energy Efficiency Ratio
SEER	–	Seasonal Energy Efficiency Ratio

Use of the AHRI Certified TM Mark indicates a manufacturer's participation in the program For verification of certification for individual products, go to www.ahridirectory.org.

NOTES:

1. Rated in accordance with AHRI Standards 210/240 (04–06 size) and 340/360 (07–14 size).
2. Ratings are based on:
   Cooling Standard: 80°F (27°C) db, 67°F (19°C) wb indoor air temp and 95°F (35°C) db outdoor air temp.
   IEER Standard: A measure that expresses cooling part–load EER efficiency for commercial unitary air–conditioning and heat pump equipment on the basis of weighted operation at various load capacities.
3. All 48HC units comply with ASHRAE 90.1 and Energy Star Energy Standard for minimum SEER and EER requirements.
4. 48HC units comply with US Energy Policy Act (2005). To evaluate code compliance requirements, refer to state and local codes.

Table 4 – HEATING RATING TABLE - NATURAL GAS & PROPANE

UNITS		GAS HEAT	AL/SS HEAT EXCHANGER		TEMP RISE (DEG F)	THERMAL EFFICIENCY (%)	AFUE (%)
			INPUT / OUTPUT STAGE 1 (MBH)	INPUT / OUTPUT STAGE 2 (MBH)			
Single Phase	04	LOW	–	72 / 56	25 – 55	82%	79.1%
		MED	–	115 / 89	55 – 85	80%	78.5%
		HIGH	–	–	–	–	–
	05	LOW	–	72 / 56	25 – 55	82%	79.1%
		MED	–	115 / 90	35 – 65	81%	79%
		HIGH	–	150 / 117	50 – 80	80%	78.8%
	06	LOW	–	72 / 56	20 – 55	82%	79.1%
		MED	–	115 / 90	30 – 65	81%	79%
		HIGH	–	150 / 117	40 – 80	80%	78.8%
Three Phase	04	LOW	50 / 41	72 / 56	25 – 55	82%	–
		MED	82 / 66	115 / 89	55 – 85	80%	–
		HIGH	–	–	–	–	–
	05	LOW	50 / 41	72 / 56	25 – 55	82%	–
		MED	82 / 66	115 / 90	35 – 65	81%	–
		HIGH	120 / 96	150 / 117	50 – 80	80%	–
	06	LOW	50 / 41	72 / 56	20 – 55	82%	–
		MED	82 / 66	115 / 90	30 – 65	81%	–
		HIGH	120 / 96	150 / 117	40 – 80	80%	–
	07	LOW	50 / 41	72 / 59	15 – 55	82%	–
		MED	90 / 73	125 / 103	20 – 50	82%	–
		HIGH	105 / 84	150 / 120	30 – 60	81%	–
	08	LOW	90 / 73	125 / 103	20 – 50	82%	–
		MED	120 / 98	180 / 148	35 – 65	82%	–
		HIGH	180 / 147	224 / 184	45 – 75	82%	–
	09	LOW	90 / 73	125 / 103	20 – 50	82%	–
		MED	120 / 98	180 / 148	30 – 65	82%	–
		HIGH	180 / 147	224 / 184	40 – 75	82%	–
	11	LOW	120 / 98	180 / 148	25 – 65	82%	–
		MED	180 / 147	224 / 184	30 – 65	82%	–
		HIGH	200 / 160	250 / 205	35 – 70	80%	–
	12	LOW	120 / 98	180 / 148	25 – 65	82%	–
		MED	180 / 147	224 / 184	30 – 65	82%	–
		HIGH	200 / 160	250 / 205	35 – 70	80%	–
	14	LOW	120 / 96	150 / 120	15 – 60	80%	–
		MED	144 / 118	180 / 146	20 – 55	81%	–
		HIGH	192 / 156	240 / 195	25 – 60	81%	–

– Not Applicable

NOTES:

Heat ratings are for natural gas heat exchangers operated at or below 2000 ft (610 m). For information on Propane or altitudes above 2000 ft (610 m), see the Application Data section of this book. Accessory Propane/High Altitude kits are also available.

In the USA the input rating for altitudes above 2000 ft (610m) must be derated by 4% for each 1000 ft (305 m) above sea level. In Canada, the input rating must be derated by 10% for altitudes of 2000 ft (610 m) to 4500 ft (1372 m) above sea level.

Table 5 – HEATING RATING TABLE - LOW NO_X[1]

UNIT		GAS HEAT	LOW NOx HEAT EXCHANGER INPUT / OUTPUT STAGE 1 (MBH)	TEMP RISE (DEG F)	THERMAL EFFICIENCY (%)	AFUE (%)
Single Phase	04	LOW	60 / 47	20 – 50	81%	80.6%
		MED	90 / 72	30 – 60	81%	80.6%
		HIGH	–	–	–	–
	05	LOW	60 / 47	20 – 50	81%	80.6%
		MED	90 / 72	30 – 60	81%	80.6%
		HIGH	120 / 97	40 – 70	81%	81.5%
	06	LOW	60 / 47	15 – 50	81%	80.6%
		MED	90 / 72	25 – 60	80%	80.6%
		HIGH	120 / 97	35 – 70	80%	81.5%
Three Phase	04	LOW	60 / 47	20 – 50	81%	–
		MED	90 / 72	30 – 60	81%	–
		HIGH	–	–	–	–
	05	LOW	60 / 47	20 – 50	81%	–
		MED	90 / 72	30 – 60	81%	–
		HIGH	120 / 97	40 – 70	81%	–
	06	LOW	60 / 47	15 – 50	81%	–
		MED	90 / 72	25 – 60	80%	–
		HIGH	120 / 97	35 – 70	80%	–

– Not Applicable

NOTE:

1. Units meet California's South Coast Air Quality Management District (SCAQMD) Low–NO_x emissions requirement of 40 nanograms per joule or less.

Table 6 – SOUND PERFORMANCE TABLE

UNIT	COOLING STAGES	OUTDOOR SOUND (dB) AT 60								
		A–WEIGHTED	63	125	250	500	1000	2000	4000	8000
A04	1	76	78.2	78.0	74.2	73.3	70.6	66.0	62.4	56.9
A05	1	78	84.7	83.6	77.1	74.6	72.3	68.3	64.7	60.9
A06	1	77	87.5	82.5	76.1	73.6	71.3	67.1	64.1	60.0
A07	1	82	90.1	82.6	81.0	79.4	77.0	73.0	70.4	66.7
D08	2	82	90.6	84.3	80.2	79.3	77.1	72.2	67.4	63.7
D09	2	82	88.6	85.0	81.6	79.5	77.4	74.1	71.0	66.3
D11	2	87	85.9	87.9	85.6	84.4	82.8	78.5	74.9	72.5
D12	2	87	85.9	87.9	85.6	84.4	82.8	78.5	74.9	72.5
D14	2	83	89.3	86.0	82.9	80.7	78.5	73.6	69.6	64.5

LEGEND

dB – Decibel

NOTES:

1. Outdoor sound data is measure in accordance with AHRI.
2. Measurements are expressed in terms of sound power. Do not compare these values to sound pressure values because sound pressure depends on specific environmental factors which normally do not match individual applications. Sound power values are independent of the environment and therefore more accurate.
3. A–weighted sound ratings filter out very high and very low frequencies, to better approximate the response of "average" human ear. A–weighted measurements for Carrier units are taken in accordance with AHRI.

Table 7 – MINIMUM - MAXIMUM AIRFLOW RATINGS - NATURAL GAS & PROPANE

UNIT	HEAT LEVEL	COOLING				HEATING	
		Minimum Single Speed Fan Motor	Minimum 2–speed Fan Motor (at high speed)	Minimum 2–speed Fan Motor (at low speed)	Maximum	Minimum	Maximum
48HC**04	LOW	900	–	–	1500	990	2190
	MED					1000	1550
	HIGH					–	–
48HC**05	LOW	1200	–	–	2000	990	2190
	MED					1330	2460
	HIGH					1390	2220
48HC**06	LOW	1500	–	–	2500	990	2730
	MED					1330	2880
	HIGH					1390	2780
48HC**07	LOW	1800	–	–	3000	990	3640
	MED					1330	4750
	HIGH					1390	3750
48HC**08	LOW	2250	2535	1673	3750	1900	4750
	MED					2100	3900
	HIGH					2270	3780
48HC**09	LOW	2550	2550	1683	4250	1900	4750
	MED					2100	4560
	HIGH					2270	4250
48HC**11	LOW	3000	3380	2231	5000	1900	4750
	MED					2100	4560
	HIGH					2270	4250
48HC**12	LOW	3000	3380	2231	5000	2100	5470
	MED					2620	5670
	HIGH					2650	5290
48HC**14	LOW	3750	4225	2789	6250	1880	7500
	MED					2450	6750
	HIGH					3000	7200

– Not available

Table 8 – PHYSICAL DATA (COOLING) 3 - 6 TONS

		48HC*04	48HC*05	48HC*06	48HC*07
Refrigeration System					
	# Circuits / # Comp. / Type	1 / 1 / Scroll	1 / 1 / Scroll	1 / 1 / Scroll	1 / 1 / Scroll
	Puron® refrigerant (R–410A) charge (lbs–oz)	9 – 0	12 – 8	13 – 3	14 – 0
	Humidi–MiZer Puron refrigerant (R–410A) charge (lbs–oz)	11 – 0	19 – 12	20 – 0	22 – 8
	Metering Device	TXV	TXV	TXV	TXV
	High–press. Trip / Reset (psig)	630 / 505	630 / 505	630 / 505	630 / 505
	Low–press. Trip / Reset (psig)	54 / 117	54 / 117	54 / 117	54 / 117
	Compressor Capacity Staging (%)	100%	100%	100%	100%
Evap. Coil					
	Material (Tube Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al
	Coil type	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF
	Rows / FPI	3 / 15	3 / 15	4 / 15	3 / 15
	Total Face Area (ft^2)	5.5	7.3	7.3	8.9
	Condensate Drain Conn. Size	3/4–in	3/4–in	3/4–in	3/4–in
Humidi–MiZer Coil					
	Material (Tube Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al
	Coil type	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF
	Rows / FPI	1 / 17	2 / 17	2 / 17	2 / 17
	Total Face Area (ft^2)	3.9	5.2	5.2	5.2
Evap. Fan and Motor					
Standard Static 1 phase	Motor Qty / Drive Type	1 / Direct	1 / Direct	1 / Direct	–
	Max BHP	1.0	1.0	1.0	–
	RPM Range	600–1200	600–1200	600–1200	–
	Motor Frame Size	48	48	48	–
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	–
	Fan Diameter (in)	10 x 10	10 x 10	10 x 10	–
Standard Static 3 phase	Motor Qty / Drive Type	1 / Direct	1 / Direct	1 / Direct	1 / Belt
	Max BHP	1.0	1.0	1.0	1.7
	RPM Range	600–1200	600–1200	600–1200	489–747
	Motor Frame Size	48	48	48	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
	Fan Diameter (in)	10 x 10	10 x 10	11 x 10	15 x 15
Standard Static 3 phase*	Motor Qty / Drive Type	1 / Belt	1 / Belt	1 / Belt	–
	Max BHP	1.2	1.2	1.2	–
	RPM Range	560–854	560–854	770–1175	–
	Motor Frame Size	48	48	48	–
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	–
	Fan Diameter (in)	10 x 10	10 x 10	10 x 10	–

* Humidi–MiZer models only
– Not Applicable

Table 8 (cont.) – PHYSICAL DATA (COOLING) 3 – 6 TONS

		48HC*04	48HC*05	48HC*06	48HC*07
Evap. Fan and Motor					
Medium Static 3 phase	Motor Qty / Drive Type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	1.2	1.7	2.4	2.9
	RPM Range	770 – 1175	920 – 1303	1035 – 1466	733 – 949
	Motor Frame Size	48	56	56	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
	Fan Diameter (in)	10 x 10	10 x 10	10 x 10	15 x 15
Medium Static 3 phase*	Motor Qty / Drive Type	1 / Belt	1 / Belt	1 / Belt	–
	Max BHP	1.2	1.7	2.4	–
	RPM Range	770 – 1175	770 – 1175	1035 – 1466	–
	Motor Frame Size	48	48	56	–
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	–
	Fan Diameter (in)	10 x 10	10 x 10	10 x 10	–
High Static 3 phase	Motor Qty / Drive Type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	2.4	2.9	2.9	4.7
	RPM Range	1035 – 1466	1208 – 1639	1303 – 1687	909 – 1102
	Motor Frame Size	56	56	56	14
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
	Fan Diameter (in)	10 x 10	10 x 10	10 x 10	15 x 15
Condenser Coil					
	Material (Tube/Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al
	Coil type	3/8 – in RTPF	3/8 – in RTPF	3/8 – in RTPF	3/8 – in RTPF
	Rows / FPI	2 / 17	2 / 17	2 / 17	2 / 17
	Total Face Area (ft^2)	12.7	21.3	21.3	20.5
Condenser fan / motor					
	Qty / Motor Drive Type	1/ Direct	1/ Direct	1/ Direct	2/ Direct
	Motor HP / RPM	1/8 / 825	1/4 / 1100	1/4 / 1100	1/4 / 1100
	Fan diameter (in)	22	22	22	22
Filters					
	RA Filter # / Size (in)	2 / 16 x 25 x 2	4 / 16 x 16 x 2	4 / 16 x 16 x 2	4 / 16 x 20 x 2
	OA inlet screen # / Size (in)	1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 36 x 1

* Humidi – MiZer models only
– Not Applicable

Table 9 – PHYSICAL DATA (HEATING) 3 - 6 TONS

	48HC**04	48HC**05	48HC**06	48HC**07
Gas Connection				
# of Gas Valves	1	1	1	1
Nat. gas supply line press (in. w.g.)/(PSIG)	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47
Propane supply line press (in. w.g.)/(PSIG)	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47
Heat Anticipator Setting (Amps)				
1st stage	0.14	0.14	0.14	0.14
2nd stage	0.14	0.14	0.14	0.14
Natural Gas, Propane Heat				
# of stages / # of burners (total)	1 or 2 / 2	1 or 2 / 2	1 or 2 / 2	2 / 2
LOW Connection size	1/2–in NPT	1/2–in NPT	1/2–in NPT	1/2–in NPT
LOW Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	195 / 115
LOW Temperature rise range (F)	25 – 55	25 – 55	20 – 55	15 – 55
# of stages / # of burners (total)	1 or 2 / 3	1 or 2 / 3	1 or 2 / 3	2 / 3
MED Connection size	1/2–in NPT	1/2–in NPT	1/2–in NPT	1/2–in NPT
MED Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	195 / 115
MED Temperature rise range (F)	55 – 85	35 – 65	30 – 65	20 – 50
# of stages / # of burners (total)	–	1 or 2 / 3	1 or 2 / 3	2 / 4
HIGH Connection size	–	1/2–in NPT	1/2–in NPT	3/4–in NPT
HIGH Rollout switch opens / closes	–	195 / 115	195 / 115	195 / 115
HIGH Temperature rise range (F)	–	50 – 80	40 – 80	30 – 60
Low NO_x Gas Heat				
# of stages / # of burners (total)	1 / 2	1 / 2	1 / 2	–
LOW Connection size	1/2–in NPT	1/2–in NPT	1/2–in NPT	–
LOW Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	–
LOW Temperature rise range (F)	20 – 50	20 – 50	15 – 50	–
# of stages / # of burners (total)	1 / 3	1 / 3	1 / 3	–
MED Connection size	1/2–in NPT	1/2–in NPT	1/2–in NPT	–
MED Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	–
MED Temperature rise range (F)	30 – 60	30 – 60	25 – 60	–
				–
# of stages / # of burners (total)	–	1 / 3	1 / 3	–
HIGH Connection size	–	1/2–in NPT	1/2–in NPT	–
HIGH Rollout switch opens / closes	–	195 / 115	195 / 115	–
HIGH Temperature rise range (F)	–	40 – 70	35 – 70	–

– Not Applicable

Table 10 – PHYSICAL DATA (COOLING) 7.5 - 12.5 TONS

	48HC*08	48HC*09	48HC*11	48HC*12	48HC*14
Refrigeration System					
# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll
Puron Refrig (R–410A) charge A/B (lbs–oz)	9 – 10 / 9 – 10	9 – 14 / 9 – 14	12 – 10 / 13 – 0	12 – 11 / 12 – 5	16 – 7 / 15 – 5
Humidi–MiZer Puron Refrig (R–410A) charge A/B (lbs–oz)	17–0 / 17–0	15–2 / 15–2	–	18–3 / 17–3	25–8 / 22–8
Metering device	TXV	TXV	TXV	TXV	TXV
High–press. Trip / Reset (psig)	630 / 505	630 / 505	630 / 505	630 / 505	630 / 505
Low–press. Trip / Reset (psig)	54 / 117	54 / 117	27 / 44	54 / 117	54 / 117
Compressor Capacity Staging (%)	50% / 100%	50% / 100%	50% / 100%	50% / 100%	50% / 100%
Evaporator Coil					
Material (Tube/Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al
Coil type	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF
Rows / FPI	4 / 15	4 / 15	4 / 15	4 / 15	4 / 15
Total face area (ft2)	11.1	11.1	11.1	11.1	17.5
Condensate drain conn. size	3/4–in	3/4–in	3/4–in	3/4–in	3/4–in
Humidi–MiZer Coil					
Material (Tube/Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al
Coil type	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF
Rows / FPI	2 / 17	2 / 17	2 / 17	2 / 17	1 / 17
Total face area (ft2)	6.3	8.4	8.6	8.6	13.8
Evaporator fan and motor					
Standard Static 3 phase – Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt	1 / Belt
Max BHP	1.7	1.7	2.4	2.4	2.9
RPM range	518–733	518–733	591–838	591–838	440–609
Motor Frame Size	56	56	56	56	56Y
Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15	18 x 18
Medium Static 3 phase – Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt	1 / Belt
Max BHP	2.4	2.4	3.7	3.7	3.7
RPM range	690–936	690–936	838–1084	838–1084	609–778
Motor Frame Size	56	56	56HZ	56HZ	56HZ
Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15	18 x 18
High Static 3 phase – Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt	1 / Belt
Max BHP	3.7	3.7	4.9	4.9	6.1*
RPM range	838–1084	838–1084	1022–1240	1022–1240	776–955
Motor Frame Size	56	56	145TY	145TY	S184T
Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15	18 x 18
Condenser Coil					
Material (Tube/Fin)	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al
Coil type	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF	3/8–in RTPF
Rows / FPI	2 / 17	2 / 17	3 / 17	3 / 17	2 / 17
Total Face Area (ft^2)	25.1	25.1	25.1	25.1	2 at 23.1
Condenser fan / motor					
Qty / Motor drive type	2 / direct	2 / direct	1 / direct ECM	1 / direct	3 / direct
Motor HP / RPM	1/4 / 1100	1/4 / 1100	1 / 1050	1 / 1175	1/4 / 1100
Fan diameter (in)	22	22	30	30	22
Filters					
RA Filter # / size (in)	4 / 20 x 20 x 2	4 / 20 x 20 x 2	4 / 20 x 20 x 2	4 / 20 x 20 x 2	6 / 18 x 24 x 2 Vert 2 / 24 x 27 x 1
OA inlet screen # / size (in)	1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 24 x 1	Horz 1 / 30 x 39 x 1

– Not Applicable

Table 11 – PHYSICAL DATA (HEATING) 7.5 - 12.5 TONS

	48HC**08	48HC**09	48HC**11	48HC**12	48HC**14
Gas Connection					
# of Gas Valves	1	1	1	1	1
Nat. gas supply line press (in. w.g.)/(PSIG)	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47	4 –13 / 0.18 – 0.47	5 –13 / 0.18 – 0.47
Propane supply line press (in. w.g.)/(PSIG)	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47	11 –13 / 0.40 – 0.47
Heat Anticipator Setting (Amps)					
1st stage	0.14	0.14	0.14	0.14	0.14
2nd stage	0.14	0.14	0.14	0.14	0.14
Natural Gas, Propane Heat					
# of stages / # of burners (total)	2 / 3	2 / 3	2 / 4	2 / 4	2 / 5
LOW – Connection size	1/2–in NPT	1/2–in NPT	3/4–in NPT	3/4–in NPT	3/4–in NPT
LOW – Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	195 / 115	225 / 145
LOW – Temperature rise range (F)	20 – 50	20 – 50	25 – 65	25 – 65	15 – 60
# of stages / # of burners (total)	2 / 4	2 / 4	2 / 5	2 / 5	2 / 6
MED – Connection size	3/4–in NPT	3/4–in NPT	3/4–in NPT	3/4–in NPT	3/4–in NPT
MED – Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	195 / 115	225 / 145
MED – Temperature rise range (F)	35 – 65	30 – 65	30 – 65	30 – 65	20 – 55
# of stages / # of burners (total)	2 / 5	2 / 5	2 / 5	2 / 5	2 / 8
HIGH – Connection size	3/4–in NPT	3/4–in NPT	3/4–in NPT	3/4–in NPT	3/4–in NPT
HIGH – Rollout switch opens / closes	195 / 115	195 / 115	195 / 115	195 / 115	225 / 145
HIGH – Temperature rise range (F)	45 – 75	40 – 75	35 – 70	35 – 70	25 – 60

CURBS & WEIGHTS DIMENSIONS – 48HC 04-06

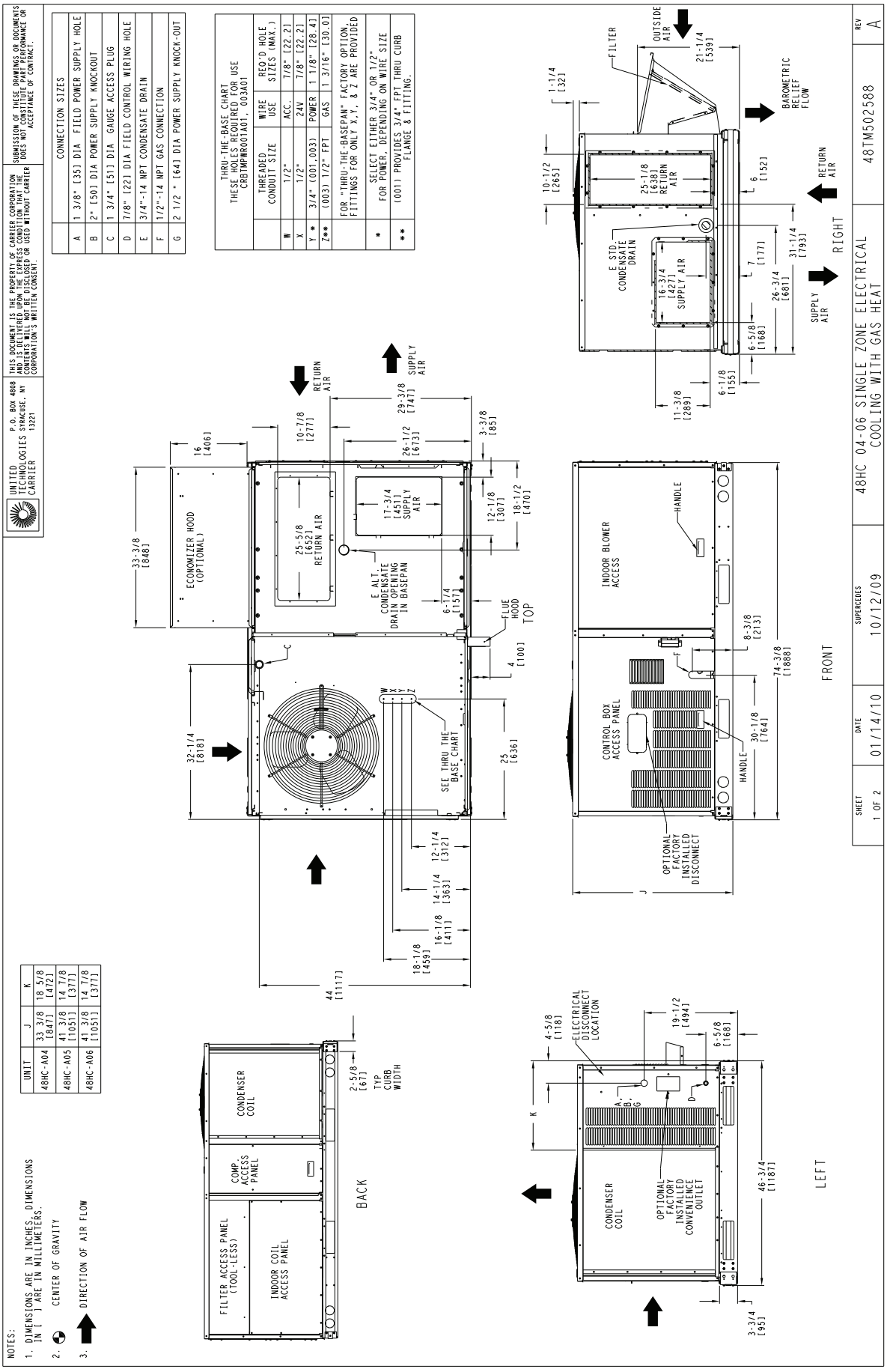
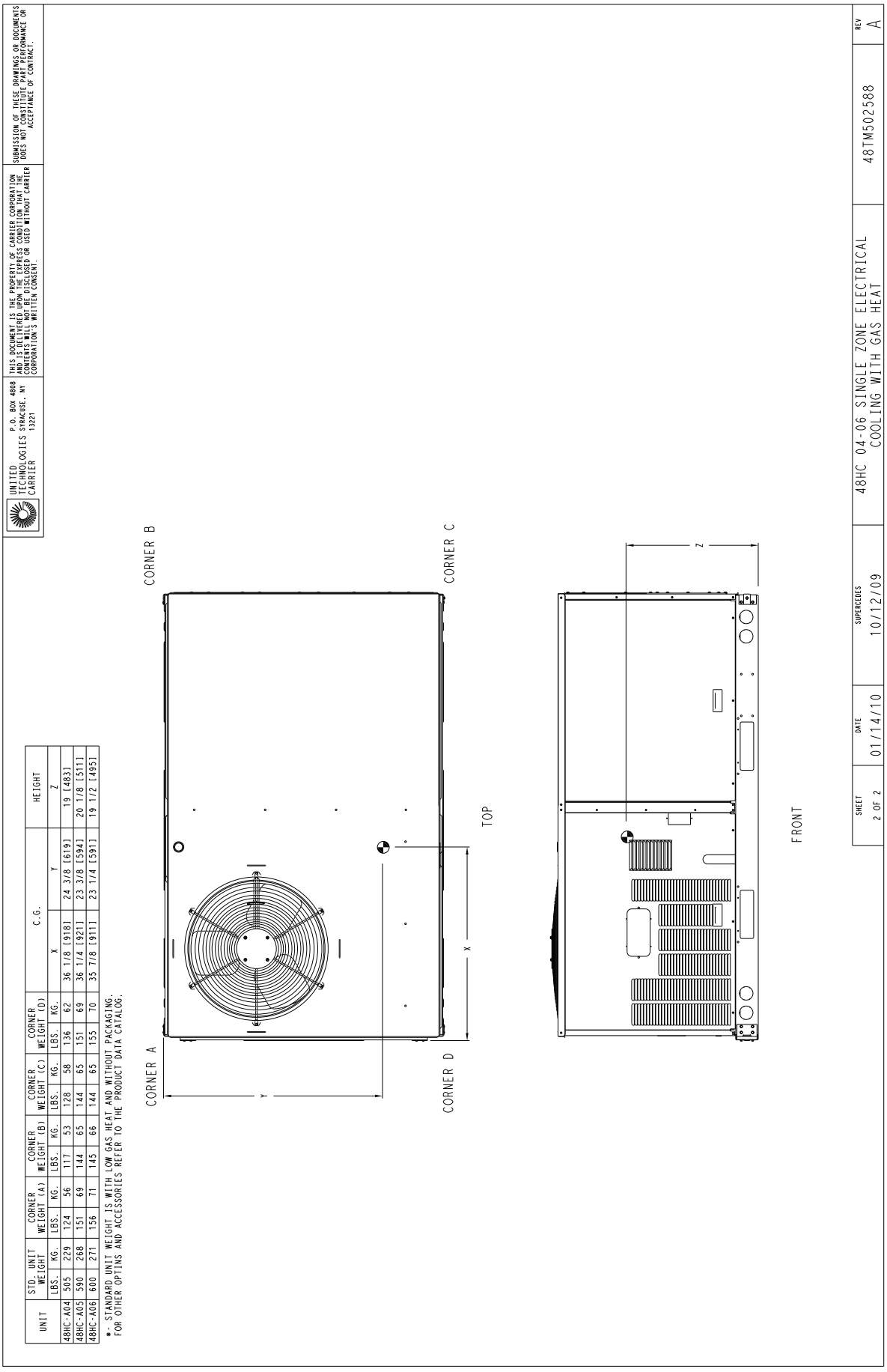


Fig. 1 – Dimensions 48HC 04-06

CURBS & WEIGHTS DIMENSIONS – 48HC 04–06 (cont.)



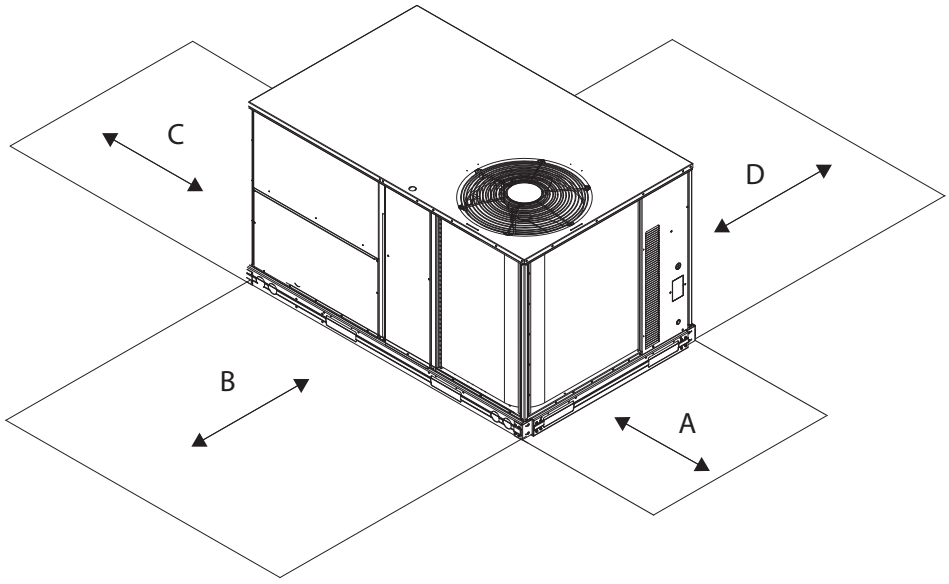
UNIT	STD. UNIT WEIGHT		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		HEIGHT
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC-A04	505	229	124	56	117	53	128	58	136	62	36 1/8 [918]	24 3/8 [619]	19 [483]
48HC-A05	590	268	151	69	144	65	144	65	151	69	36 1/4 [921]	23 3/8 [594]	20 1/8 [511]
48HC-A06	600	271	156	71	145	66	144	65	155	70	35 7/8 [911]	23 1/4 [591]	19 1/2 [495]

*- STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTINS AND ACCESSORIES REFER TO THE PRODUCT DATA CATALOG.

C10105

Fig. 2 – Dimensions 48HC 04–06

CURBS & WEIGHTS DIMENSIONS – 48HC 04–06 (cont.)



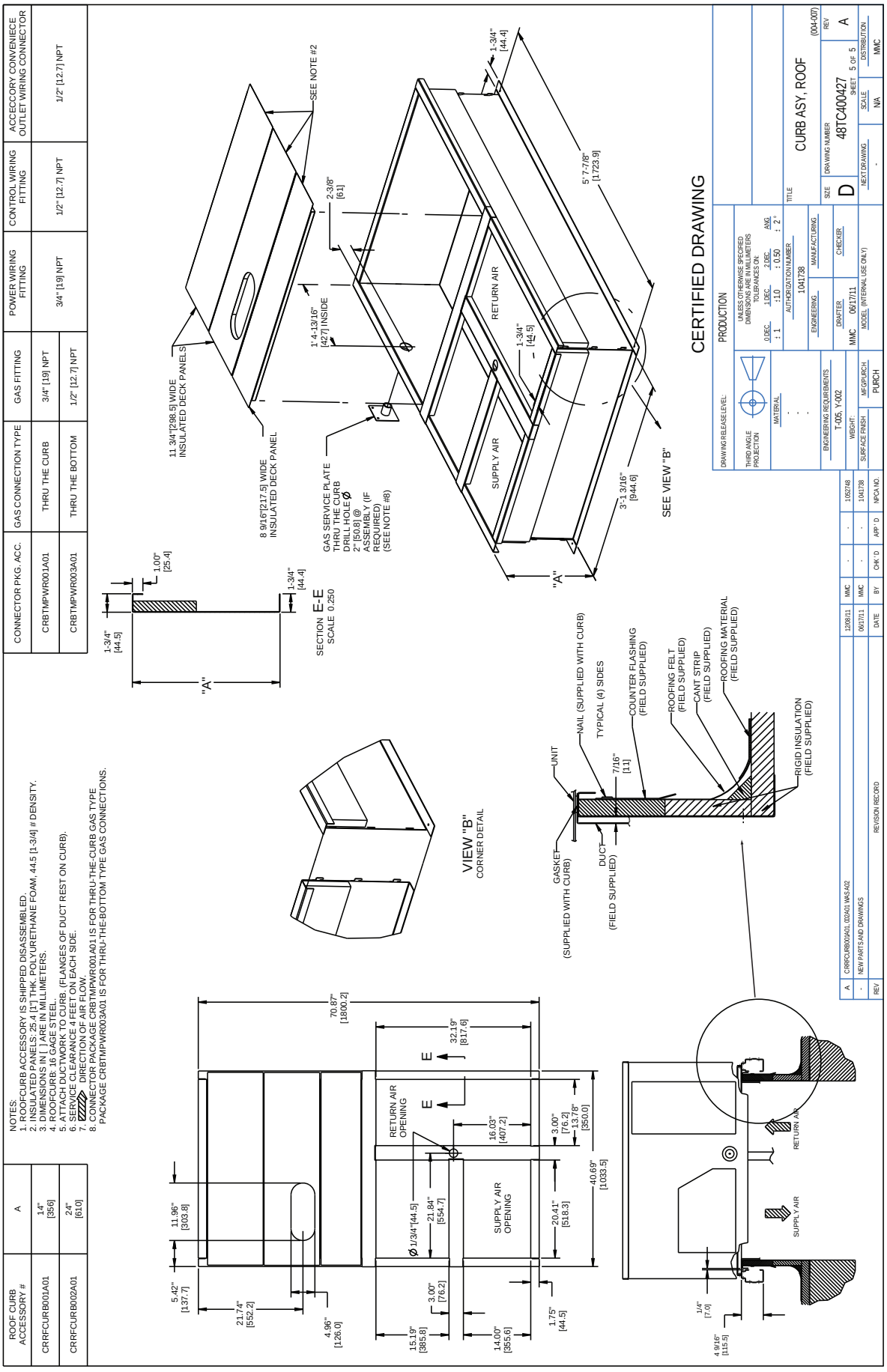
C08337

Fig. 3 – Service Clearance

LOC	DIMENSION	CONDITION
A	48–in (1219 mm)	Unit disconnect is mounted on panel
	18–in (457 mm)	No disconnect, convenience outlet option
	18–in (457 mm)	Recommended service clearance
	12–in (305 mm)	Minimum clearance
B	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for sources of flue products within 10–ft of unit fresh air intake hood
C	36–in (914 mm)	Side condensate drain is used
	18–in (457 mm)	Minimum clearance
D	48–in (1219 mm)	No flue discharge accessory installed, surface is combustible material
	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for adjacent units or building fresh air intakes within 10–ft of this unit's flue outlet

NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

CURBS & WEIGHTS DIMENSIONS – 48HC 04–06 (cont.)

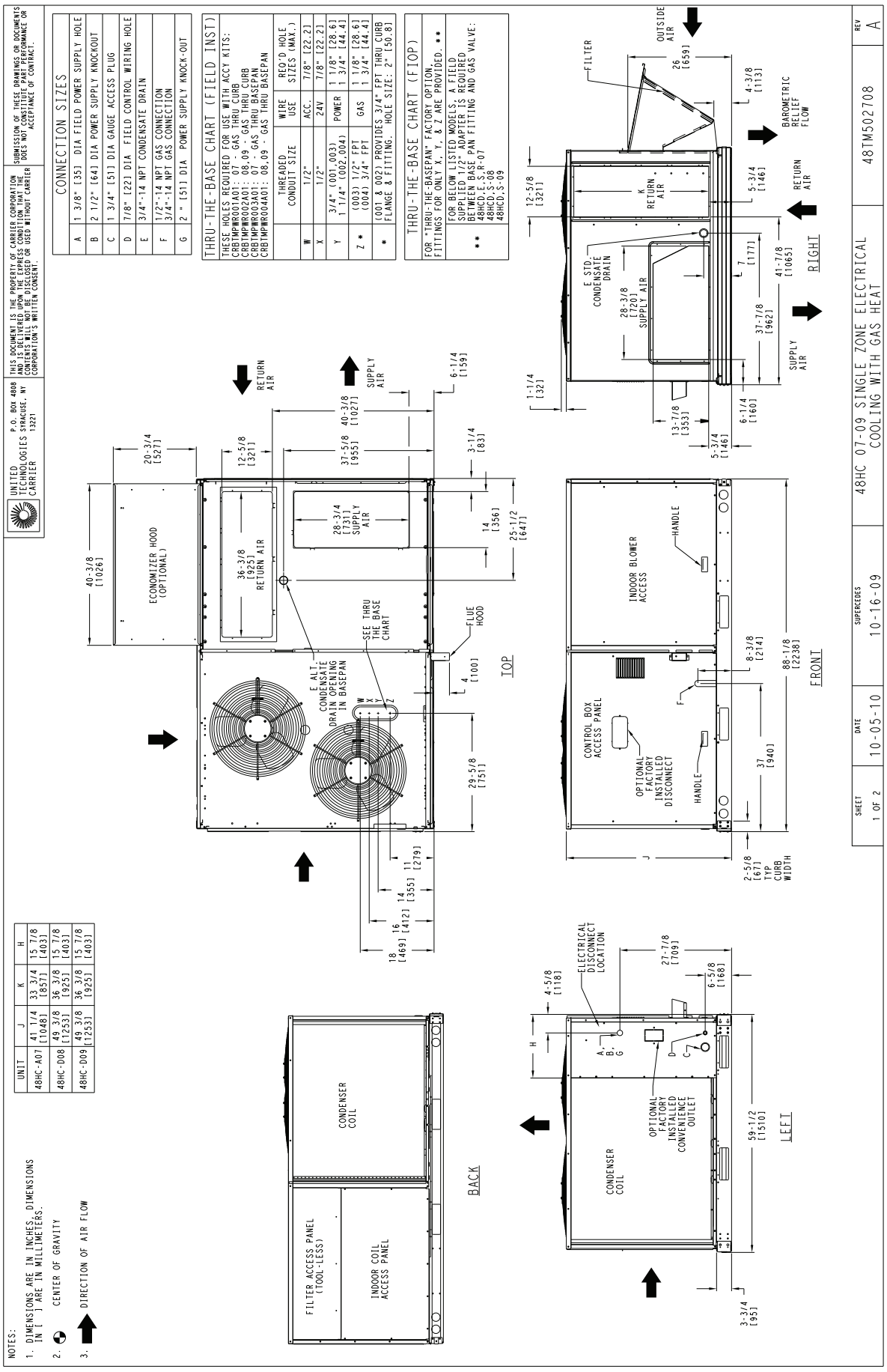


ROOF CURB ACCESSORY #	A
CRRFCURB001A01	14" [356]
CRRFCURB002A01	24" [610]

CONNECTOR PKG. ACC.	GAS CONNECTION TYPE	GAS FITTING	POWER WIRING FITTING	CONTROL WIRING FITTING	ACCECCORY CONVENIECE OUTLET WIRING CONNECTOR
CRBTMPWR001A01	THRU THE CURB	3/4" [19] NPT	3/4" [19] NPT	1/2" [12.7] NPT	1/2" [12.7] NPT
CRBTMPWR003A01	THRU THE BOTTOM	1/2" [12.7] NPT			

Fig. 4 – Roof Curb Details

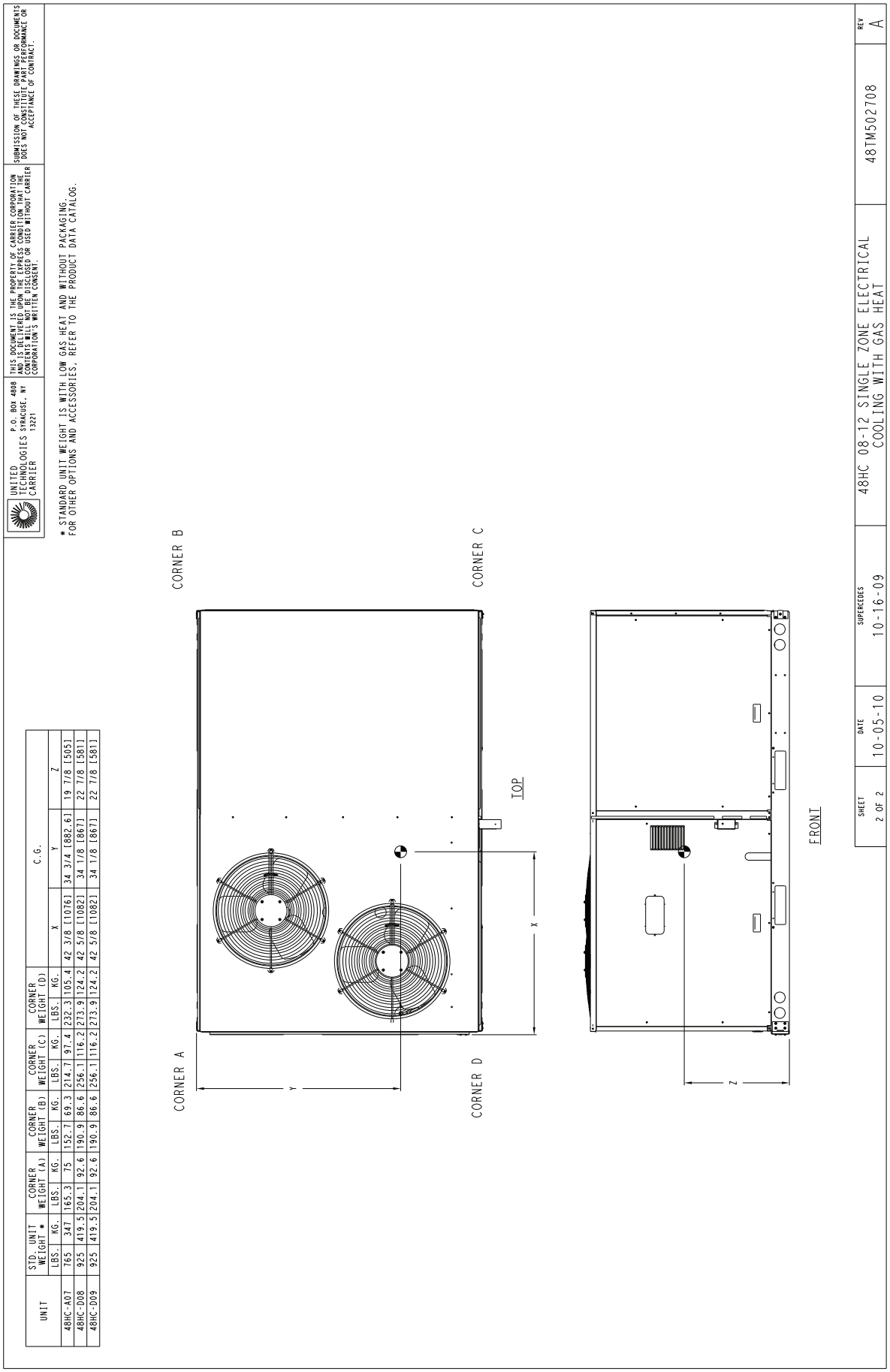
CURBS & WEIGHTS DIMENSIONS – 48HC 07–09



C11322

Fig. 5 – Dimensions 48HC 07–09

CURBS & WEIGHTS DIMENSIONS – 48HC 07–09 (cont.)

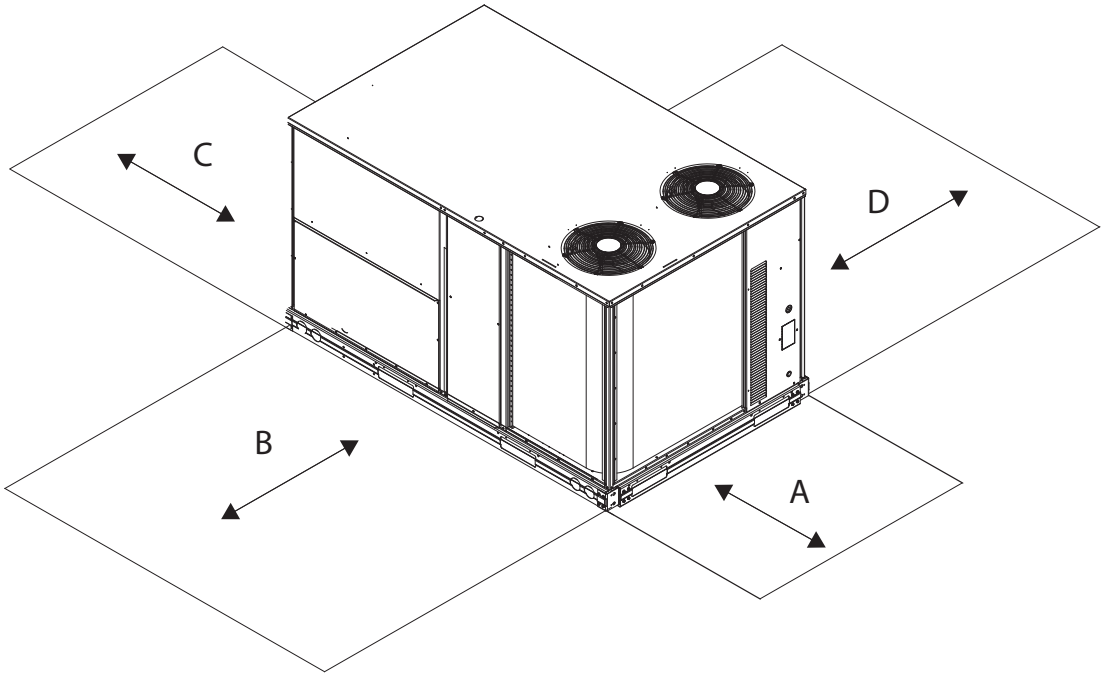


UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC-A07	765	347	165.3	75	152.7	69.3	214.7	97.4	232.3	105.4	42 3/8 [1076]	34 3/4 [882.6]	19 7/8 [505]
48HC-D08	925	419.5	204.1	92.6	190.9	86.6	256.1	116.2	273.9	124.2	42 5/8 [1082]	34 1/8 [867]	22 7/8 [581]
48HC-D09	925	419.5	204.1	92.6	190.9	86.6	256.1	116.2	273.9	124.2	42 5/8 [1082]	34 1/8 [867]	22 7/8 [581]

C11323

Fig. 6 – Dimensions 48HC 07–09

CURBS & WEIGHTS DIMENSIONS – 48HC 07–09 (cont.)



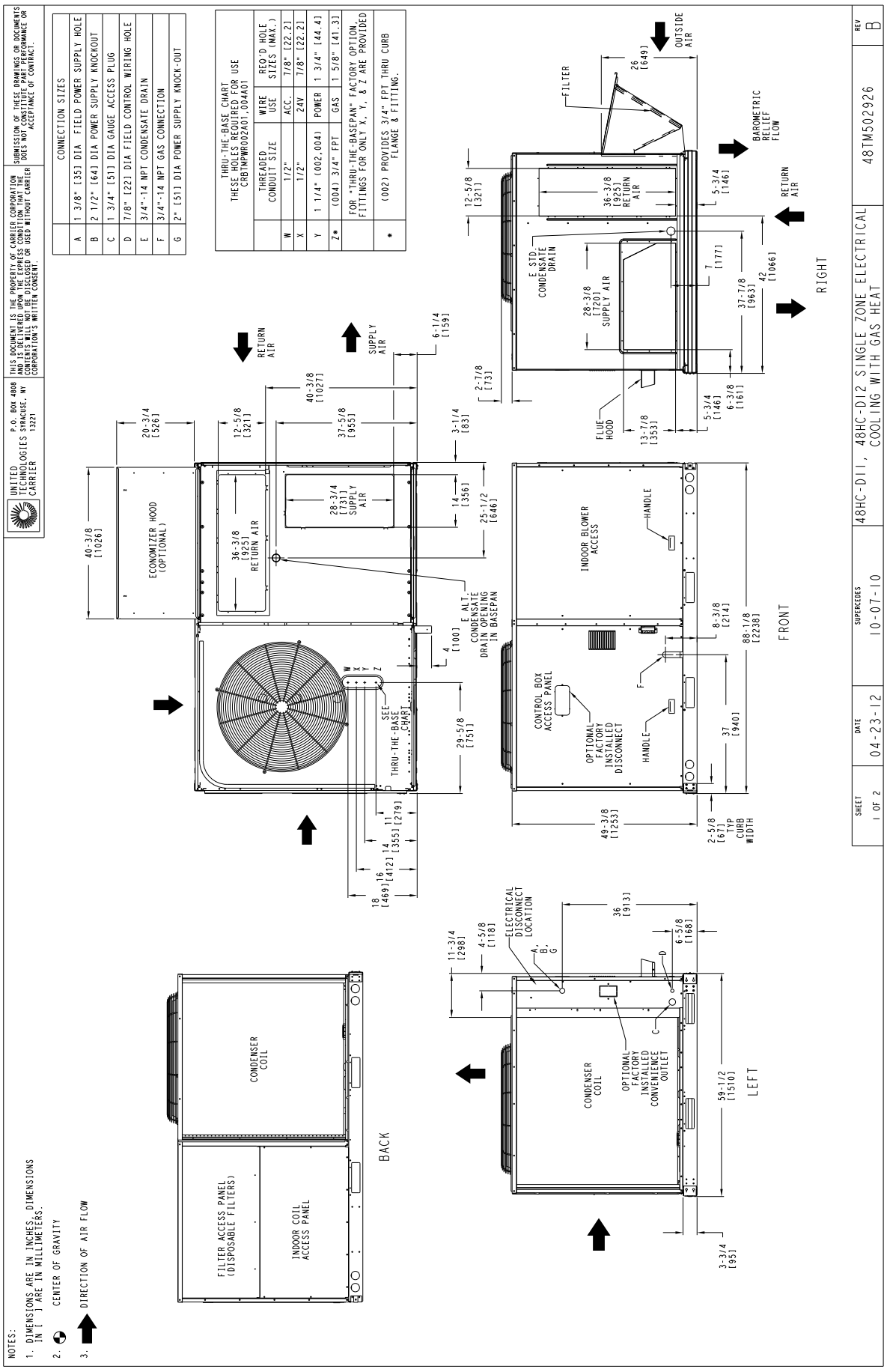
C10577

Fig. 7 – Service Clearance

LOC	DIMENSION	CONDITION
A	48–in (1219 mm)	Unit disconnect is mounted on panel
	18–in (457 mm)	No disconnect, convenience outlet option
	18–in (457 mm)	Recommended service clearance
	12–in (305 mm)	Minimum clearance
B	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for sources of flue products within 10–ft of unit fresh air intake hood
C	36–in (914 mm)	Side condensate drain is used
	18–in (457 mm)	Minimum clearance
D	48–in (1219 mm)	No flue discharge accessory installed, surface is combustible material
	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for adjacent units or building fresh air intakes within 10–ft of this unit's flue outlet

NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

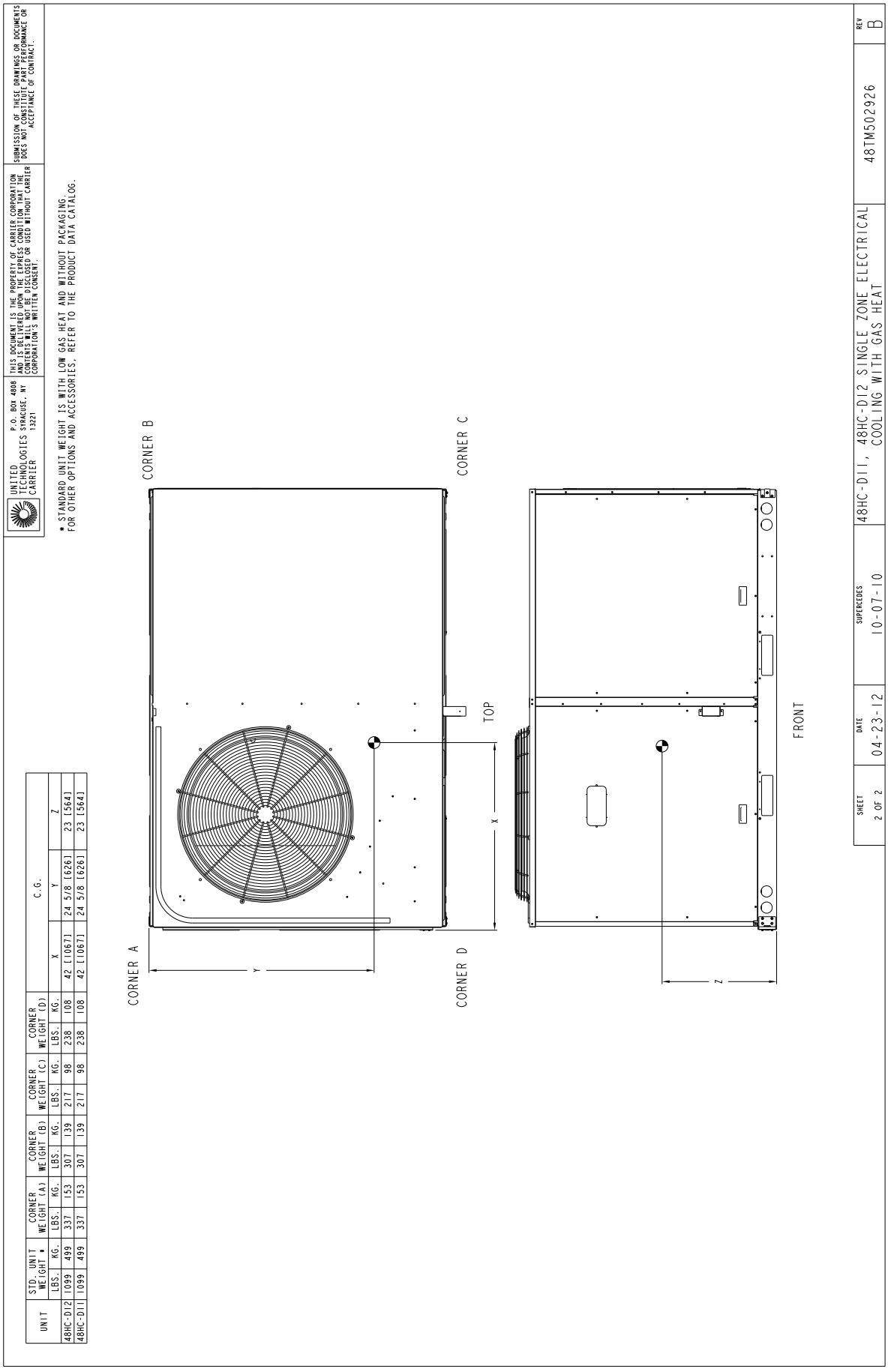
CURBS & WEIGHTS DIMENSIONS – 48HC 11–12



C12269

Fig. 8 – Dimensions 48HC 11–12

CURBS & WEIGHTS DIMENSIONS – 48HC 11–12 (cont.)

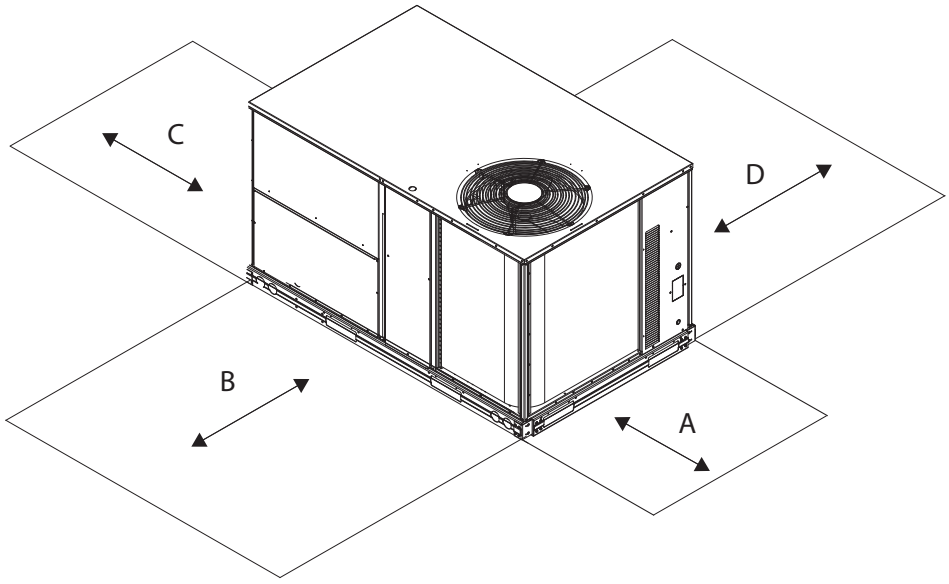


UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC-D12	1099	499	337	153	307	139	217	98	238	108	42 [1067]	24 5/8 [626]	23 [564]
48HC-D11	1099	499	337	153	307	139	217	98	238	108	42 [1067]	24 5/8 [626]	23 [564]

C12270

Fig. 9 – Dimensions 48HC 12

CURBS & WEIGHTS DIMENSIONS – 48HC 11–12 (cont.)



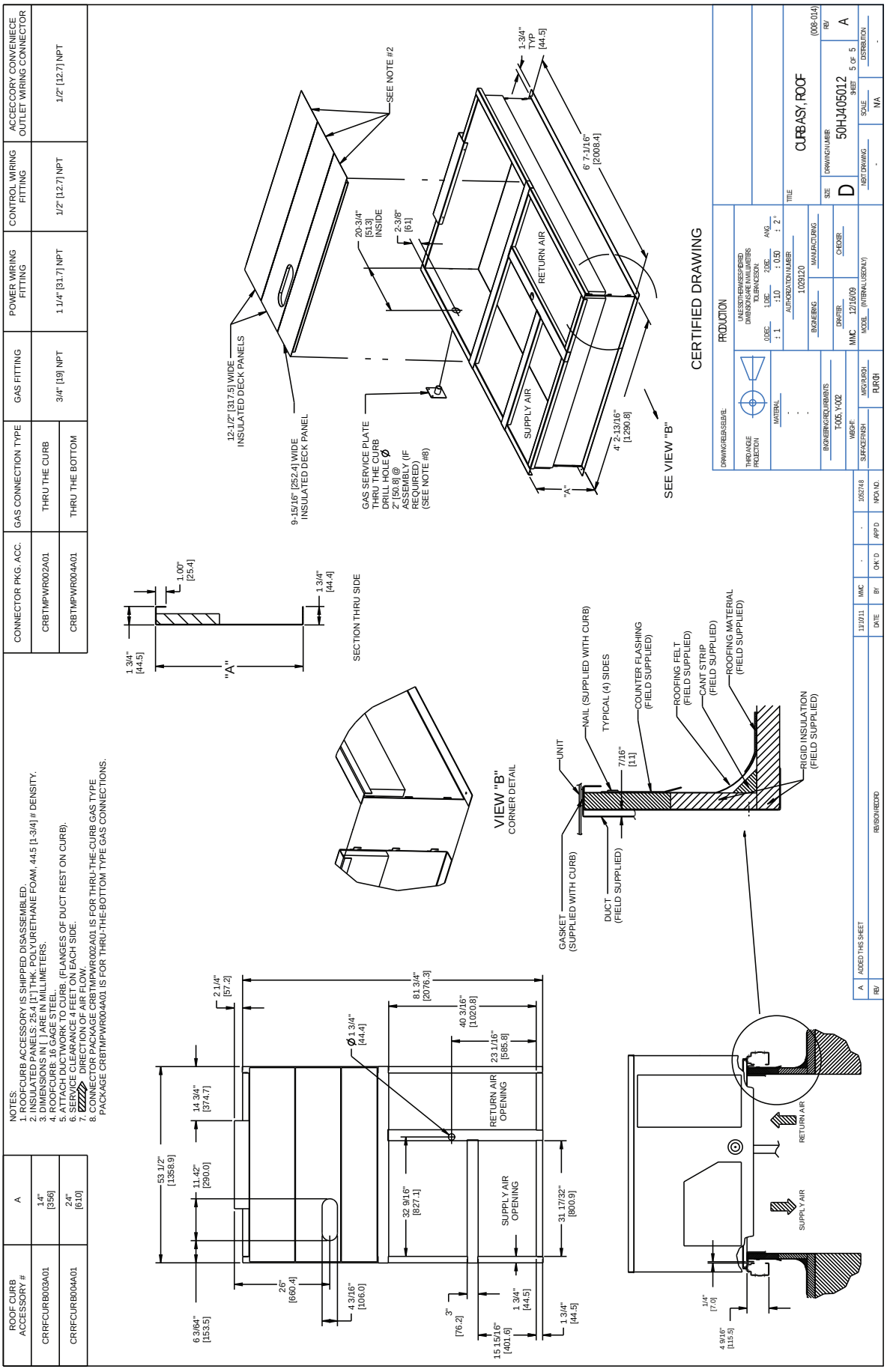
C08337

Fig. 10 – Service Clearance

LOC	DIMENSION	CONDITION
A	48–in (1219 mm)	Unit disconnect is mounted on panel
	18–in (457 mm)	No disconnect, convenience outlet option
	18–in (457 mm)	Recommended service clearance
	12–in (305 mm)	Minimum clearance
B	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for sources of flue products within 10–ft of unit fresh air intake hood
C	36–in (914 mm)	Side condensate drain is used
	18–in (457 mm)	Minimum clearance
D	48–in (1219 mm)	No flue discharge accessory installed, surface is combustible material
	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for adjacent units or building fresh air intakes within 10–ft of this unit's flue outlet

NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

CURBS & WEIGHTS DIMENSIONS – 48HC 07–12 (cont.)



ROOF CURB ACCESSORY #	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z
CRRFCURB003A01	14" [356]	53 1/2" [1358.9]	11.42" [290.0]	14 3/4" [374.7]	2 1/4" [57.2]	6 3/64" [153.5]	26" [660.4]	4 3/16" [106.0]	Ø 1 3/4" [44.4]	81 3/4" [2076.3]	40 3/16" [1022.8]	23 1/16" [585.8]	32 9/16" [827.1]	31 17/32" [800.9]	3" [76.2]	15 15/16" [401.6]	1 3/4" [44.5]	1 3/4" [44.5]						
CRRFCURB004A01	24" [610]																							

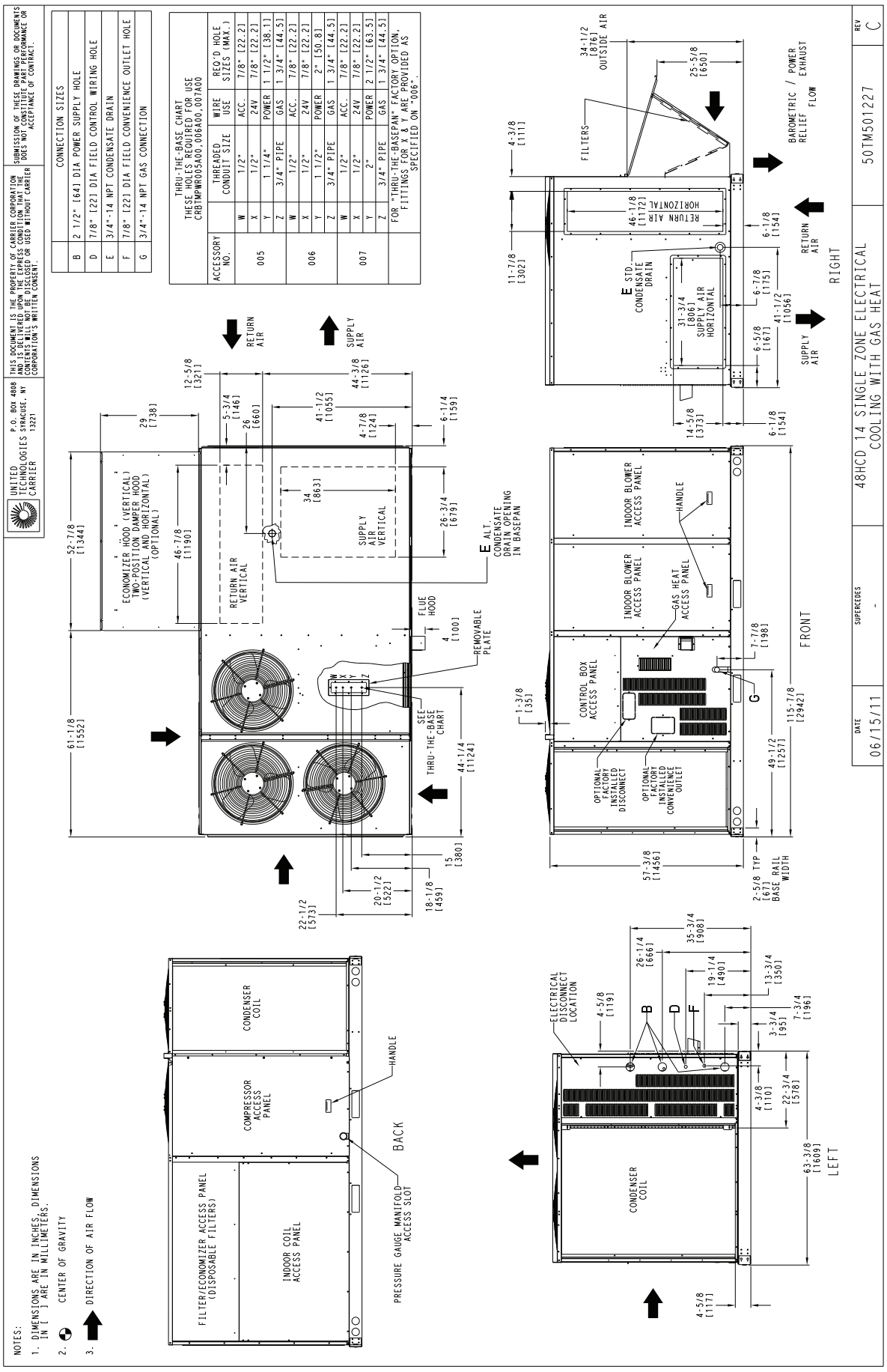
CONNECTOR PKG. ACC.	GAS CONNECTION TYPE	GAS FITTING	POWER WIRING FITTING	CONTROL WIRING FITTING	ACCECCORY CONVENIECE OUTLET WIRING CONNECTOR
CRBTMPWR002A01	THRU THE CURB	3/4" [19] NPT	1 1/4" [31.7] NPT	1/2" [12.7] NPT	1/2" [12.7] NPT
CRBTMPWR004A01	THRU THE BOTTOM				

NOTES:
1. ROOFCURB ACCESSORY IS SHIPPED DISASSEMBLED.
2. INSULATED PANELS: 25.4 [1"] THK, POLYURETHANE FOAM, 44.5 [1-3/4] # DENSITY.
3. DIMENSIONS IN [ ] ARE IN MILLIMETERS.
4. ROOFCURB: 16 GAGE STEEL.
5. ATTACH DUCTWORK TO CURB. (FLANGES OF DUCT REST ON CURB).
6. SERVICE CLEARANCE 4 FEET ON EACH SIDE.
7. DIRECTION OF AIR FLOW.
8. CONNECTOR PACKAGE CRBTMPWR002A01 IS FOR THRU-THE-CURB GAS TYPE PACKAGE CRBTMPWR004A01 IS FOR THRU-THE-BOTTOM TYPE GAS CONNECTIONS.

C12597

Fig. 11 – Roof Curb Details

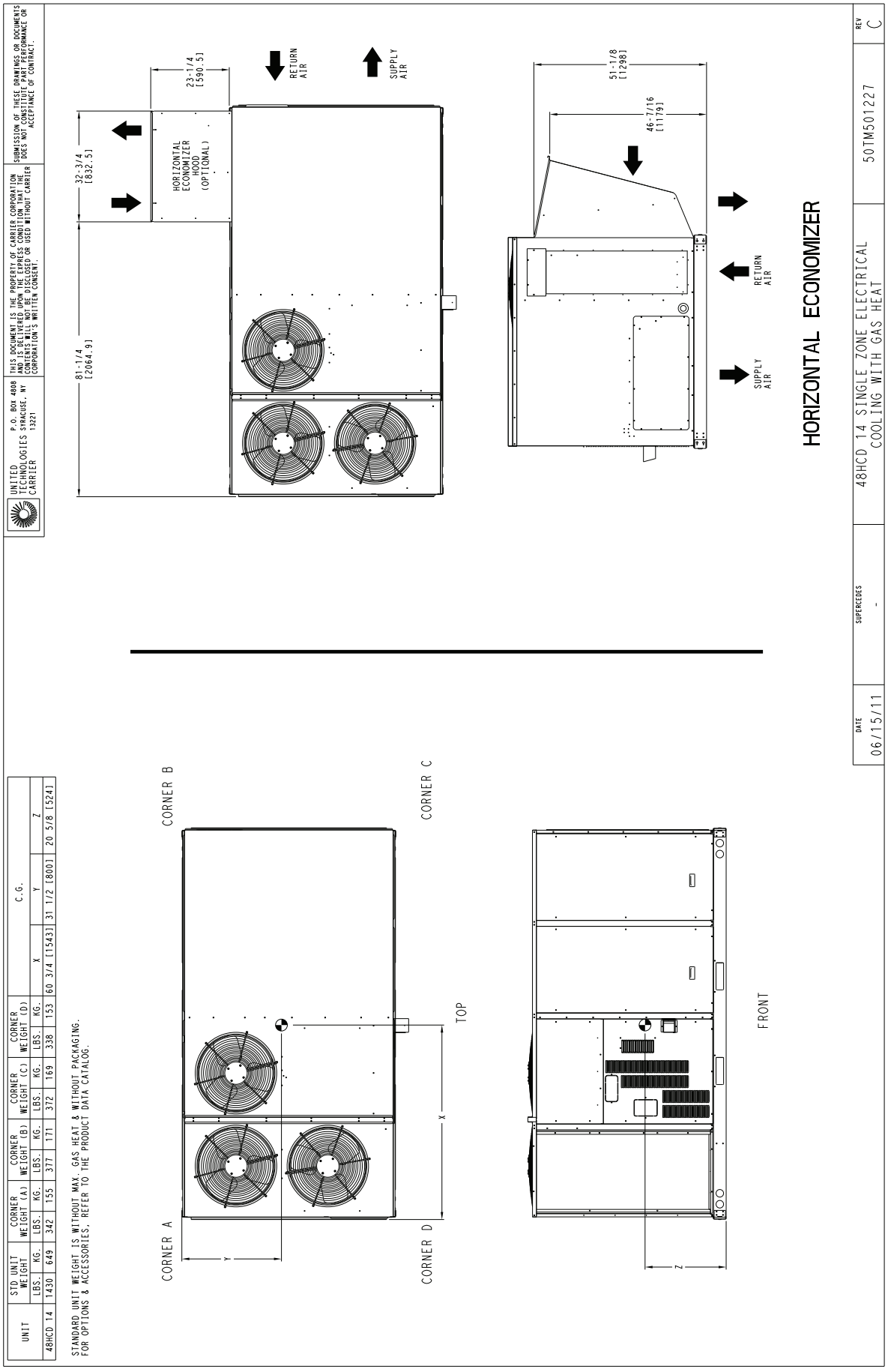
CURBS & WEIGHTS DIMENSIONS – 48HC 14



C11326

Fig. 12 – Dimensions 48HC 14

CURBS & WEIGHTS DIMENSIONS – 48HC 14 (cont.)



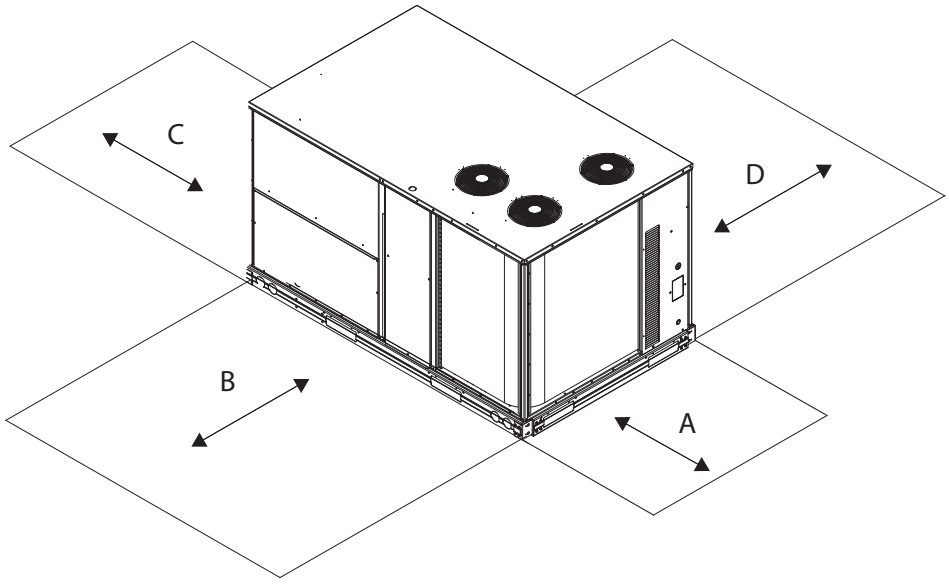
UNIT	STD UNIT WEIGHT		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HCD 14	1430	649	342	155	377	171	372	169	338	153	60 3/4 [1543]	31 1/2 [800]	20 5/8 [524]

STANDARD UNIT WEIGHT IS WITHOUT MAX. GAS HEAT & WITHOUT PACKAGING.
FOR OPTIONS & ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.

C11327

Fig. 13 – Dimensions 48HC 14

CURBS & WEIGHTS DIMENSIONS – 48HC 14 (cont.)



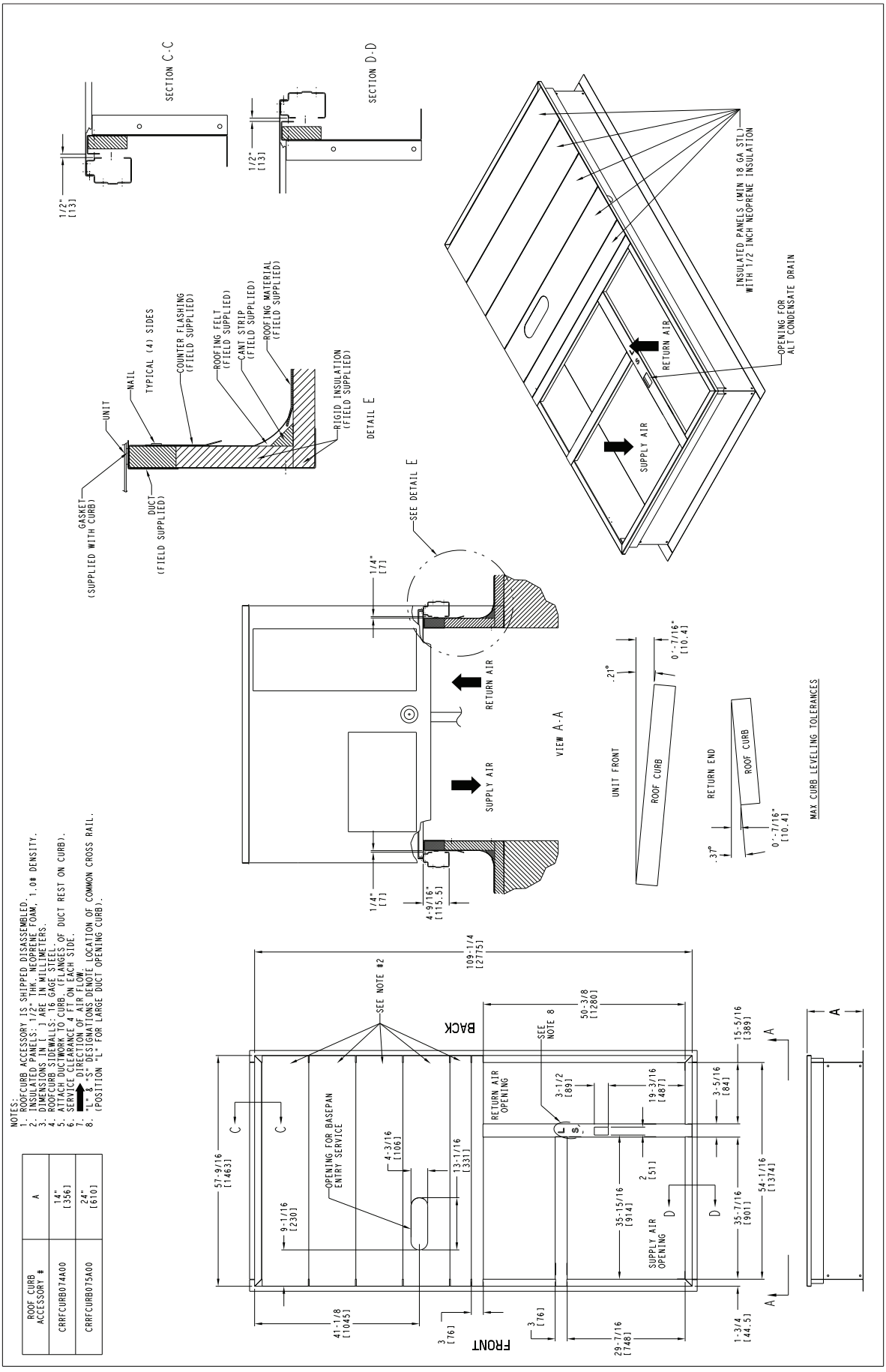
C10578B

Fig. 14 – Service Clearance

LOC	DIMENSION	CONDITION
A	48–in (1219 mm)	Unit disconnect is mounted on panel
	18–in (457 mm)	No disconnect, convenience outlet option
	18–in (457 mm)	Recommended service clearance
	12–in (305 mm)	Minimum clearance
B	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for sources of flue products within 10–ft of unit fresh air intake hood
C	36–in (914 mm)	Side condensate drain is used
	18–in (457 mm)	Minimum clearance
D	48–in (1219 mm)	No flue discharge accessory installed or available, surface is combustible material
	42–in (1067 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit)
	36–in (914 mm)	Surface behind servicer is electrically non–conductive (e.g., wood, fiberglass)
	Special	Check for adjacent units or building fresh air intakes within 10–ft of this unit's flue outlet

NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

CURBS & WEIGHTS DIMENSIONS – 48HC 14 (cont.)



ROOF CURB ACCESSORY #	A
CRRFCURB074A00	14" [356]
CRRFCURB075A00	24" [610]

NOTES:
1. ROOFCURB ACCESSORY IS SHIPPED DISASSEMBLED.
2. INSULATED PANELS: 1/2" THK. NEOPRENE FOAM, 1.0# DENSITY.
3. DIMENSIONS ARE IN INCHES AND MILLIMETERS.
4. ROOFCURB SIDEWALLS: 16 GAGE STEEL.
5. ATTACH DUCTWORK TO CURB (FLANGES OF DUCT REST ON CURB).
6. SERVICE CLEARANCE 4 FT ON EACH SIDE.
7. ➡ DIRECTION OF AIR FLOW.
8. "L" & "S" DESIGNATIONS DENOTE LOCATION OF COMMON CROSS RAIL. (POSITION "L" FOR LARGE DUCT OPENING CURB).

C10772B

Fig. 15 – Roof Curb Details

OPTIONS & ACCESSORY WEIGHTS

OPTION / ACCESSORY	OPTION / ACCESSORY WEIGHTS																	
	04		05		06		07		08		09		11		12		14	
	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
Humidi–MiZer[1]	15	7	23	10	25	11	29	13	38	17	47	21	47	21	47	21	57	26
Power Exhaust – vertical	50	23	50	23	50	23	75	34	75	34	75	34	75	34	75	34	85	39
Power Exhaust – horizontal	30	14	30	14	30	14	30	14	30	14	30	14	30	14	30	14	75	34
EconoMi$er (X, IV or 2)	50	23	50	23	50	23	75	34	75	34	75	34	75	34	75	34	132	60
Two Position damper	39	18	39	18	39	18	58	26	58	26	58	26	58	26	58	26	65	29
Manual Dampers	12	5	12	5	12	5	18	8	18	8	18	8	18	8	18	8	25	11
Medium Gas Heat	12	5	9	4	9	4	15	7	15	7	15	7	18	8	18	8	18	8
High Gas Heat	–	–	17	8	17	8	29	13	29	13	29	13	35	16	35	16	42	19
Hail Guard (louvered)	16	7	16	7	16	7	34	15	34	15	34	15	34	15	34	15	45	20
Cu/Cu Condenser Coil	35	16	35	16	35	16	95	43	95	43	95	43	170	77	170	77	190	86
Cu/Cu Cond. & Evap. Coils	60	27	60	27	90	41	140	64	140	64	195	88	270	122	270	122	280	127
Roof Curb (14–in. curb)	115	52	115	52	115	52	143	65	143	65	143	65	143	65	143	65	180	82
Roof Curb (24–in. curb)	197	89	197	89	197	89	245	111	245	111	245	111	245	111	245	111	255	116
CO_2 sensor	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2
Flue Discharge Deflector	7	3	7	3	7	3	7	3	7	3	7	3	7	3	7	3	–	–
Optional Indoor Motor/Drive	10	5	10	5	10	5	15	7	15	7	15	7	15	7	15	7	45	20
Motor Master Controller	35	16	35	16	35	16	35	16	35	16	35	16	35	16	35	16	40	18
Low Ambient Controller	5	2	5	2	5	2	5	2	5	2	5	2	8	3	10	5	30	14
Return Smoke Detector	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2
Supply Smoke Detector	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2
Fan/Filter Status Switch	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Non–Fused Disconnect	15	7	15	7	15	7	15	7	15	7	15	7	15	7	15	7	15	7
HACR Circuit Breaker	15	7	15	7	15	7	15	7	15	7	15	7	15	7	15	7	15	7
Powered Convenience Outlet	35	16	35	16	35	16	35	16	35	16	35	16	35	16	35	16	35	16
Non–Powered C.O.	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2
Enthalpy Sensor	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Differential Enthalpy Sensor	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
SAV System with VFD	–	–	–	–	–	–	–	–	20	9	20	9	20	9	20	9	20	9

NOTE: Where multiple variations are available, the heaviest combination is listed.

– Not Available

[1] For Humidi–MiZer add MotorMaster Controller.

APPLICATION DATA

Min operating ambient temp (cooling):

In mechanical cooling mode, your Carrier rooftop unit can safely operate down to an outdoor ambient temperature of 35°F (-2°C) and 25°F (-4°C), with an accessory winter start kit. It is possible to provide cooling at lower outdoor ambient temperatures by using less outside air, economizers, and/or accessory low ambient kits.

Max operating ambient temp (cooling):

The maximum operating ambient temperature for cooling mode is 125°F (52°C). While cooling operation above 125°F (52°C) may be possible, it could cause either a reduction in performance, reliability, or a protective action by the unit's internal safety devices.

Min mixed air temp (heating):

Using the factory settings, the minimum temperatures for the mixed air (the combined temperature of the warm return air and the cold outdoor air) entering the dimpled, gas heat exchangers are:

Aluminized	Stainless Steel
50°F (10°C) continuous	40°F (4°C) continuous
45°F (7°C) intermittent	35°F (2°C) intermittent

Operating at lower mixed-air temperatures may be possible, if a field-supplied, outdoor air thermostat initiates both heat stages when the temperature is less than the minimum temperatures listed above. Please contact your local Carrier representative for assistance.

Min and max airflow (heating and cooling):

To maintain safe and reliable operation of your rooftop, operate within the heating airflow limits during heating mode and cooling airflow limits during cooling mode. Operating above the max may cause blow-off, undesired airflow noise, or airflow related problems with the rooftop unit. Operating below the min may cause problems with coil freeze-up and unsafe heating operation. Heating and cooling limitations differ when evaluating operating CFM, the minimum value is the HIGHER of the cooling and heating minimum CFM values published in Table 7 and the maximum value is the LOWER of the cooling and heating minimum values published in Table 7.

Heating-to-cooling changeover:

Your unit will automatically change from heating to cooling mode when using a thermostat with an auto-change-over feature.

Airflow:

All units are draw-though in cooling mode and blow-through in heating mode.

Outdoor air application strategies:

Economizers reduce operating expenses and compressor run time by providing a free source of cooling and a means of ventilation to match application changing needs. In fact, they should be considered for most applications. Also, consider the various economizer control methods and their benefits, as well as sensors required to accomplish your application goals. Please contact your local Carrier representative for assistance.

Motor limits, break horsepower (BHP):

Due to internal design of Carrier units, the air path, and specially designed motors, the full horsepower (maximum continuous BHP) band, as listed in Table 8 and 10, can be used with the utmost confidence. There is no need for extra safety factors, as Carrier motors are designed and rigorously tested to use the entire, listed BHP range without either nuisance tripping or premature motor failure.

Propane heating:

Propane has different physical qualities than natural gas. As a result, Propane requires different fuel to air mixture. To optimize the fuel/air mixture for Propane, Carrier sells different burner orifices in an easy to install accessory kit. To select the correct burner orifices or determine the heat capacity for an Propane application, use either the selection software, or the unit's service manual.

High altitude heating:

High altitudes have less oxygen, which affects the fuel/air mixture in heat exchangers. In order to maintain a proper fuel/air mixture, heat exchangers operating in altitudes above 2000 ft (610 m) require different orifices. To select the correct burner orifices or determine the heat capacity for a high altitude application, use either the selection software, or the unit's service manual.

High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion on altitudes above 2000 ft (610 m).

NOTE: Typical natural gas heating value ranges from 975 to 1050 Btu/ft^3 at sea level nationally. The heating value goes down approximately 1.7% per every thousand feet elevation. Standard factory orifices can typically be used up to 2000 ft (610m) elevation without any operational issues.

NOTE: For installations in Canada, the input rating should be derated by 10% for altitudes from 2000 ft (610m) to 4500 ft (1372m) above sea level.

APPLICATION DATA (cont.)

Sizing a rooftop

Bigger isn't necessarily better. While an air conditioner needs to have enough capacity to meet the design loads, it doesn't need excess capacity. In fact, excess capacity typically results in very poor part load performance and humidity control.

Using higher design temperatures than ASHRAE recommends for your location, adding "safety factors" to the calculated load, are all signs of oversizing air conditioners. Oversizing the air conditioner leads to poor humidity control, reduced efficiency, higher utility bills, larger indoor temperature swings, excessive noise, and increased wear and tear on the air conditioner.

Rather than oversizing an air conditioner, engineers should "right-size" or even slightly undersize air conditioners. Correctly sizing an air conditioner controls humidity better; promotes efficiency; reduces utility bills; extends equipment life, and maintains even, comfortable temperatures. Please contact your local Carrier representative for assistance.

Low ambient applications

The optional Carrier economizer can adequately cool your space by bringing in fresh, cool outside air. In fact, when so equipped, accessory low-ambient kit may not be necessary. In low ambient conditions, unless the outdoor air is excessively humid or contaminated, economizer-based "free cooling" is the preferred less costly and energy conscious method.

In low ambient applications where outside air might not be desired (such as contaminated or excessively humid outdoor environments), your Carrier rooftop can operate to ambient temperatures down to -20°F (-29°C) using the recommended field installed accessory Motormaster low ambient controller or 0°F (-18°C) with the factory installed low ambient controller option.

SELECTION PROCEDURE (WITH 48HC*A07 EXAMPLE)[1]

I. Determine cooling and heating loads.

Given:

Mixed air dry bulb	80°F (27°C)
Mixed air wet bulb	67°F (19°C)
Ambient dry bulb	95°F (35°C)
TC_{Load}	73.6 MBH
SHC_{Load}	53.3 MBH
Vertical supply air	2100 CFM
Heating load	85.0 MBH
External static pressure	0.67 in. wg
Electrical characteristics	230–3–60

II. Make an initial guess at cooling tons.

Refrig. tons = TC_{Load} / 12 MBH per ton
Refrig. tons = 72.0 / 12 = 6.0 tons
In this case, start by looking at the 48HC**07.

III. Look up the rooftop's TC and SHC.

Table 18 shows that, at the application's supply air CFM, mixed air and ambient temperatures, the 48HC*A07 supplies:
TC = 73.6 MBH[2]
SHC = 53.3 MBH[2]

IV. Calculate the building latent heat load.

$LC_{Load} = TC_{Load} - SHC_{Load}$
LC_{Load} = 72.0 MBH – 54.0 MBH = 18.0 MBH

V. Calculate RTU latent heat capacity.

LC = TC – SHC
LC = 73.6 MBH – 53.3 MBH = 20.3 MBH

VI. Compare RTU capacities to loads.[3]

Compare the rooftop's SHC and LC to the building's sensible and latent heat loads.

VII. Select factory options (FIOP)

Local code requires an economizer for any unit with TC greater than 65.0 MBH.

VIII. Calculate the total static pressure.

External static pressure	0.67 in. wg
Sum of FIOP / Accessory static	+0.13 in. wg
Total Static Pressure	0.80 in. wg

IX. Look up the indoor fan RPM & BHP.

Table 42 shows, at 2100 CFM & ESP= 0.8,
RPM = 712 & BHP = 1.17

X. Convert BHP (Step VIII) into fan motor heat.

Fan motor heat = 2.546* BHP/Motor Eff.[4]
Fan motor heat = 3.7 MBH

XI. Calculate RTU heating capacity.

Building heating load	85.0 MBH
Fan motor heat	–3.7 MBH
Required heating capacity	81.3 MBH

XII. Select a gas heater.

Table 4 shows the heating capacities of the 48HCEA07 = 103.0 MBH. Select the 48HCEA07

XIII. Determine electrical requirements.

MCA/MOCP tables show the MCA and Breaker Size of a 48HC*A07 (without convenience outlet) as:
MCA = 32.0 amps & MOCP = 50.0 amps
Min. disconnect size: FLA = 31.0 & LRA = 148.

Legend

BHP	—	Break horsepower
FLA	—	Full load amps
LC	—	Latent capacity
LRA	—	Lock rotor amp
MBH	—	(1,000) BTUH
MCA	—	Min. circuit ampacity
MOCP	—	Max. over–current protection
RPM	—	Revolutions per minute
RTU	—	Rooftop unit
SHC	—	Sensible heat capacity
TC	—	Total capacity

NOTES:

1. Selection software by Carrier saves time by performing many of the steps above. Contact your Carrier sales representative for assistance.
2. Unit ratings are gross capacities and do not include the effect of evaporator fan motor heat. See Step XI. for determining amount of evaporator fan motor heat to subtract from total and sensible capacities to obtain net cooling and net sensible capacities.
3. Selecting a unit with a SHC slightly lower than the SHC_{Load} is often better than oversizing. Slightly lower SHC's will help control indoor humidity, and prevent temperature swings.
4. Indoor fan motor efficiency is available in Table 82. Use the decimal form in the equation, eg. 80% = .8.

Table 12 – COOLING CAPACITIES 1-STAGE COOLING 3 TONS

48HC*A04				AMBIENT TEMPERATURE															
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
900 Cfm	EA (wb)	58	TC	32.1	32.1	36.3	30.8	30.8	34.9	29.4	29.4	33.4	28.0	28.0	31.7	26.3	26.3	29.8
			SHC	27.8	32.1	36.3	26.7	30.8	34.9	25.5	29.4	33.4	24.2	28.0	31.7	22.8	26.3	29.8
		62	TC	34.0	34.0	34.3	32.3	32.3	33.5	30.6	30.6	32.6	28.7	28.7	31.7	26.6	26.6	30.6
			SHC	25.0	29.7	34.3	24.2	28.9	33.5	23.4	28.0	32.6	22.5	27.1	31.7	21.5	26.0	30.6
		67	TC	37.3	37.3	37.3	35.5	35.5	35.5	33.6	33.6	33.6	31.5	31.5	31.5	29.2	29.2	29.2
			SHC	20.7	25.4	30.0	20.0	24.6	29.3	19.2	23.8	28.4	18.3	22.9	27.6	17.4	22.0	26.6
		72	TC	40.8	40.8	40.8	38.9	38.9	38.9	36.9	36.9	36.9	34.6	34.6	34.6	32.2	32.2	32.2
			SHC	16.3	21.0	25.7	15.6	20.3	25.0	14.8	19.5	24.1	13.9	18.6	23.3	13.0	17.7	22.3
		76	TC	–	43.9	43.9	–	41.8	41.8	–	39.6	39.6	–	37.2	37.2	–	34.6	34.6
			SHC	–	17.4	22.4	–	16.7	21.7	–	15.9	20.8	–	15.1	19.9	–	14.2	19.0
1050 Cfm	EA (wb)	58	TC	33.8	33.8	38.4	32.5	32.5	36.8	31.0	31.0	35.1	29.4	29.4	33.3	27.6	27.6	31.3
			SHC	29.3	33.8	38.4	28.1	32.5	36.8	26.9	31.0	35.1	25.5	29.4	33.3	23.9	27.6	31.3
		62	TC	35.1	35.1	37.5	33.3	33.3	36.6	31.5	31.5	35.7	29.6	29.6	34.5	27.7	27.7	32.6
			SHC	26.9	32.2	37.5	26.0	31.3	36.6	25.1	30.4	35.7	24.1	29.3	34.5	22.7	27.7	32.6
		67	TC	38.4	38.4	38.4	36.5	36.5	36.5	34.5	34.5	34.5	32.3	32.3	32.3	29.9	29.9	29.9
			SHC	22.0	27.3	32.7	21.2	26.5	31.9	20.3	25.7	31.0	19.4	24.8	30.1	18.5	23.8	29.1
		72	TC	42.0	42.0	42.0	40.0	40.0	40.0	37.8	37.8	37.8	35.5	35.5	35.5	32.9	32.9	32.9
			SHC	16.9	22.3	27.6	16.1	21.5	26.9	15.3	20.7	26.0	14.4	19.8	25.1	13.5	18.8	24.2
		76	TC	–	45.0	45.0	–	42.9	42.9	–	40.6	40.6	–	38.0	38.0	–	35.3	35.3
			SHC	–	18.1	23.8	–	17.4	23.0	–	16.6	22.2	–	15.7	21.3	–	14.8	20.3
1200 Cfm	EA (wb)	58	TC	35.3	35.3	40.0	33.9	33.9	38.4	32.3	32.3	36.6	30.6	30.6	34.7	28.7	28.7	32.5
			SHC	30.6	35.3	40.0	29.4	33.9	38.4	28.0	32.3	36.6	26.5	30.6	34.7	24.9	28.7	32.5
		62	TC	35.9	35.9	40.5	34.2	34.2	39.4	32.4	32.4	38.1	30.6	30.6	36.1	28.7	28.7	33.9
			SHC	28.6	34.5	40.5	27.7	33.6	39.4	26.6	32.4	38.1	25.2	30.6	36.1	23.6	28.7	33.9
		67	TC	39.3	39.3	39.3	37.3	37.3	37.3	35.2	35.2	35.2	32.9	32.9	32.9	30.5	30.5	31.6
			SHC	23.1	29.1	35.2	22.3	28.3	34.4	21.4	27.5	33.5	20.5	26.6	32.6	19.5	25.6	31.6
		72	TC	42.9	42.9	42.9	40.8	40.8	40.8	38.5	38.5	38.5	36.1	36.1	36.1	33.4	33.4	33.4
			SHC	17.3	23.4	29.5	16.6	22.6	28.7	15.7	21.8	27.9	14.8	20.9	27.0	13.9	19.9	26.0
		76	TC	–	45.9	45.9	–	43.7	43.7	–	41.3	41.3	–	38.7	38.7	–	35.9	35.9
			SHC	–	18.8	25.1	–	18.0	24.3	–	17.2	23.4	–	16.3	22.5	–	15.4	21.5
1350 Cfm	EA (wb)	58	TC	36.6	36.6	41.5	35.1	35.1	39.7	33.4	33.4	37.9	31.6	31.6	35.8	29.6	29.6	33.6
			SHC	31.7	36.6	41.5	30.4	35.1	39.7	28.9	33.4	37.9	27.4	31.6	35.8	25.7	29.6	33.6
		62	TC	36.7	36.7	43.2	35.1	35.1	41.3	33.4	33.4	39.4	31.6	31.6	37.3	29.6	29.6	34.9
			SHC	30.2	36.7	43.2	28.8	35.1	41.3	27.5	33.4	39.4	26.0	31.6	37.3	24.4	29.6	34.9
		67	TC	39.9	39.9	39.9	37.9	37.9	37.9	35.8	35.8	35.9	33.4	33.4	34.9	30.9	30.9	33.9
			SHC	24.2	30.9	37.6	23.4	30.1	36.8	22.5	29.2	35.9	21.6	28.3	34.9	20.6	27.2	33.9
		72	TC	43.6	43.6	43.6	41.4	41.4	41.4	39.1	39.1	39.1	36.6	36.6	36.6	33.9	33.9	33.9
			SHC	17.8	24.5	31.3	17.0	23.7	30.5	16.1	22.9	29.6	15.2	22.0	28.7	14.3	21.0	27.7
		78	TC	–	46.7	46.7	–	44.4	44.4	–	41.9	41.9	–	39.2	39.2	–	36.3	36.3
			SHC	–	19.4	26.3	–	18.6	25.5	–	17.8	24.6	–	16.9	23.7	–	15.9	22.7
1500 Cfm	EA (wb)	58	TC	37.7	37.7	42.7	36.1	36.1	40.9	34.3	34.3	38.9	32.5	32.5	36.8	30.4	30.4	34.4
			SHC	32.6	37.7	42.7	31.3	36.1	40.9	29.8	34.3	38.9	28.1	32.5	36.8	26.3	30.4	34.4
		62	TC	37.7	37.7	44.4	36.1	36.1	42.5	34.4	34.4	40.5	32.5	32.5	38.3	30.4	30.4	35.8
			SHC	31.0	37.7	44.4	29.7	36.1	42.5	28.3	34.4	40.5	26.7	32.5	38.3	25.0	30.4	35.8
		67	TC	40.5	40.5	40.5	38.4	38.4	39.1	36.2	36.2	38.2	33.8	33.8	37.2	31.2	31.2	36.1
			SHC	25.2	32.6	40.0	24.4	31.7	39.1	23.5	30.8	38.2	22.5	29.9	37.2	21.5	28.8	36.1
		72	TC	44.2	44.2	44.2	41.9	41.9	41.9	39.6	39.6	39.6	37.0	37.0	37.0	34.2	34.2	34.2
			SHC	18.2	25.6	33.0	17.4	24.8	32.2	16.5	23.9	31.3	15.6	23.0	30.4	14.7	22.0	29.4
		76	TC	–	47.2	47.2	–	44.9	44.9	–	42.3	42.3	–	39.6	39.6	–	36.7	36.7
			SHC	–	19.9	27.5	–	19.1	26.7	–	18.3	25.8	–	17.4	24.9	–	16.4	23.9

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC04 (3 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		900 / 0.01			1200 / 0.02			1500 / 0.04		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	44.6	40.3	36.5	47.0	43.0	39.1	48.8	44.3	40.8
	SHC	19.8	24.5	29.3	22.6	29.1	35.3	25.4	33.0	40.4
	kW	2.02	1.97	1.93	1.96	2.00	2.05	2.08	2.02	1.98
85	TC	42.1	38.1	34.4	44.6	40.5	36.9	46.1	41.9	38.6
	SHC	17.5	22.5	27.4	20.4	26.8	33.2	22.9	30.8	38.2
	kW	2.28	2.23	2.19	2.22	2.26	2.31	2.33	2.28	2.24
95	TC	39.6	35.8	32.3	41.9	38.0	34.5	43.2	39.3	36.2
	SHC	15.2	20.3	25.5	17.8	24.5	31.1	20.2	28.4	35.9
	kW	2.56	2.51	2.47	2.50	2.54	2.60	2.62	2.56	2.52
105	TC	36.8	33.2	30.0	38.9	35.3	32.0	40.2	36.5	33.6
	SHC	12.7	18.1	23.4	15.1	22.0	28.8	17.5	25.8	33.6
	kW	2.88	2.83	2.79	2.82	2.86	2.91	2.93	2.88	2.84
115	TC	33.9	30.5	27.5	35.8	32.4	29.4	37.0	33.5	30.9
	SHC	10.1	15.7	21.2	12.3	19.5	26.4	14.5	23.1	30.9
	kW	3.23	3.19	3.15	3.17	3.21	3.26	3.28	3.23	3.19
125	TC	30.8	27.7	24.9	32.5	29.3	26.5	33.5	30.3	27.9
	SHC	7.3	13.1	18.9	9.4	16.7	23.9	11.4	20.3	27.9
	kW	3.62	3.59	3.56	3.57	3.60	3.65	3.66	3.62	3.59

48HC04 (3 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR - Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator - Cfm								
		900	1200	1500	900	1200	1500	900	1200	1500
80	TC	16.46	17.15	17.74	16.66	17.23	17.79	16.85	17.74	18.29
	SHC	5.10	6.60	8.15	3.21	4.33	5.61	1.59	2.75	3.83
	kW	1.94	2.01	2.02	2.04	2.13	2.15	2.12	2.14	2.16
75	TC	16.61	17.52	18.09	17.18	18.09	18.67	17.69	18.61	19.19
	SHC	5.24	6.96	8.48	3.71	5.15	6.45	2.40	3.59	4.69
	kW	1.98	2.00	2.01	1.99	2.01	2.02	2.00	2.02	2.03
70	TC	17.00	18.06	18.63	17.56	18.46	19.40	18.41	19.35	20.10
	SHC	5.62	7.47	9.00	4.08	5.50	7.16	3.09	4.31	5.58
	kW	1.96	1.94	1.96	1.97	2.00	1.94	1.91	1.94	1.92
60	TC	17.63	18.49	19.37	18.17	19.38	19.95	18.66	19.52	20.46
	SHC	6.21	7.89	9.71	4.66	6.39	7.68	3.31	4.45	5.90
	kW	1.93	1.96	1.92	1.95	1.92	1.94	1.97	2.00	1.96
50	TC	17.82	18.59	19.72	18.31	19.73	20.26	18.76	20.21	20.73
	SHC	6.40	7.99	10.05	4.79	6.71	7.97	3.40	5.11	6.16
	kW	1.98	2.03	1.94	2.01	1.94	1.97	2.03	1.96	1.99
40	TC	17.70	19.38	19.85	19.10	20.30	20.34	19.53	20.76	21.26
	SHC	6.30	8.74	10.17	5.54	7.26	8.05	4.13	5.64	6.67
	kW	2.07	1.95	1.99	1.93	1.91	2.02	1.96	1.94	1.97

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 14 – COOLING CAPACITIES 1-STAGE COOLING 4 TONS

48HC*A05				AMBIENT TEMPERATURE													
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
1200 Cfm	EA (wb)	58	TC	43.2	43.2	49.1	41.5	41.5	47.2	39.7	39.7	45.1	37.7	37.7	42.9	35.6	35.6	40.4
			SHC	37.3	43.2	49.1	35.9	41.5	47.2	34.3	39.7	45.1	32.6	37.7	42.9	30.7	35.6	40.4
		62	TC	45.9	45.9	46.0	43.7	43.7	45.0	41.3	41.3	43.8	38.8	38.8	42.6	36.0	36.0	41.2
			SHC	33.5	39.8	46.0	32.5	38.7	45.0	31.3	37.6	43.8	30.1	36.3	42.6	28.8	35.0	41.2
		67	TC	50.5	50.5	50.5	48.0	48.0	48.0	45.4	45.4	45.4	42.6	42.6	42.6	39.6	39.6	39.6
			SHC	27.9	34.1	40.4	26.8	33.1	39.4	25.7	32.0	38.2	24.5	30.8	37.1	23.2	29.5	35.8
		72	TC	55.4	55.4	55.4	52.7	52.7	52.7	49.9	49.9	49.9	46.8	46.8	46.8	43.5	43.5	43.5
			SHC	22.0	28.4	34.7	21.0	27.3	33.7	19.9	26.2	32.5	18.7	25.0	31.3	17.4	23.8	30.1
		76	TC	–	59.7	59.7	–	56.8	56.8	–	53.7	53.7	–	50.4	50.4	–	46.8	46.8
			SHC	–	23.6	30.2	–	22.6	29.2	–	21.5	28.1	–	20.3	26.8	–	19.1	25.5
1400 Cfm	EA (wb)	58	TC	45.6	45.6	51.9	43.8	43.8	49.8	41.9	41.9	47.6	39.7	39.7	45.1	37.3	37.3	42.4
			SHC	39.4	45.6	51.9	37.9	43.8	49.8	36.2	41.9	47.6	34.3	39.7	45.1	32.3	37.3	42.4
		62	TC	47.4	47.4	50.5	45.1	45.1	49.3	42.6	42.6	48.0	40.0	40.0	46.5	37.4	37.4	44.2
			SHC	36.0	43.2	50.5	34.9	42.1	49.3	33.7	40.9	48.0	32.4	39.5	46.5	30.6	37.4	44.2
		67	TC	52.1	52.1	52.1	49.5	49.5	49.5	46.7	46.7	46.7	43.7	43.7	43.7	40.5	40.5	40.5
			SHC	29.5	36.8	44.0	28.4	35.7	42.9	27.3	34.5	41.8	26.0	33.3	40.5	24.7	32.0	39.2
		72	TC	57.1	57.1	57.1	54.3	54.3	54.3	51.2	51.2	51.2	48.0	48.0	48.0	44.5	44.5	44.5
			SHC	22.8	30.1	37.4	21.7	29.0	36.3	20.5	27.8	35.1	19.3	26.6	33.9	18.0	25.3	32.6
		76	TC	–	61.4	61.4	–	58.3	58.3	–	55.1	55.1	–	51.6	51.6	–	47.8	47.8
			SHC	–	24.6	32.2	–	23.5	31.1	–	22.4	29.9	–	21.2	28.7	–	19.9	27.4
1600 Cfm	EA (wb)	58	TC	47.7	47.7	54.2	45.8	45.8	52.0	43.7	43.7	49.6	41.3	41.3	47.0	38.8	38.8	44.1
			SHC	41.2	47.7	54.2	39.5	45.8	52.0	37.7	43.7	49.6	35.7	41.3	47.0	33.5	38.8	44.1
		62	TC	48.7	48.7	54.5	46.3	46.3	53.2	43.7	43.7	51.7	41.4	41.4	48.9	38.8	38.8	45.9
			SHC	38.3	46.4	54.5	37.1	45.2	53.2	35.8	43.7	51.7	33.9	41.4	48.9	31.8	38.8	45.9
		67	TC	53.3	53.3	53.3	50.6	50.6	50.6	47.7	47.7	47.7	44.6	44.6	44.6	41.2	41.2	42.6
			SHC	31.0	39.2	47.5	29.9	38.1	46.3	28.7	37.0	45.2	27.5	35.7	43.9	26.2	34.4	42.6
		72	TC	58.4	58.4	58.4	55.4	55.4	55.4	52.3	52.3	52.3	48.9	48.9	48.9	45.2	45.2	45.2
			SHC	23.4	31.7	39.9	22.3	30.6	38.8	21.1	29.4	37.6	19.9	28.2	36.4	18.6	26.8	35.1
		76	TC	–	62.7	62.7	–	59.5	59.5	–	56.1	56.1	–	52.5	52.5	–	48.6	48.6
			SHC	–	25.5	34.0	–	24.4	32.9	–	23.2	31.7	–	22.0	30.4	–	20.7	29.1
1800 Cfm	EA (wb)	58	TC	49.5	49.5	56.2	47.4	47.4	53.9	45.2	45.2	51.3	42.7	42.7	48.5	40.1	40.1	45.5
			SHC	42.8	49.5	56.2	41.0	47.4	53.9	39.0	45.2	51.3	36.9	42.7	48.5	34.6	40.1	45.5
		62	TC	49.8	49.8	58.1	47.5	47.5	56.1	45.2	45.2	53.4	42.8	42.8	50.5	40.1	40.1	47.4
			SHC	40.4	49.2	58.1	38.8	47.5	56.1	37.0	45.2	53.4	35.0	42.8	50.5	32.8	40.1	47.4
		67	TC	54.3	54.3	54.3	51.5	51.5	51.5	48.5	48.5	48.5	45.3	45.3	47.1	41.8	41.8	45.7
			SHC	32.5	41.7	50.8	31.4	40.5	49.7	30.2	39.3	48.5	28.9	38.0	47.1	27.5	36.6	45.7
		72	TC	59.4	59.4	59.4	56.3	56.3	56.3	53.1	53.1	53.1	49.6	49.6	49.6	45.8	45.8	45.8
			SHC	24.0	33.2	42.4	22.9	32.1	41.3	21.7	30.9	40.1	20.4	29.6	38.8	19.1	28.3	37.5
		76	TC	–	63.8	63.8	–	60.5	60.5	–	57.0	57.0	–	53.2	53.2	–	49.2	49.2
			SHC	–	26.3	35.8	–	25.2	34.6	–	24.0	33.4	–	22.8	32.1	–	21.5	30.8
2000 Cfm	EA (wb)	58	TC	51.0	51.0	58.0	48.8	48.8	55.5	46.5	46.5	52.8	43.9	43.9	49.9	41.1	41.1	46.7
			SHC	44.1	51.0	58.0	42.2	48.8	55.5	40.2	46.5	52.8	37.9	43.9	49.9	35.5	41.1	46.7
		62	TC	51.1	51.1	60.4	48.9	48.9	57.8	46.5	46.5	55.0	44.0	44.0	51.9	41.1	41.1	48.6
			SHC	41.8	51.1	60.4	40.0	48.9	57.8	38.1	46.5	55.0	36.0	44.0	51.9	33.7	41.1	48.6
		67	TC	55.1	55.1	55.1	52.1	52.1	52.9	49.1	49.1	51.6	45.8	45.8	50.2	42.3	42.3	48.7
			SHC	33.9	44.0	54.1	32.7	42.8	52.9	31.5	41.5	51.6	30.2	40.2	50.2	28.8	38.8	48.7
		72	TC	60.3	60.3	60.3	57.1	57.1	57.1	53.7	53.7	53.7	50.1	50.1	50.1	46.3	46.3	46.3
			SHC	24.5	34.7	44.8	23.4	33.5	43.6	22.2	32.3	42.4	21.0	31.1	41.2	19.6	29.7	39.8
		76	TC	–	64.6	64.6	–	61.2	61.2	–	57.6	57.6	–	53.8	53.8	–	49.7	49.7
			SHC	–	27.1	37.5	–	26.0	36.3	–	24.8	35.1	–	23.5	33.8	–	22.2	32.4

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC05 (4 TONS) – UNIT WITH HUMIDI–MIZER IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		1200 / 0.04			1600 / 0.07			2000 / 0.10		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	57.8	52.3	47.2	61.5	55.6	50.6	63.7	57.9	0.0
	SHC	24.2	30.5	36.8	27.9	35.9	44.0	31.2	40.9	0.0
	kW	2.50	2.47	2.44	2.46	2.48	2.51	2.53	2.50	0.00
85	TC	54.1	48.9	44.1	57.1	52.0	47.3	59.6	54.0	49.5
	SHC	20.7	27.3	33.9	23.9	32.6	41.0	27.3	37.3	47.1
	kW	2.81	2.78	2.76	2.78	2.80	2.82	2.84	2.81	2.79
95	TC	50.1	45.3	40.8	53.3	48.2	43.7	55.2	50.1	45.8
	SHC	17.0	24.0	30.9	20.4	29.1	37.7	23.3	33.6	43.6
	kW	3.16	3.14	3.12	3.13	3.15	3.18	3.19	3.16	3.14
105	TC	45.7	41.1	37.2	48.6	43.8	39.8	50.5	45.5	41.8
	SHC	12.9	20.1	27.6	16.0	25.0	34.1	19.0	29.4	39.9
	kW	3.56	3.54	3.52	3.54	3.55	3.58	3.59	3.56	3.55
115	TC	41.1	37.0	33.2	43.5	39.2	35.5	45.4	41.1	37.5
	SHC	8.7	16.4	23.9	11.3	20.7	30.1	14.3	25.4	35.8
	kW	4.02	4.01	4.00	4.00	4.01	4.03	4.04	4.03	4.01
125	TC	36.3	32.5	29.0	38.6	34.7	31.2	40.2	36.1	32.9
	SHC	4.3	12.2	20.1	6.8	16.6	26.2	9.4	20.8	31.5
	kW	4.54	4.53	4.53	4.53	4.54	4.54	4.55	4.54	4.54

48HC05 (4 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		1200	1600	2000	1200	1600	2000	1200	1600	2000
80	TC	18.64	19.95	20.78	19.35	20.71	21.51	20.00	21.37	22.33
	SHC	0.78	4.36	8.24	–1.95	1.01	4.29	–4.33	–1.91	0.99
	kW	2.66	2.68	2.69	2.67	2.69	2.69	2.68	2.69	2.68
75	TC	19.37	21.21	22.15	20.47	21.97	22.92	21.15	22.78	23.65
	SHC	1.48	5.52	9.49	–0.91	2.18	5.57	–3.26	–0.61	2.20
	kW	2.62	2.54	2.54	2.56	2.55	2.55	2.56	2.55	2.56
70	TC	19.92	21.63	22.64	20.77	22.52	23.61	21.70	23.39	24.26
	SHC	2.01	5.94	9.98	–0.61	2.70	6.23	–2.72	–0.02	2.78
	kW	2.60	2.56	2.54	2.58	2.54	2.53	2.54	2.52	2.54
60	TC	20.11	21.27	22.23	20.75	23.15	23.43	22.49	23.78	24.55
	SHC	2.24	5.70	9.70	–0.57	3.35	6.15	–1.95	0.40	3.13
	kW	2.69	2.74	2.73	2.72	2.58	2.68	2.56	2.60	2.63
50	TC	21.56	22.70	23.37	22.18	23.33	24.01	22.75	23.90	25.40
	SHC	3.61	7.03	10.76	0.78	3.57	6.73	–1.67	0.57	3.96
	kW	2.57	2.63	2.66	2.60	2.66	2.69	2.63	2.69	2.62
40	TC	21.67	23.23	24.04	22.76	23.82	25.57	23.28	24.34	26.13
	SHC	3.74	7.56	9.89	1.35	4.06	8.17	–1.15	1.01	4.67
	kW	2.64	2.64	2.69	2.61	2.67	2.58	2.64	2.70	2.61

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 16 – COOLING CAPACITIES 1-STAGE COOLING 5 TONS

48HC*A06				AMBIENT TEMPERATURE																
				85			95			105			115			125				
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)				
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85		
1500 Cfm	EA (wb)	58	TC	53.4	53.4	60.6	51.3	51.3	58.2	49.0	49.0	55.6	46.5	46.5	52.7	43.7	43.7	49.5		
			SHC	46.3	53.4	60.6	44.5	51.3	58.2	42.5	49.0	55.6	40.3	46.5	52.7	37.9	43.7	49.5		
		62	TC	55.6	55.6	58.2	52.9	52.9	56.9	50.0	50.0	55.5	46.9	46.9	53.9	43.8	43.8	51.6		
			SHC	42.0	50.1	58.2	40.7	48.8	56.9	39.4	47.4	55.5	37.9	45.9	53.9	36.0	43.8	51.6		
		67	TC	60.8	60.8	60.8	57.8	57.8	57.8	54.6	54.6	54.6	51.1	51.1	51.1	47.4	47.4	47.4		
			SHC	34.4	42.6	50.7	33.2	41.3	49.4	31.8	39.9	48.1	30.4	38.5	46.6	28.9	37.0	45.1		
		72	TC	66.6	66.6	66.6	63.2	63.2	63.2	59.7	59.7	59.7	55.9	55.9	55.9	51.8	51.8	51.8		
			SHC	26.7	34.8	43.0	25.4	33.6	41.7	24.1	32.2	40.4	22.6	30.8	38.9	21.1	29.3	37.4		
		76	TC	–	71.4	71.4	–	67.9	67.9	–	64.0	64.0	–	59.9	59.9	–	55.5	55.5		
			SHC	–	28.5	36.7	–	27.2	35.5	–	25.9	34.2	–	24.5	32.7	–	23.0	31.3		
1750 Cfm	EA (wb)	58	TC	56.3	56.3	63.8	54.0	54.0	61.2	51.5	51.5	58.3	48.7	48.7	55.2	45.7	45.7	51.8		
			SHC	48.8	56.3	63.8	46.8	54.0	61.2	44.6	51.5	58.3	42.2	48.7	55.2	39.6	45.7	51.8		
		62	TC	57.3	57.3	64.0	54.5	54.5	62.5	51.6	51.6	60.7	48.8	48.8	57.5	45.8	45.8	53.9		
			SHC	45.3	54.7	64.0	44.0	53.3	62.5	42.4	51.6	60.7	40.1	48.8	57.5	37.6	45.8	53.9		
		67	TC	62.5	62.5	62.5	59.3	59.3	59.3	55.9	55.9	55.9	52.3	52.3	52.3	48.3	48.3	49.7		
			SHC	36.6	46.0	55.4	35.3	44.7	54.1	33.9	43.3	52.7	32.4	41.8	51.3	30.9	40.3	49.7		
		72	TC	68.3	68.3	68.3	64.8	64.8	64.8	61.0	61.0	61.0	57.0	57.0	57.0	52.7	52.7	52.7		
			SHC	27.5	37.0	46.5	26.2	35.7	45.2	24.9	34.4	43.8	23.4	32.9	42.4	21.9	31.4	40.8		
		76	TC	–	73.2	73.2	–	69.4	69.4	–	65.4	65.4	–	61.1	61.1	–	56.5	56.5		
			SHC	–	29.7	39.3	–	28.4	38.0	–	27.1	36.7	–	25.6	35.2	–	24.1	33.7		
2000 Cfm	EA (wb)	58	TC	58.7	58.7	66.5	56.2	56.2	63.7	53.5	53.5	60.6	50.6	50.6	57.3	47.3	47.3	53.7		
			SHC	50.9	58.7	66.5	48.7	56.2	63.7	46.4	53.5	60.6	43.8	50.6	57.3	41.0	47.3	53.7		
		62	TC	58.8	58.8	69.2	56.3	56.3	66.3	53.6	53.6	63.1	50.6	50.6	59.6	47.4	47.4	55.8		
			SHC	48.3	58.8	69.2	46.3	56.3	66.3	44.0	53.6	63.1	41.6	50.6	59.6	39.0	47.4	55.8		
		67	TC	63.8	63.8	63.8	60.4	60.4	60.4	56.9	56.9	57.3	53.1	53.1	55.8	49.1	49.1	54.1		
			SHC	38.6	49.3	60.1	37.3	48.0	58.7	35.9	46.6	57.3	34.4	45.1	55.8	32.8	43.4	54.1		
		72	TC	69.6	69.6	69.6	65.9	65.9	65.9	62.1	62.1	62.1	57.9	57.9	57.9	53.5	53.5	53.5		
			SHC	28.4	39.1	49.9	27.0	37.8	48.6	25.7	36.4	47.2	24.2	35.0	45.7	22.6	33.4	44.2		
		76	TC	–	74.5	74.5	–	70.6	70.6	–	66.5	66.5	–	62.0	62.0	–	–	–		
			SHC	–	30.8	41.8	–	29.5	40.4	–	28.2	39.0	–	26.7	37.6	–	–	–		
2250 Cfm	EA (wb)	58	TC	60.7	60.7	68.8	58.1	58.1	65.8	55.2	55.2	62.6	52.1	52.1	59.1	48.7	48.7	55.2		
			SHC	52.6	60.7	68.8	50.3	58.1	65.8	47.9	55.2	62.6	45.2	52.1	59.1	42.2	48.7	55.2		
		62	TC	60.8	60.8	71.6	58.1	58.1	68.5	55.3	55.3	65.1	52.2	52.2	61.4	48.7	48.7	57.4		
			SHC	50.0	60.8	71.6	47.8	58.1	68.5	45.4	55.3	65.1	42.9	52.2	61.4	40.1	48.7	57.4		
		67	TC	64.7	64.7	64.7	61.3	61.3	63.2	57.7	57.7	61.7	53.8	53.8	60.1	49.7	49.7	58.3		
			SHC	40.6	52.6	64.5	39.2	51.2	63.2	37.8	49.7	61.7	36.2	48.2	60.1	34.6	46.5	58.3		
		72	TC	70.6	70.6	70.6	66.8	66.8	66.8	62.8	62.8	62.8	58.6	58.6	58.6	54.0	54.0	54.0		
			SHC	29.1	41.2	53.3	27.8	39.9	51.9	26.4	38.4	50.5	24.9	37.0	49.0	23.3	35.4	47.4		
		76	TC	–	75.6	75.6	–	71.6	71.6	–	67.3	67.3	–	–	–	–	–	–		
			SHC	–	31.9	44.1	–	30.6	42.8	–	29.2	41.4	–	–	–	–	–	–		
2500 Cfm	EA (wb)	58	TC	62.5	62.5	70.8	59.7	59.7	67.6	56.7	56.7	64.2	53.4	53.4	60.5	49.9	49.9	56.5		
			SHC	54.1	62.5	70.8	51.7	59.7	67.6	49.1	56.7	64.2	46.3	53.4	60.5	43.2	49.9	56.5		
		62	TC	62.5	62.5	73.6	59.7	59.7	70.3	56.7	56.7	66.8	53.5	53.5	63.0	49.9	49.9	58.8		
			SHC	51.4	62.5	73.6	49.1	59.7	70.3	46.6	56.7	66.8	43.9	53.5	63.0	41.0	49.9	58.8		
		67	TC	65.5	65.5	68.9	62.0	62.0	67.4	58.3	58.3	65.9	54.4	54.4	64.2	50.2	50.2	62.2		
			SHC	42.5	55.7	68.9	41.1	54.3	67.4	39.6	52.7	65.9	38.0	51.1	64.2	36.3	49.2	62.2		
		72	TC	71.4	71.4	71.4	67.5	67.5	67.5	63.4	63.4	63.4	59.1	59.1	59.1	54.4	54.4	54.4		
			SHC	29.9	43.2	56.5	28.5	41.8	55.2	27.1	40.4	53.7	25.6	38.9	52.2	24.0	37.3	50.6		
		76	TC	–	76.4	76.4	–	72.3	72.3	–	–	–	–	–	–	–	–	–		
			SHC	–	33.0	46.4	–	31.6	45.1	–	–	–	–	–	–	–	–	–		

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC06 (5 TONS) – UNIT WITH HUMIDI–MIZER IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		1500 / 0.01			2000 / 0.02			2500 / 0.03		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	66.9	60.3	54.8	71.0	64.4	58.6	73.5	66.9	61.6
	SHC	25.8	34.1	43.0	30.5	41.7	52.6	35.0	48.6	61.2
	kW	3.11	3.06	3.03	3.05	3.09	3.16	3.16	3.11	3.07
85	TC	62.4	56.5	51.2	66.3	60.1	54.7	68.2	62.3	57.5
	SHC	21.5	30.6	39.6	26.1	37.6	49.0	29.9	44.2	57.2
	kW	3.47	3.43	3.39	3.42	3.46	3.51	3.52	3.48	3.44
95	TC	57.8	52.3	47.3	61.3	55.6	50.6	63.5	57.7	53.2
	SHC	17.2	26.6	35.9	21.4	33.3	45.1	25.6	39.9	53.2
	kW	3.89	3.85	3.80	3.83	3.88	3.93	3.95	3.90	3.86
105	TC	52.8	47.5	42.9	55.4	50.0	45.3	58.0	52.2	47.9
	SHC	12.5	22.1	31.7	15.8	28.1	40.1	20.4	34.7	47.9
	kW	4.36	4.31	4.26	4.29	4.33	4.38	4.42	4.36	4.32
115	TC	47.4	42.8	38.6	50.1	45.2	41.1	51.8	47.1	43.4
	SHC	7.4	17.7	27.8	11.0	23.6	36.1	14.7	30.0	43.4
	kW	4.88	4.83	4.78	4.81	4.86	4.91	4.93	4.88	4.84
125	TC	41.6	37.5	33.8	44.0	39.7	35.8	45.8	41.3	38.0
	SHC	2.1	12.8	23.3	5.3	18.6	31.2	9.1	24.7	38.0
	kW	5.44	5.39	5.35	5.37	5.42	5.47	5.49	5.44	5.40

48HC06 (5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		1500	2000	2500	1500	2000	2500	1500	2000	2500
80	TC	25.29	27.61	28.72	26.81	28.62	29.71	27.68	29.53	30.63
	SHC	5.06	10.68	15.86	2.37	6.73	11.22	–0.40	3.30	7.17
	kW	3.23	3.12	3.13	3.12	3.13	3.14	3.12	3.14	3.15
75	TC	26.69	28.45	29.73	27.65	29.64	30.73	28.53	30.55	31.65
	SHC	6.39	11.52	16.85	3.20	7.72	12.20	0.43	4.29	8.16
	kW	3.08	3.11	3.09	3.10	3.09	3.11	3.11	3.10	3.12
70	TC	27.04	29.08	30.15	28.29	30.04	31.09	29.13	30.91	31.97
	SHC	6.76	12.14	17.28	3.82	8.14	12.60	1.02	4.67	8.51
	kW	3.15	3.12	3.15	3.11	3.14	3.17	3.13	3.16	3.18
60	TC	27.99	29.57	31.33	28.86	30.46	32.25	29.63	32.44	33.81
	SHC	7.70	12.66	18.45	4.41	8.60	13.74	1.54	6.16	10.28
	kW	3.17	3.23	3.15	3.21	3.26	3.18	3.23	3.12	3.10
50	TC	30.09	31.66	32.64	30.93	32.57	33.53	31.73	33.38	34.35
	SHC	9.72	14.66	19.72	6.40	10.61	14.99	3.56	7.10	10.85
	kW	3.01	3.07	3.11	3.04	3.10	3.15	3.07	3.14	3.18
40	TC	28.39	30.78	32.67	31.13	32.60	34.40	31.86	33.33	36.07
	SHC	8.17	13.89	19.80	6.63	10.69	15.85	3.72	7.10	12.51
	kW	3.39	3.32	3.24	3.14	3.23	3.15	3.18	3.27	3.08

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 18 – COOLING CAPACITIES 1-STAGE COOLING 6 TONS

48HC*A07				AMBIENT TEMPERATURE															
				85			95			105			115			125			
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
1800 Cfm	EA (wb)	58	TC	64.1	64.1	72.5	61.8	61.8	69.9	59.2	59.2	67	56.3	56.3	63.7	53.2	53.2	60.2	
			SHC	55.7	64.1	72.5	53.7	61.8	69.9	51.4	59.2	67	48.9	56.3	63.7	46.2	53.2	60.2	
		62	TC	67.9	67.9	68.5	64.9	64.9	67	61.5	61.5	65.3	57.9	57.9	63.5	54	54	61.4	
			SHC	50.2	59.4	68.5	48.8	57.9	67	47.1	56.2	65.3	45.4	54.4	63.5	43.4	52.4	61.4	
		67	TC	74.8	74.8	74.8	71.5	71.5	71.5	67.8	67.8	67.8	63.8	63.8	63.8	59.5	59.5	59.5	
			SHC	41.8	50.9	60.1	40.3	49.5	58.7	38.8	47.9	57.1	37.1	46.2	55.4	35.3	44.4	53.6	
		72	TC	82.2	82.2	82.2	78.7	78.7	78.7	74.7	74.7	74.7	70.4	70.4	70.4	65.6	65.6	65.6	
			SHC	33	42.3	51.6	31.6	40.9	50.2	30.1	39.3	48.6	28.4	37.7	46.9	26.7	35.9	45.1	
		76	TC	–	88.7	88.7	–	84.8	84.8	–	80.6	80.6	–	76	76	–	70.9	70.9	
			SHC	–	35.3	45.2	–	33.9	43.7	–	32.4	42	–	30.7	40.3	–	28.9	38.5	
2100 Cfm	EA (wb)	58	TC	67.6	67.6	76.5	65.1	65.1	73.7	62.3	62.3	70.5	59.3	59.3	67.1	55.9	55.9	63.2	
			SHC	58.7	67.6	76.5	56.6	65.1	73.7	54.1	62.3	70.5	51.5	59.3	67.1	48.5	55.9	63.2	
		62	TC	70.1	70.1	74.9	67	67	73.2	63.5	63.5	71.3	59.7	59.7	69.1	56	56	65.8	
			SHC	53.9	64.4	74.9	52.4	62.8	73.2	50.6	61	71.3	48.7	58.9	69.1	46.2	56	65.8	
		67	TC	77.1	77.1	77.1	73.6	73.6	73.6	69.7	69.7	69.7	65.5	65.5	65.5	60.9	60.9	60.9	
			SHC	44.2	54.8	65.3	42.7	53.3	63.9	41.2	51.7	62.3	39.4	50	60.5	37.6	48.1	58.6	
		72	TC	84.7	84.7	84.7	80.9	80.9	80.9	76.8	76.8	76.8	72.2	72.2	72.2	67.2	67.2	67.2	
			SHC	34.2	44.8	55.5	32.7	43.4	54	31.1	41.8	52.4	29.5	40.1	50.7	27.6	38.2	48.8	
		76	TC	–	91.3	91.3	–	87.2	87.2	–	82.7	82.7	–	77.8	77.8	–	72.5	72.5	
			SHC	–	36.7	47.8	–	35.3	46.3	–	33.7	44.7	–	32	43	–	30.2	41.1	
2400 Cfm	EA (wb)	58	TC	70.6	70.6	79.9	68	68	76.9	65	65	73.5	61.7	61.7	69.8	58.1	58.1	65.8	
			SHC	61.3	70.6	79.9	59	68	76.9	56.4	65	73.5	53.6	61.7	69.8	50.5	58.1	65.8	
		62	TC	72	72	80.6	68.7	68.7	78.7	65.2	65.2	76.6	61.8	61.8	72.6	58.2	58.2	68.4	
			SHC	57.3	69	80.6	55.6	67.2	78.7	53.7	65.2	76.6	50.9	61.8	72.6	48	58.2	68.4	
		67	TC	78.9	78.9	78.9	75.2	75.2	75.2	71.2	71.2	71.2	66.8	66.8	66.8	62	62	63.4	
			SHC	46.5	58.4	70.3	45	56.9	68.8	43.4	55.3	67.2	41.6	53.5	65.4	39.7	51.6	63.4	
		72	TC	86.6	86.6	86.6	82.7	82.7	82.7	78.3	78.3	78.3	73.6	73.6	73.6	68.4	68.4	68.4	
			SHC	35.2	47.2	59.2	33.7	45.7	57.7	32.1	44.1	56	30.4	42.3	54.3	28.5	40.5	52.4	
		76	TC	–	93.3	93.3	–	89	89	–	84.4	84.4	–	79.3	79.3	–	73.7	73.7	
			SHC	–	38	50.4	–	36.6	48.9	–	35	47.3	–	33.3	45.5	–	31.4	43.6	
2700 Cfm	EA (wb)	58	TC	73.2	73.2	82.8	70.4	70.4	79.6	67.3	67.3	76.1	63.8	63.8	72.2	60	60	67.9	
			SHC	63.6	73.2	82.8	61.1	70.4	79.6	58.4	67.3	76.1	55.4	63.8	72.2	52.1	60	67.9	
		62	TC	73.7	73.7	85.5	70.5	70.5	82.8	67.3	67.3	79.1	63.9	63.9	75.1	60.1	60.1	70.6	
			SHC	60.2	72.9	85.5	58.1	70.5	82.8	55.5	67.3	79.1	52.7	63.9	75.1	49.5	60.1	70.6	
		67	TC	80.3	80.3	80.3	76.5	76.5	76.5	72.4	72.4	72.4	67.8	67.8	70	62.9	62.9	67.9	
			SHC	48.7	61.9	75.1	47.1	60.4	73.6	45.5	58.7	71.9	43.7	56.8	70	41.7	54.8	67.9	
		72	TC	88.2	88.2	88.2	84	84	84	79.6	79.6	79.6	74.6	74.6	74.6	69.3	69.3	69.3	
			SHC	36.1	49.4	62.7	34.6	47.9	61.2	33	46.2	59.5	31.2	44.5	57.7	29.3	42.6	55.8	
		76	TC	–	94.9	94.9	–	90.4	90.4	–	85.6	85.6	–	80.4	80.4	–	74.7	74.7	
			SHC	–	39.2	52.9	–	37.7	51.4	–	36.1	49.7	–	34.4	47.9	–	32.5	46	
3000 Cfm	EA (wb)	58	TC	75.4	75.4	85.3	72.5	72.5	82	69.2	69.2	78.3	65.6	65.6	74.2	61.7	61.7	69.8	
			SHC	65.5	75.4	85.3	62.9	72.5	82	60.1	69.2	78.3	57	65.6	74.2	53.5	61.7	69.8	
		62	TC	75.5	75.5	88.7	72.5	72.5	85.3	69.3	69.3	81.4	65.7	65.7	77.2	61.7	61.7	72.5	
			SHC	62.2	75.5	88.7	59.8	72.5	85.3	57.1	69.3	81.4	54.1	65.7	77.2	50.9	61.7	72.5	
		67	TC	81.4	81.4	81.4	77.5	77.5	78.1	73.3	73.3	76.4	68.7	68.7	74.4	63.7	63.7	72.2	
			SHC	50.7	65.2	79.7	49.2	63.7	78.1	47.5	61.9	76.4	45.6	60	74.4	43.6	57.9	72.2	
		72	TC	89.4	89.4	89.4	85.2	85.2	85.2	80.5	80.5	80.5	75.5	75.5	75.5	70.1	70.1	70.1	
			SHC	36.9	51.5	66.1	35.4	50	64.6	33.8	48.3	62.9	32	46.5	61.1	30.1	44.6	59.1	
		76	TC	–	96.1	96.1	–	91.6	91.6	–	86.7	86.7	–	81.3	81.3	–	75.5	75.5	
			SHC	–	40.4	55.3	–	38.9	53.8	–	37.2	52.1	–	35.5	50.3	–	33.6	48.3	

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC07 (6 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		1800 / 0.06			2400 / 0.08			3000 / 0.10		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	85.7	77.4	70.0	91.1	82.6	74.9	94.5	85.7	78.4
	SHC	38.2	47.1	56.1	43.9	55.6	67.1	49.0	63.1	76.4
	kW	4.05	4.01	3.97	4.00	4.04	4.08	4.09	4.05	4.02
85	TC	80.9	73.1	66.0	85.9	77.9	70.6	89.2	80.9	73.9
	SHC	33.5	42.9	52.3	38.8	51.1	63.0	43.9	58.6	72.1
	kW	4.46	4.43	4.39	4.42	4.45	4.48	4.51	4.47	4.43
95	TC	75.7	68.4	61.7	80.6	72.9	66.0	83.6	75.7	69.1
	SHC	28.7	38.5	48.3	33.8	46.4	58.7	38.6	53.7	67.6
	kW	4.92	4.89	4.86	4.88	4.91	4.95	4.96	4.92	4.90
105	TC	70.2	63.3	57.0	74.7	67.5	61.1	77.5	70.1	64.0
	SHC	23.6	33.9	44.1	28.4	41.4	54.2	32.9	48.6	62.7
	kW	5.43	5.40	5.37	5.39	5.42	5.45	5.47	5.43	5.41
115	TC	64.3	57.8	52.0	68.4	61.7	55.7	71.0	64.1	58.3
	SHC	18.2	28.9	39.6	22.7	36.2	49.4	27.0	43.1	58.2
	kW	5.99	5.96	5.93	5.95	5.98	6.01	6.02	5.99	5.97
125	TC	57.9	52.0	46.6	61.6	55.4	49.9	64.0	57.5	52.4
	SHC	12.4	23.8	34.9	16.6	30.7	44.3	20.7	37.3	52.4
	kW	6.59	6.57	6.55	6.56	6.59	6.61	6.62	6.60	6.58

48HC07 (6 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		1800	2400	3000	1800	2400	3000	1800	2400	3000
80	TC	24.17	25.88	26.92	25.35	27.08	28.15	26.39	28.18	29.25
	SHC	–1.44	2.99	7.86	–5.08	–1.55	2.50	–8.25	–5.47	–2.14
	kW	4.15	4.16	4.17	4.17	4.18	4.18	4.18	4.19	4.20
75	TC	26.03	27.87	28.95	27.27	29.11	30.21	28.36	30.24	31.35
	SHC	0.43	4.97	9.86	–3.12	0.49	4.56	–6.19	–3.36	–0.03
	kW	3.96	3.97	3.98	3.98	3.99	4.00	4.00	4.01	4.01
70	TC	26.50	28.76	30.07	27.92	29.99	31.34	29.45	31.67	33.23
	SHC	0.87	5.84	10.97	–2.49	1.35	5.68	–5.06	–1.85	1.94
	kW	3.97	3.93	3.91	3.96	3.95	3.93	3.92	3.89	3.87
60	TC	27.59	29.22	30.17	28.70	30.33	31.30	31.50	31.32	32.91
	SHC	1.91	6.25	11.02	–1.79	1.63	5.57	–3.31	–2.39	1.45
	kW	3.95	3.99	4.01	3.99	4.02	4.04	4.09	4.05	4.01
50	TC	27.77	29.18	30.03	28.75	30.18	32.02	29.63	32.07	32.96
	SHC	2.03	6.18	10.85	–1.80	1.43	6.25	–5.14	–1.69	1.45
	kW	4.03	4.08	4.11	4.07	4.12	4.05	4.12	4.06	4.09
40	TC	29.02	30.38	31.46	29.96	31.32	32.09	30.79	33.49	34.34
	SHC	3.26	7.34	10.07	–0.63	2.54	6.29	–4.01	–0.30	2.80
	kW	3.96	4.02	4.08	4.01	4.08	4.11	4.06	4.00	4.03

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 20 – COOLING CAPACITIES 2-STAGE COOLING 7.5 TONS

48HC*D08				AMBIENT TEMPERATURE													
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
2250 Cfm	EA (wb)	58	TC	81	81	91.8	77.9	77.9	88.4	74.7	74.7	84.6	71.1	71.1	80.6	67.3	67.3	76.3
			SHC	70.2	81	91.8	67.5	77.9	88.4	64.7	74.7	84.6	61.6	71.1	80.6	58.3	67.3	76.3
		62	TC	85.1	85.1	87.2	81.1	81.1	85.3	76.9	76.9	83.2	72.5	72.5	81	67.8	67.8	78.5
			SHC	63.3	75.3	87.2	61.4	73.4	85.3	59.5	71.3	83.2	57.3	69.2	81	55	66.7	78.5
		67	TC	93.3	93.3	93.3	89	89	89	84.3	84.3	84.3	79.4	79.4	79.4	74.1	74.1	74.1
			SHC	52.3	64.2	76.2	50.4	62.4	74.4	48.4	60.4	72.4	46.4	58.3	70.3	44.2	56.2	68.1
		72	TC	102.3	102.3	102.3	97.5	97.5	97.5	92.5	92.5	92.5	87.1	87.1	87.1	81.3	81.3	81.3
			SHC	40.9	53	65	39	51.1	63.1	37.1	49.2	61.2	35.1	47.1	59.1	32.9	44.9	57
		76	TC	–	110	110	–	104.8	104.8	–	99.4	99.4	–	93.5	93.5	–	87.3	87.3
			SHC	–	43.7	56.1	–	41.9	54.2	–	39.9	52.2	–	37.9	50.2	–	35.8	48
2625 Cfm	EA (wb)	58	TC	85.4	85.4	96.9	82.1	82.1	93.1	78.6	78.6	89.1	74.7	74.7	84.7	70.5	70.5	80
			SHC	74	85.4	96.9	71.2	82.1	93.1	68.1	78.6	89.1	64.7	74.7	84.7	61.1	70.5	80
		62	TC	87.8	87.8	95.7	83.7	83.7	93.6	79.3	79.3	91.3	75	75	87.8	70.6	70.6	83.2
			SHC	68.2	82	95.7	66.2	79.9	93.6	64.1	77.7	91.3	61.3	74.6	87.8	58	70.6	83.2
		67	TC	96	96	96	91.4	91.4	91.4	86.5	86.5	86.5	81.3	81.3	81.3	75.8	75.8	75.8
			SHC	55.4	69.3	83.2	53.5	67.4	81.2	51.5	65.4	79.2	49.4	63.2	77.1	47.2	61	74.8
		72	TC	105.2	105.2	105.2	100.1	100.1	100.1	94.8	94.8	94.8	89.1	89.1	89.1	83	83	83
			SHC	42.3	56.2	70.2	40.4	54.3	68.2	38.4	52.3	66.2	36.3	50.2	64.1	34.1	48	61.9
		76	TC	–	112.9	112.9	–	107.5	107.5	–	101.7	101.7	–	95.6	95.6	–	89.1	89.1
			SHC	–	45.5	59.8	–	43.6	57.8	–	41.7	55.8	–	39.6	53.7	–	37.4	51.5
3000 Cfm	EA (wb)	58	TC	89.2	89.2	101.1	85.6	85.6	97.1	81.8	81.8	92.8	77.7	77.7	88.1	73.2	73.2	83
			SHC	77.3	89.2	101.1	74.2	85.6	97.1	70.9	81.8	92.8	67.3	77.7	88.1	63.5	73.2	83
		62	TC	90.1	90.1	103.5	86.1	86.1	100.3	81.9	81.9	96.5	77.8	77.8	91.6	73.3	73.3	86.4
			SHC	72.7	88.1	103.5	70.1	85.2	100.3	67.3	81.9	96.5	63.9	77.8	91.6	60.2	73.3	86.4
		67	TC	98.1	98.1	98.1	93.3	93.3	93.3	88.2	88.2	88.2	82.8	82.8	83.6	77	77	81.3
			SHC	58.4	74.1	89.9	56.5	72.2	87.9	54.4	70.1	85.8	52.3	67.9	83.6	50	65.6	81.3
		72	TC	107.3	107.3	107.3	102.1	102.1	102.1	96.5	96.5	96.5	90.6	90.6	90.6	84.3	84.3	84.3
			SHC	43.5	59.3	75.1	41.6	57.3	73.1	39.5	55.3	71.1	37.4	53.2	69	35.2	50.9	66.7
		76	TC	–	115.2	115.2	–	109.5	109.5	–	103.5	103.5	–	97.2	97.2	–	90.4	90.4
			SHC	–	47.2	63.2	–	45.3	61.3	–	43.3	59.3	–	41.2	57.1	–	38.9	54.8
3375 Cfm	EA (wb)	58	TC	92.4	92.4	104.7	88.6	88.6	100.4	84.6	84.6	95.9	80.2	80.2	90.9	75.5	75.5	85.6
			SHC	80	92.4	104.7	76.8	88.6	100.4	73.3	84.6	95.9	69.5	80.2	90.9	65.4	75.5	85.6
		62	TC	92.5	92.5	109	88.7	88.7	104.5	84.6	84.6	99.7	80.3	80.3	94.6	75.6	75.6	89
			SHC	76	92.5	109	72.9	88.7	104.5	69.6	84.6	99.7	66	80.3	94.6	62.1	75.6	89
		67	TC	99.7	99.7	99.7	94.8	94.8	94.8	89.5	89.5	92.2	84	84	89.9	78	78	87.4
			SHC	61.3	78.8	96.4	59.3	76.8	94.3	57.2	74.7	92.2	55	72.4	89.9	52.6	70	87.4
		72	TC	109	109	109	103.6	103.6	103.6	97.8	97.8	97.8	91.8	91.8	91.8	85.3	85.3	85.3
			SHC	44.6	62.2	79.9	42.7	60.3	77.9	40.6	58.2	75.8	38.5	56.1	73.6	36.2	53.8	71.3
		76	TC	–	116.9	116.9	–	111.1	111.1	–	104.9	104.9	–	98.4	98.4	–	91.5	91.5
			SHC	–	48.8	66.6	–	46.8	64.6	–	44.8	62.6	–	42.7	60.4	–	40.4	58.1
3750 Cfm	EA (wb)	58	TC	95.1	95.1	107.8	91.2	91.2	103.3	86.9	86.9	98.5	82.3	82.3	93.3	77.4	77.4	87.8
			SHC	82.4	95.1	107.8	79	91.2	103.3	75.3	86.9	98.5	71.3	82.3	93.3	67.1	77.4	87.8
		62	TC	95.2	95.2	112.2	91.2	91.2	107.5	87	87	102.5	82.4	82.4	97.1	77.5	77.5	91.3
			SHC	78.2	95.2	112.2	75	91.2	107.5	71.5	87	102.5	67.7	82.4	97.1	63.7	77.5	91.3
		67	TC	101.1	101.1	102.6	96	96	100.5	90.6	90.6	98.3	84.9	84.9	95.9	78.9	78.9	93.2
			SHC	64	83.3	102.6	62	81.2	100.5	59.8	79.1	98.3	57.6	76.7	95.9	55.1	74.2	93.2
		72	TC	110.4	110.4	110.4	104.8	104.8	104.8	98.9	98.9	98.9	92.7	92.7	92.7	86.1	86.1	86.1
			SHC	45.7	65.1	84.5	43.7	63.1	82.5	41.7	61	80.4	39.5	58.8	78.2	37.2	56.5	75.9
		76	TC	–	118.3	118.3	–	112.4	112.4	–	106	106	–	99.4	99.4	–	92.3	92.3
			SHC	–	50.3	69.9	–	48.3	67.9	–	46.2	65.8	–	44.1	63.6	–	41.8	61.3

* See Minimum – Maximum Airflow Ratings in Table 7. Do not operate outside these limits.

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC08 (7.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IS SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		2250 / 0.03			3000 / 0.04			3750 / 0.06		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	101.9	92.9	84.0	109.6	96.3	89.9	113.6	103.0	94.5
	SHC	43.9	54.6	66.7	50.2	62.7	80.9	56.8	75.8	93.0
	kW	4.60	4.54	4.48	4.65	4.50	4.52	4.68	4.60	4.55
85	TC	96.6	87.3	78.9	102.8	92.9	84.5	106.5	96.7	88.7
	SHC	36.8	49.3	61.9	43.8	59.7	75.9	50.2	69.8	87.4
	kW	5.15	5.09	5.04	5.20	5.13	5.08	5.22	5.16	5.11
95	TC	90.2	81.4	73.5	95.7	86.8	78.8	99.4	90.1	82.7
	SHC	30.8	43.9	56.9	37.2	54.1	70.5	43.6	63.8	81.6
	kW	5.78	5.72	5.67	5.82	5.76	5.71	5.85	5.79	5.74
105	TC	83.5	75.2	67.8	88.8	80.2	72.7	92.0	83.2	76.4
	SHC	24.6	38.2	51.7	30.8	48.0	64.9	36.7	57.4	75.5
	kW	6.50	6.45	6.40	6.54	6.48	6.43	6.57	6.50	6.46
115	TC	76.3	68.7	61.8	81.1	73.2	66.3	84.1	76.0	69.7
	SHC	17.9	32.1	46.2	23.7	41.5	59.0	29.4	50.7	69.0
	kW	7.32	7.28	7.24	7.35	7.31	7.27	7.38	7.32	7.29
125	TC	68.6	61.6	55.4	73.0	65.7	59.3	75.8	68.2	62.6
	SHC	10.9	25.6	40.3	16.2	34.7	52.6	21.7	43.6	62.1
	kW	8.24	8.22	8.20	8.27	8.23	8.21	8.29	8.25	8.22

48HC08 (7.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		2250	3000	3750	2250	3000	3750	2250	3000	3750
80	TC	24.06	26.14	27.48	25.50	27.56	28.78	26.59	28.71	29.96
	SHC	–5.55	1.16	8.38	–10.20	–4.69	1.40	–14.39	–9.85	–4.68
	kW	4.43	4.42	4.41	4.40	4.41	4.42	4.42	4.43	4.44
75	TC	24.87	27.26	28.47	26.06	28.53	30.02	27.67	29.77	31.02
	SHC	–4.77	2.23	9.32	–9.65	–3.76	2.59	–13.35	–8.83	–3.66
	kW	4.42	4.36	4.38	4.45	4.38	4.36	4.36	4.39	4.40
70	TC	25.16	27.88	28.56	26.72	29.10	30.26	28.17	30.20	31.83
	SHC	–4.48	2.84	9.45	–9.02	–3.19	2.85	–12.88	–8.40	–2.87
	kW	4.49	4.38	4.48	4.44	4.41	4.44	4.40	4.44	4.40
60	TC	26.43	28.14	29.14	27.49	29.24	30.27	28.50	30.24	32.33
	SHC	–3.25	3.14	10.05	–8.26	–2.99	2.94	–12.54	–8.29	–2.32
	kW	4.48	4.55	4.59	4.53	4.60	4.65	4.58	4.65	4.54
50	TC	27.19	29.55	31.26	28.94	30.59	32.36	30.54	31.54	32.52
	SHC	–2.50	4.50	12.05	–6.87	–1.69	4.92	–10.60	–7.02	–2.07
	kW	4.53	4.51	4.46	4.48	4.57	4.52	4.43	4.63	4.70
40	TC	27.92	31.58	32.82	28.81	32.60	33.54	31.82	33.50	34.44
	SHC	–1.79	6.42	10.84	–6.94	0.23	6.05	–9.36	–5.15	–0.25
	kW	4.57	4.37	4.46	4.65	4.45	4.51	4.40	4.51	4.58

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 22 – COOLING CAPACITIES 2-STAGE COOLING 8.5 TONS

48HC*D09				AMBIENT TEMPERATURE															
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
2550 Cfm	EA (wb)	58	TC	90.5	90.5	102.4	87	87	98.5	83.2	83.2	94.2	79.1	79.1	89.6	74.7	74.7	84.6
			SHC	78.6	90.5	102.4	75.5	87	98.5	72.2	83.2	94.2	68.7	79.1	89.6	64.8	74.7	84.6
		62	TC	94.8	94.8	98.1	90.2	90.2	95.8	85.4	85.4	93.4	80.3	80.3	90.8	74.9	74.9	87.8
			SHC	71.2	84.6	98.1	69.1	82.4	95.8	66.8	80.1	93.4	64.3	77.5	90.8	61.6	74.7	87.8
		67	TC	104	104	104	99	99	99	93.7	93.7	93.7	88	88	88	81.9	81.9	81.9
			SHC	58.7	72.2	85.7	56.6	70	83.5	54.3	67.8	81.3	52	65.4	78.9	49.5	62.9	76.4
		72	TC	114	114	114	108.5	108.5	108.5	102.7	102.7	102.7	96.5	96.5	96.5	89.8	89.8	89.8
			SHC	45.8	59.3	72.9	43.7	57.2	70.8	41.4	55	68.5	39.1	52.7	66.2	36.7	50.2	63.7
		76	TC	–	122.4	122.4	–	116.5	116.5	–	110.3	110.3	–	103.7	103.7	–	96.5	96.5
			SHC	–	48.8	62.8	–	46.7	60.6	–	44.5	58.4	–	42.2	56	–	39.8	53.5
2975 Cfm	EA (wb)	58	TC	95.4	95.4	108	91.6	91.6	103.7	87.5	87.5	99	83.1	83.1	94	78.3	78.3	88.6
			SHC	82.8	95.4	108	79.5	91.6	103.7	75.9	87.5	99	72.1	83.1	94	68	78.3	88.6
		62	TC	97.7	97.7	107.4	93	93	104.9	88.1	88.1	102.1	83.2	83.2	97.9	78.4	78.4	92.2
			SHC	76.7	92	107.4	74.3	89.6	104.9	71.8	86.9	102.1	68.6	83.2	97.9	64.6	78.4	92.2
		67	TC	106.9	106.9	106.9	101.6	101.6	101.6	96	96	96	90.1	90.1	90.1	83.7	83.7	83.9
			SHC	62.3	77.8	93.4	60.1	75.6	91.2	57.8	73.3	88.9	55.4	70.9	86.5	52.8	68.3	83.9
		72	TC	117	117	117	111.2	111.2	111.2	105.1	105.1	105.1	98.6	98.6	98.6	91.7	91.7	91.7
			SHC	47.3	62.9	78.6	45.1	60.8	76.4	42.9	58.5	74.1	40.5	56.1	71.7	38	53.6	69.2
		76	TC	–	125.6	125.6	–	119.4	119.4	–	112.8	112.8	–	105.9	105.9	–	98.4	98.4
			SHC	–	50.8	66.8	–	48.7	64.6	–	46.4	62.3	–	44.1	59.9	–	41.6	57.4
3400 Cfm	EA (wb)	58	TC	99.5	99.5	112.7	95.4	95.4	108	91	91	103	86.3	86.3	97.7	81.2	81.2	91.9
			SHC	86.4	99.5	112.7	82.8	95.4	108	79	91	103	74.9	86.3	97.7	70.5	81.2	91.9
		62	TC	100.3	100.3	115.8	95.6	95.6	112.4	91.2	91.2	107.2	86.4	86.4	101.6	81.3	81.3	95.6
			SHC	81.5	98.6	115.8	78.7	95.6	112.4	75.1	91.2	107.2	71.2	86.4	101.6	67	81.3	95.6
		67	TC	109.1	109.1	109.1	103.6	103.6	103.6	97.8	97.8	97.8	91.6	91.6	93.7	85	85	90.9
			SHC	65.6	83.2	100.8	63.4	81	98.6	61	78.6	96.2	58.6	76.1	93.7	55.9	73.4	90.9
		72	TC	119.3	119.3	119.3	113.3	113.3	113.3	107	107	107	100.3	100.3	100.3	93	93	93
			SHC	48.7	66.4	84.1	46.5	64.2	81.8	44.2	61.8	79.5	41.8	59.4	77.1	39.2	56.9	74.5
		76	TC	–	128	128	–	121.5	121.5	–	114.7	114.7	–	107.5	107.5	–	99.8	99.8
			SHC	–	52.6	70.6	–	50.5	68.4	–	48.2	66.1	–	45.8	63.6	–	43.3	61.1
3825 Cfm	EA (wb)	58	TC	103	103	116.6	98.7	98.7	111.7	94	94	106.4	89	89	100.8	83.6	83.6	94.7
			SHC	89.4	103	116.6	85.6	98.7	111.7	81.6	94	106.4	77.3	89	100.8	72.6	83.6	94.7
		62	TC	103.1	103.1	121.3	98.8	98.8	116.1	94.1	94.1	110.7	89.1	89.1	104.8	83.7	83.7	98.4
			SHC	85	103.1	121.3	81.4	98.8	116.1	77.5	94.1	110.7	73.4	89.1	104.8	69	83.7	98.4
		67	TC	110.9	110.9	110.9	105.2	105.2	105.7	99.2	99.2	103.2	92.9	92.9	100.5	86.1	86.1	97.6
			SHC	68.8	88.4	108	66.5	86.1	105.7	64.1	83.7	103.2	61.6	81.1	100.5	58.9	78.3	97.6
		72	TC	121.2	121.2	121.2	114.9	114.9	114.9	108.4	108.4	108.4	101.5	101.5	101.5	94.1	94.1	94.1
			SHC	50	69.7	89.4	47.7	67.4	87.1	45.4	65.1	84.7	43	62.6	82.3	40.4	60	79.6
		76	TC	–	129.8	129.8	–	123.2	123.2	–	116.2	116.2	–	108.8	108.8	–	100.9	100.9
			SHC	–	54.4	74.3	–	52.2	72.1	–	49.9	69.7	–	47.5	67.3	–	44.9	64.7
4250 Cfm	EA (wb)	58	TC	106	106	119.9	101.4	101.4	114.8	96.6	96.6	109.3	91.3	91.3	103.4	85.7	85.7	97
			SHC	92	106	119.9	88	101.4	114.8	83.8	96.6	109.3	79.3	91.3	103.4	74.4	85.7	97
		62	TC	106.1	106.1	124.7	101.5	101.5	119.4	96.6	96.6	113.6	91.4	91.4	107.5	85.7	85.7	100.8
			SHC	87.4	106.1	124.7	83.6	101.5	119.4	79.6	96.6	113.6	75.3	91.4	107.5	70.6	85.7	100.8
		67	TC	112.3	112.3	114.9	106.5	106.5	112.5	100.4	100.4	109.9	93.9	93.9	107	87.1	87.1	103.8
			SHC	71.8	93.4	114.9	69.5	91	112.5	67	88.5	109.9	64.4	85.7	107	61.6	82.7	103.8
		72	TC	122.6	122.6	122.6	116.2	116.2	116.2	109.5	109.5	109.5	102.5	102.5	102.5	94.9	94.9	94.9
			SHC	51.2	72.8	94.5	48.9	70.5	92.2	46.6	68.2	89.8	44.1	65.7	87.3	41.5	63.1	84.6
		76	TC	–	131.3	131.3	–	124.5	124.5	–	117.4	117.4	–	109.8	109.8	–	101.8	101.8
			SHC	–	56	77.9	–	53.8	75.6	–	51.5	73.3	–	49.1	70.8	–	46.5	68.1

* See Minimum – Maximum Airflow Ratings in Table 7. Do not operate outside these limits.

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC09 (8.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		2550 / 0.04			3400 / 0.06			4250 / 0.08		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	114.7	103.9	93.9	104.3	110.6	100.5	122.9	114.6	105.5
	SHC	48.7	62.2	75.7	84.7	74.2	91.4	60.6	85.1	103.9
	kW	5.17	5.09	5.01	5.10	5.14	5.07	5.20	5.18	5.11
85	TC	107.8	97.4	88.0	114.2	102.9	94.2	116.2	107.6	98.7
	SHC	42.3	56.3	70.3	49.7	67.0	85.6	61.1	78.7	97.3
	kW	5.79	5.71	5.63	5.85	5.75	5.69	5.88	5.80	5.72
95	TC	100.5	90.8	82.0	106.6	96.2	87.7	110.2	100.1	92.2
	SHC	35.6	50.2	64.8	42.8	61.0	79.6	49.2	71.9	91.0
	kW	6.50	6.42	6.34	6.56	6.46	6.40	6.59	6.50	6.44
105	TC	92.7	83.8	75.7	98.5	89.0	80.9	102.1	92.4	85.1
	SHC	28.5	43.9	59.1	35.4	54.6	73.4	41.9	64.9	84.2
	kW	7.30	7.23	7.16	7.36	7.28	7.21	7.40	7.31	7.25
115	TC	85.0	76.5	69.0	90.0	81.3	73.8	93.3	84.4	77.7
	SHC	21.5	37.4	53.1	27.7	47.6	66.9	34.0	57.7	77.0
	kW	8.23	8.16	8.10	8.27	8.20	8.14	8.31	8.23	8.18
125	TC	76.5	68.8	61.8	81.1	72.9	66.2	84.1	75.8	69.8
	SHC	13.8	30.4	46.7	19.7	40.0	60.1	25.6	50.0	69.8
	kW	9.25	9.20	9.16	9.28	9.22	9.19	9.31	9.25	9.21

48HC09 (8.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		2550	3400	4250	2550	3400	4250	2550	3400	4250
80	TC	27.53	29.56	30.72	28.95	31.03	32.22	30.26	32.33	33.58
	SHC	–3.84	3.82	11.92	–9.25	–2.92	4.09	–13.93	–8.77	–2.82
	kW	5.09	5.11	5.13	5.11	5.14	5.15	5.14	5.15	5.17
75	TC	29.09	31.60	32.81	30.77	33.10	34.33	32.30	34.45	35.73
	SHC	–2.34	5.72	13.84	–7.51	–0.98	6.04	–11.95	–6.78	–0.82
	kW	4.97	4.91	4.93	4.95	4.94	4.95	4.94	4.96	4.97
70	TC	29.58	32.45	33.63	31.48	34.12	35.55	33.12	35.65	37.38
	SHC	–1.88	6.54	14.63	–6.83	0.00	7.20	–11.16	–5.63	0.75
	kW	4.99	4.90	4.92	4.96	4.90	4.89	4.93	4.90	4.86
60	TC	30.71	33.44	34.52	32.90	34.79	35.86	34.07	36.02	37.09
	SHC	–0.78	7.52	15.54	–5.47	0.68	7.57	–10.28	–5.24	0.55
	kW	5.03	4.95	5.00	4.94	5.01	5.05	4.99	5.06	5.09
50	TC	32.63	34.31	35.26	33.81	35.53	36.51	34.90	36.66	37.65
	SHC	1.05	8.38	16.29	–4.60	1.42	8.24	–9.49	–4.59	1.14
	kW	4.92	5.01	5.06	4.99	5.07	5.13	5.05	5.14	5.19
40	TC	31.94	33.26	35.77	32.96	35.70	37.86	35.17	38.01	38.92
	SHC	0.45	7.47	13.75	–5.35	1.63	9.52	–9.20	–3.29	2.36
	kW	5.16	5.27	5.20	5.25	5.19	5.10	5.16	5.11	5.17

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 24 – COOLING CAPACITIES 2-STAGE COOLING 10 TONS (12.0 EER)

48HC*D11				AMBIENT TEMPERATURE															
				85			95			105			115			125			
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
3000 Cfm	EA (wB)	58	THC	105.6	105.6	118.0	101.7	101.7	114.1	97.5	97.5	109.9	97.5	97.5	109.9	87.8	87.8	100.2	
			SHC	93.3	105.6	118.0	89.4	101.7	114.1	85.1	97.5	109.9	85.1	97.5	109.9	75.4	87.8	100.2	
		62	THC	110.6	110.6	110.6	105.5	105.5	108.0	100.1	100.1	105.5	100.1	100.1	105.5	88.5	88.5	98.5	
			SHC	85.6	98.0	110.3	83.3	95.7	108.0	80.7	93.1	105.5	80.7	93.1	105.5	73.8	86.1	98.5	
		67	THC	120.5	120.5	120.5	115.0	115.0	115.0	109.0	109.0	109.0	109.0	109.0	109.0	95.7	95.7	95.7	
			SHC	70.0	82.3	94.7	67.7	80.1	92.5	65.4	77.8	90.1	65.4	77.8	90.1	60.0	72.4	84.8	
		72	THC	131.4	131.4	131.4	125.4	125.4	125.4	118.8	118.8	118.8	118.8	118.8	118.8	104.2	104.2	104.2	
			SHC	53.9	66.3	78.7	51.8	64.2	76.6	49.5	61.9	74.3	49.5	61.9	74.3	44.3	56.7	69.1	
		76	THC	–	140.8	140.8	–	134.2	134.2	–	127.0	127.0	–	127.0	127.0	–	111.5	111.5	
			SHC	–	52.5	64.9	–	50.8	63.2	–	48.7	61.1	–	48.7	61.1	–	44.0	56.4	
3500 Cfm	EA (wB)	58	THC	110.9	110.9	125.3	106.7	106.7	121.1	102.1	102.1	116.5	102.1	102.1	116.5	91.6	91.6	106.0	
			SHC	96.4	110.9	125.3	92.2	106.7	121.1	87.6	102.1	116.5	87.6	102.1	116.5	77.1	91.6	106.0	
		62	THC	113.6	113.6	120.7	108.4	108.4	118.1	103.1	103.1	114.5	103.1	103.1	114.5	92.0	92.0	105.3	
			SHC	91.9	106.3	120.7	89.3	103.7	118.1	85.7	100.1	114.5	85.7	100.1	114.5	76.4	90.8	105.3	
		67	THC	123.5	123.5	123.5	117.8	117.8	117.8	111.5	111.5	111.5	111.5	111.5	111.5	97.6	97.6	97.6	
			SHC	74.2	88.6	103.1	72.2	86.6	101.0	69.8	84.3	98.7	69.8	84.3	98.7	64.3	78.8	93.2	
		72	THC	134.6	134.6	134.6	128.2	128.2	128.2	121.3	121.3	121.3	121.3	121.3	121.3	106.1	106.1	106.1	
			SHC	55.9	70.3	84.8	53.7	68.1	82.6	51.4	65.8	80.2	51.4	65.8	80.2	46.1	60.6	75.0	
		76	THC	–	144.0	144.0	–	137.1	137.1	–	129.7	129.7	–	129.7	129.7	–	113.5	113.5	
			SHC	–	55.3	69.7	–	53.1	67.6	–	50.9	65.4	–	50.9	65.4	–	46.0	60.5	
4000 Cfm	EA (wB)	58	THC	115.3	115.3	131.8	110.7	110.7	127.2	105.8	105.8	122.3	105.8	105.8	122.3	94.6	94.6	111.1	
			SHC	98.8	115.3	131.8	94.2	110.7	127.2	89.3	105.8	122.3	89.3	105.8	122.3	78.1	94.6	111.1	
		62	THC	116.5	116.5	129.1	112.0	112.0	124.0	106.5	106.5	120.9	106.5	106.5	120.9	94.7	94.7	111.2	
			SHC	96.1	112.6	129.1	91.0	107.5	124.0	87.9	104.4	120.9	87.9	104.4	120.9	78.2	94.7	111.2	
		67	THC	125.9	125.9	125.9	119.8	119.8	119.8	113.3	113.3	113.3	113.3	113.3	113.3	99.1	99.1	101.1	
			SHC	78.2	94.7	111.2	76.0	92.5	109.0	73.5	90.0	106.5	73.5	90.0	106.5	68.1	84.6	101.1	
		72	THC	137.0	137.0	137.0	130.3	130.3	130.3	123.2	123.2	123.2	123.2	123.2	123.2	107.5	107.5	107.5	
			SHC	57.7	74.2	90.7	55.4	71.9	88.4	53.0	69.5	86.0	53.0	69.5	86.0	47.7	64.2	80.7	
		76	THC	–	146.5	146.5	–	139.3	139.3	–	131.6	131.6	–	131.6	131.6	–	115.0	115.0	
			SHC	–	57.4	73.9	–	55.3	71.8	–	53.0	69.5	–	53.0	69.5	–	48.0	64.5	
4500 Cfm	EA (wB)	58	THC	118.9	118.9	137.5	114.1	114.1	132.7	108.9	108.9	127.5	108.9	108.9	127.5	97.2	97.2	115.8	
			SHC	100.3	118.9	137.5	95.5	114.1	132.7	90.3	108.9	127.5	90.3	108.9	127.5	78.6	97.2	115.8	
		62	THC	119.9	119.9	135.3	115.0	115.0	130.8	109.2	109.2	126.7	109.2	109.2	126.7	97.2	97.2	115.8	
			SHC	98.2	116.8	135.3	93.7	112.3	130.8	89.6	108.2	126.7	89.6	108.2	126.7	78.7	97.2	115.8	
		67	THC	127.7	127.7	127.7	121.4	121.4	121.4	114.8	114.8	114.8	114.8	114.8	114.8	100.1	100.1	108.5	
			SHC	82.1	100.7	119.3	79.8	98.3	116.9	77.2	95.8	114.4	77.2	95.8	114.4	71.4	89.9	108.5	
		72	THC	138.9	138.9	138.9	132.1	132.1	132.1	124.7	124.7	124.7	124.7	124.7	124.7	108.6	108.6	108.6	
			SHC	59.3	77.9	96.5	57.2	75.7	94.3	54.8	73.3	91.9	54.8	73.3	91.9	49.3	67.9	86.5	
		76	THC	–	148.4	148.4	–	141.1	141.1	–	133.2	133.2	–	133.2	133.2	–	116.1	116.1	
			SHC	–	59.4	78.0	–	57.2	75.8	–	54.9	73.5	–	54.9	73.5	–	49.9	68.4	
5000 Cfm	EA (wB)	58	THC	122.0	122.0	142.6	117.0	117.0	137.6	111.6	111.6	132.2	111.6	111.6	132.2	99.3	99.3	119.9	
			SHC	101.4	122.0	142.6	96.4	117.0	137.6	90.9	111.6	132.2	90.9	111.6	132.2	78.7	99.3	119.9	
		62	THC	122.7	122.7	141.4	117.1	117.1	137.7	111.6	111.6	132.2	111.6	111.6	132.2	99.4	99.4	120.0	
			SHC	100.2	120.8	141.4	96.4	117.1	137.7	91.0	111.6	132.2	91.0	111.6	132.2	78.8	99.4	120.0	
		67	THC	129.2	129.2	129.2	122.8	122.8	124.6	115.9	115.9	121.9	115.9	115.9	121.9	101.1	101.1	115.7	
			SHC	85.7	106.4	127.0	83.3	104.0	124.6	80.7	101.3	121.9	80.7	101.3	121.9	74.4	95.1	115.7	
		72	THC	140.5	140.5	140.5	133.4	133.4	133.4	125.9	125.9	125.9	125.9	125.9	125.9	109.6	109.6	109.6	
			SHC	61.0	81.6	102.3	58.7	79.3	99.9	56.3	76.9	97.5	56.3	76.9	97.5	50.9	71.5	92.1	
		76	THC	–	150.1	150.1	–	142.6	142.6	–	134.5	134.5	–	134.5	134.5	–	117.1	117.1	
			SHC	–	61.4	82.0	–	59.2	79.8	–	56.8	77.4	–	56.8	77.4	–	51.7	72.3	

* See Minimum – Maximum Airflow Ratings in Table 7. Do not operate outside these limits.

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

Humidi – MiZer currently not available on this size model.

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet – bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 25 – COOLING CAPACITIES 2-STAGE COOLING 10 TONS (11.5 EER)

48HC*D12				AMBIENT TEMPERATURE														
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
3000 Cfm	EA (wb)	58	TC	104.3	104.3	118.5	99.5	99.5	113	93.4	93.4	106.1	86.7	86.7	98.6	79.7	79.7	90.6
			SHC	90.2	104.3	118.5	86	99.5	113	80.6	93.4	106.1	74.9	86.7	98.6	68.8	79.7	90.6
		62	TC	109.7	109.7	112.4	103.6	103.6	109.5	95.9	95.9	105.9	87.6	87.6	101.2	79.8	79.8	94.4
			SHC	80.8	96.6	112.4	78	93.8	109.5	74.5	90.2	105.9	70.3	85.7	101.2	65.2	79.8	94.4
		67	TC	121.5	121.5	121.5	115.4	115.4	115.4	107.8	107.8	107.8	98.7	98.7	98.7	89.1	89.1	89.1
			SHC	65.2	81	96.9	62.7	78.6	94.5	59.7	75.6	91.5	56.2	72	87.9	52.5	68.3	84.2
		72	TC	133	133	133	127.1	127.1	127.1	120.5	120.5	120.5	112	112	112	102.1	102.1	102.1
			SHC	48.7	64.5	80.4	46.5	62.4	78.3	44.1	60	75.9	41.2	57.1	73	37.8	53.7	69.6
		76	TC	–	140.9	140.9	–	135.1	135.1	–	128.4	128.4	–	121.3	121.3	–	112.5	112.5
			SHC	–	50.6	67.1	–	48.7	65.2	–	46.6	63.1	–	44.3	60.7	–	41.4	57.7
3500 Cfm	EA (wb)	58	TC	109.9	109.9	124.9	104.9	104.9	119.3	98.7	98.7	112.2	91.6	91.6	104.2	84.2	84.2	95.8
			SHC	94.9	109.9	124.9	90.6	104.9	119.3	85.2	98.7	112.2	79	91.6	104.2	72.6	84.2	95.8
		62	TC	112.8	112.8	123.1	106.7	106.7	120	99.5	99.5	115.3	91.7	91.7	108.5	84.3	84.3	99.8
			SHC	86.8	104.9	123.1	83.9	102	120	80	97.6	115.3	74.9	91.7	108.5	68.8	84.3	99.8
		67	TC	124.2	124.2	124.2	118	118	118	110.3	110.3	110.3	101	101	101	91	91	92.5
			SHC	68.4	86.7	104.9	66.1	84.3	102.6	63.2	81.5	99.8	59.6	78	96.3	55.9	74.2	92.5
		72	TC	135.2	135.2	135.2	129.1	129.1	129.1	122.4	122.4	122.4	114.2	114.2	114.2	104.2	104.2	104.2
			SHC	49.2	67.3	85.4	47.1	65.3	83.4	44.8	63	81.2	42	60.4	78.7	38.7	57.1	75.5
		76	TC	–	142.4	142.4	–	136.5	136.5	–	129.6	129.6	–	122.4	122.4	–	114	114
			SHC	–	51.7	70.9	–	49.7	68.7	–	47.5	66.3	–	45.2	63.8	–	42.6	61.2
4000 Cfm	EA (wb)	58	TC	114.3	114.3	130	109.2	109.2	124.2	102.9	102.9	117	95.4	95.4	108.7	87.7	87.7	99.9
			SHC	98.6	114.3	130	94.2	109.2	124.2	88.7	102.9	117	82.2	95.4	108.7	75.5	87.7	99.9
		62	TC	115.3	115.3	132.4	109.6	109.6	128.3	102.9	102.9	121.9	95.5	95.5	113.2	87.8	87.8	104.1
			SHC	91.9	112.2	132.4	88.7	108.5	128.3	84	102.9	121.9	77.9	95.5	113.2	71.5	87.8	104.1
		67	TC	125.8	125.8	125.8	119.5	119.5	119.5	111.9	111.9	111.9	102.4	102.4	104.2	92.2	92.2	100.4
			SHC	71.3	91.8	112.3	69	89.6	110.2	66.2	86.9	107.6	62.8	83.5	104.2	59.1	79.7	100.4
		72	TC	136.3	136.3	136.3	130.2	130.2	130.2	123.4	123.4	123.4	115.4	115.4	115.4	105.3	105.3	105.3
			SHC	49.5	69.7	89.8	47.4	67.7	87.9	45.1	65.5	85.9	42.5	63.1	83.7	39.3	60.1	80.9
		76	TC	–	143.1	143.1	–	137.1	137.1	–	130.1	130.1	–	122.6	122.6	–	114.5	114.5
			SHC	–	52.2	73.2	–	50.2	71.1	–	48	68.7	–	45.7	66.4	–	43.3	64.1
4500 Cfm	EA (wb)	58	TC	117.5	117.5	133.8	112.4	112.4	127.9	106	106	120.7	98.4	98.4	112.1	90.3	90.3	103
			SHC	101.3	117.5	133.8	96.8	112.4	127.9	91.2	106	120.7	84.6	98.4	112.1	77.7	90.3	103
		62	TC	117.6	117.6	139.4	112.5	112.5	133.3	106.1	106.1	125.8	98.5	98.5	116.8	90.4	90.4	107.4
			SHC	95.9	117.6	139.4	91.6	112.5	133.3	86.4	106.1	125.8	80.1	98.5	116.8	73.5	90.4	107.4
		67	TC	126.6	126.6	126.6	120.2	120.2	120.2	112.8	112.8	114.8	103.2	103.2	111.6	93	93	107.6
			SHC	73.7	96.4	119.2	71.5	94.3	117.2	68.9	91.8	114.8	65.6	88.6	111.6	61.8	84.7	107.6
		72	TC	136.7	136.7	136.7	130.5	130.5	130.5	123.6	123.6	123.6	115.7	115.7	115.7	105.7	105.7	105.7
			SHC	49.4	71.6	93.7	47.4	69.7	91.9	45.1	67.5	89.9	42.7	65.4	88.2	39.5	62.6	85.8
		76	TC	–	143.1	143.1	–	137	137	–	129.9	129.9	–	122.4	122.4	–	114.3	114.3
			SHC	–	52.4	75.1	–	50.5	73.1	–	48.2	70.8	–	46	68.5	–	43.7	66.5
5000 Cfm	EA (wb)	58	TC	119.9	119.9	136.7	114.7	114.7	130.7	108.4	108.4	123.6	100.6	100.6	114.8	92.3	92.3	105.4
			SHC	103.2	119.9	136.7	98.6	114.7	130.7	93.2	108.4	123.6	86.4	100.6	114.8	79.2	92.3	105.4
		62	TC	120	120	142.4	114.7	114.7	136.2	108.5	108.5	128.8	100.7	100.7	119.7	92.4	92.4	109.9
			SHC	97.6	120	142.4	93.3	114.7	136.2	88.1	108.5	128.8	81.7	100.7	119.7	74.9	92.4	109.9
		67	TC	126.8	126.8	126.8	120.4	120.4	123.6	113.2	113.2	121.3	103.8	103.8	118.4	93.6	93.6	114
			SHC	75.7	100.6	125.4	73.6	98.6	123.6	71.2	96.2	121.3	68	93.2	118.4	64.2	89.1	114
		72	TC	136.5	136.5	136.5	130.2	130.2	130.2	123.2	123.2	123.2	115.5	115.5	115.5	105.6	105.6	105.6
			SHC	49.1	73.1	97	47.1	71.3	95.4	44.9	69.2	93.5	42.5	67.3	92	39.5	64.9	90.2
		76	TC	–	142.7	142.7	–	136.5	136.5	–	129.4	129.4	–	121.6	121.6	–	113.6	113.6
			SHC	–	52.2	76.7	–	50.4	74.7	–	48.2	72.4	–	45.9	70.1	–	43.7	68.3

* See Minimum – Maximum Airflow Ratings in Table 7. Do not operate outside these limits.

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC12 (10 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		3000/0.04			4000/0.06			5000/0.07		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	135.8	123.1	111.6	144.0	130.9	119.2	148.7	135.7	122.9
	SHC	56.7	72.8	88.9	66.1	86.9	107.4	74.4	100.1	121.0
	kW	6.42	6.26	6.13	6.54	6.37	6.22	6.61	6.43	6.26
85	TC	127.3	115.4	104.5	134.9	120.1	111.7	139.3	126.9	116.8
	SHC	48.6	65.4	82.1	57.5	76.6	100.2	65.4	91.8	115.0
	kW	7.20	7.04	6.90	7.31	7.11	7.00	7.38	7.21	7.07
95	TC	118.1	106.5	96.9	125.2	113.6	103.6	129.5	117.8	108.4
	SHC	39.9	57.0	74.9	48.3	70.5	92.4	56.2	83.1	106.8
	kW	8.06	7.89	7.76	8.17	8.00	7.86	8.24	8.07	7.93
105	TC	107.3	97.8	87.8	114.5	103.8	94.5	117.6	107.3	99.0
	SHC	29.6	48.7	66.2	38.1	61.3	83.8	44.9	73.1	97.5
	kW	8.99	8.85	8.72	9.11	8.95	8.82	9.16	9.01	8.88
115	TC	95.7	86.3	78.2	102.1	91.3	83.4	105.7	95.8	88.2
	SHC	18.6	37.8	57.1	26.4	49.4	73.2	33.6	62.3	87.0
	kW	10.03	9.89	9.79	10.14	9.97	9.86	10.20	10.05	9.94
125	TC	83.7	75.2	67.7	87.5	80.1	72.5	92.1	83.1	75.2
	SHC	7.3	27.4	47.2	12.5	38.8	62.9	20.6	50.3	74.2
	kW	11.17	11.06	10.98	11.23	11.13	11.03	11.30	11.17	11.07

48HC12 (10 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		3000	4000	5000	3000	4000	5000	3000	4000	5000
80	TC	45.83	49.08	50.90	47.62	50.84	52.72	49.16	52.45	54.33
	SHC	4.82	14.45	24.36	–1.60	6.39	14.99	–7.27	–0.59	6.73
	kW	7.33	7.46	7.55	7.40	7.53	7.62	7.46	7.60	7.68
75	TC	48.52	51.89	53.81	50.31	53.74	55.73	51.92	55.47	57.43
	SHC	7.37	17.08	27.08	0.95	9.11	17.81	–4.65	2.25	9.63
	kW	6.93	7.07	7.15	7.00	7.14	7.23	7.06	7.21	7.29
70	TC	51.15	54.66	56.69	52.96	56.60	58.66	54.65	58.34	60.43
	SHC	9.87	19.70	29.80	3.47	11.82	20.57	–2.05	4.98	12.45
	kW	6.56	6.69	6.78	6.62	6.76	6.85	6.68	6.83	6.91
60	TC	52.89	56.41	59.04	55.63	59.10	62.68	58.00	62.31	64.50
	SHC	11.58	21.44	32.07	6.06	14.26	24.41	1.21	8.78	16.36
	kW	6.60	6.80	6.72	6.53	6.71	6.51	6.46	6.48	6.58
50	TC	55.13	59.53	62.75	58.04	62.61	64.69	59.64	64.34	66.41
	SHC	13.77	24.43	35.63	8.41	17.62	26.38	2.80	10.77	18.23
	kW	6.57	6.53	6.44	6.43	6.41	6.54	6.52	6.50	6.64
40	TC	57.08	60.11	64.35	58.75	63.63	65.58	60.16	65.23	69.04
	SHC	15.67	25.05	33.55	9.13	18.64	27.28	3.34	11.67	20.76
	kW	6.51	6.77	6.62	6.64	6.54	6.70	6.75	6.65	6.50

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 27 – COOLING CAPACITIES 2-STAGE COOLING 12.5 TONS

48HC*D14				AMBIENT TEMPERATURE															
				85			95			105			115			125			
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
3750 Cfm	EA (wb)	58	TC	131.9	131.9	149.8	127.0	127.0	144.1	121.5	121.5	137.9	115.4	115.4	131.0	108.7	108.7	123.4	
			SHC	114.1	131.9	149.8	109.8	127.0	144.1	105.0	121.5	137.9	99.8	115.4	131.0	94.0	108.7	123.4	
		62	TC	138.0	138.0	143.4	131.7	131.7	140.4	124.7	124.7	136.9	117.1	117.1	133.1	109.4	109.4	127.4	
			SHC	103.4	123.4	143.4	100.4	120.4	140.4	97.1	117.0	136.9	93.4	113.2	133.1	88.8	108.1	127.4	
		67	TC	151.5	151.5	151.5	144.5	144.5	144.5	136.9	136.9	136.9	128.5	128.5	128.5	119.4	119.4	119.4	
			SHC	85.1	105.2	125.3	82.1	102.2	122.3	78.9	99.0	119.0	75.4	95.5	115.5	71.7	91.8	111.8	
		72	TC	166.1	166.1	166.1	158.5	158.5	158.5	150.2	150.2	150.2	141.1	141.1	141.1	131.3	131.3	131.3	
			SHC	66.2	86.5	106.7	63.3	83.6	103.8	60.2	80.4	100.6	56.8	76.9	97.1	53.1	73.3	93.4	
		76	TC	–	178.6	178.6	–	170.5	170.5	–	161.6	161.6	–	151.8	151.8	–	141.3	141.3	
			SHC	–	71.1	91.8	–	68.3	88.9	–	65.2	85.8	–	61.8	82.5	–	58.2	78.7	
4375 Cfm	EA (wb)	58	TC	139.2	139.2	158.0	133.8	133.8	151.9	127.9	127.9	145.2	121.3	121.3	137.7	114.1	114.1	129.5	
			SHC	120.4	139.2	158.0	115.7	133.8	151.9	110.6	127.9	145.2	104.9	121.3	137.7	98.7	114.1	129.5	
		62	TC	142.4	142.4	157.6	135.8	135.8	154.1	128.9	128.9	149.2	121.7	121.7	142.9	114.2	114.2	134.8	
			SHC	111.5	134.5	157.6	108.2	131.2	154.1	104.2	126.7	149.2	99.4	121.1	142.9	93.6	114.2	134.8	
		67	TC	155.8	155.8	155.8	148.5	148.5	148.5	140.4	140.4	140.4	131.6	131.6	131.6	122.1	122.1	123.0	
			SHC	90.3	113.6	136.8	87.3	110.5	133.8	84.0	107.2	130.5	80.4	103.6	126.8	76.6	99.8	123.0	
		72	TC	170.6	170.6	170.6	162.7	162.7	162.7	154.0	154.0	154.0	144.4	144.4	144.4	134.1	134.1	134.1	
			SHC	68.5	91.9	115.3	65.5	88.9	112.3	62.3	85.6	109.0	58.8	82.1	105.4	55.1	78.4	101.7	
		76	TC	–	183.3	183.3	–	174.8	174.8	–	165.4	165.4	–	155.2	155.2	–	144.3	144.3	
			SHC	–	74.3	98.3	–	71.3	95.2	–	68.0	91.9	–	64.6	88.3	–	60.9	84.5	
5000 Cfm	EA (wb)	58	TC	145.3	145.3	164.9	139.5	139.5	158.4	133.2	133.2	151.2	126.2	126.2	143.2	118.5	118.5	134.5	
			SHC	125.6	145.3	164.9	120.7	139.5	158.4	115.2	133.2	151.2	109.1	126.2	143.2	102.5	118.5	134.5	
		62	TC	146.5	146.5	169.3	140.2	140.2	163.9	133.3	133.3	157.4	126.3	126.3	149.1	118.6	118.6	140.0	
			SHC	118.3	143.8	169.3	114.1	139.0	163.9	109.3	133.3	157.4	103.5	126.3	149.1	97.2	118.6	140.0	
		67	TC	159.1	159.1	159.1	151.5	151.5	151.5	143.1	143.1	143.1	134.0	134.0	137.7	124.2	124.2	133.7	
			SHC	95.2	121.6	148.0	92.2	118.5	144.9	88.8	115.1	141.5	85.1	111.4	137.7	81.3	107.5	133.7	
		72	TC	174.1	174.1	174.1	165.9	165.9	165.9	156.8	156.8	156.8	146.9	146.9	146.9	136.2	136.2	136.2	
			SHC	70.5	97.0	123.5	67.5	94.0	120.5	64.2	90.7	117.1	60.6	87.1	113.5	56.9	83.3	109.6	
		76	TC	–	187.0	187.0	–	178.1	178.1	–	168.3	168.3	–	157.7	157.7	–	146.4	146.4	
			SHC	–	77.0	104.0	–	74.0	100.9	–	70.7	97.5	–	67.2	93.9	–	63.4	90.0	
5625 Cfm	EA (wb)	58	TC	150.4	150.4	170.8	144.4	144.4	163.9	137.7	137.7	156.3	130.3	130.3	147.9	122.2	122.2	138.7	
			SHC	130.1	150.4	170.8	124.9	144.4	163.9	119.0	137.7	156.3	112.7	130.3	147.9	105.7	122.2	138.7	
		62	TC	150.7	150.7	177.9	144.5	144.5	170.6	137.8	137.8	162.7	130.4	130.4	153.9	122.3	122.3	144.4	
			SHC	123.5	150.7	177.9	118.4	144.5	170.6	112.9	137.8	162.7	106.8	130.4	153.9	100.2	122.3	144.4	
		67	TC	161.7	161.7	161.7	153.9	153.9	155.6	145.3	145.3	152.1	135.9	135.9	148.2	125.9	125.9	143.9	
			SHC	100.0	129.4	158.8	96.8	126.2	155.6	93.4	122.7	152.1	89.7	118.9	148.2	85.6	114.8	143.9	
		72	TC	176.9	176.9	176.9	168.3	168.3	168.3	159.0	159.0	159.0	148.8	148.8	148.8	137.9	137.9	137.9	
			SHC	72.3	101.9	131.5	69.3	98.8	128.4	66.0	95.5	125.0	62.4	91.8	121.3	58.6	88.0	117.4	
		76	TC	–	189.8	189.8	–	180.6	180.6	–	170.6	170.6	–	159.7	159.7	–	148.1	148.1	
			SHC	–	79.6	109.7	–	76.5	106.5	–	73.2	103.0	–	69.6	99.2	–	65.7	95.1	
6250 Cfm	EA (wb)	58	TC	154.8	154.8	175.8	148.5	148.5	168.6	141.5	141.5	160.6	133.7	133.7	151.8	125.3	125.3	142.3	
			SHC	133.9	154.8	175.8	128.4	148.5	168.6	122.3	141.5	160.6	115.6	133.7	151.8	108.4	125.3	142.3	
		62	TC	155.0	155.0	183.0	148.6	148.6	175.5	141.6	141.6	167.2	133.9	133.9	158.0	125.4	125.4	148.1	
			SHC	127.0	155.0	183.0	121.8	148.6	175.5	116.0	141.6	167.2	109.7	133.9	158.0	102.8	125.4	148.1	
		67	TC	163.8	163.8	169.3	155.8	155.8	166.0	147.0	147.0	162.3	137.5	137.5	158.1	127.4	127.4	153.3	
			SHC	104.5	136.9	169.3	101.3	133.6	166.0	97.8	130.0	162.3	93.9	126.0	158.1	89.7	121.5	153.3	
		72	TC	179.1	179.1	179.1	170.3	170.3	170.3	160.8	160.8	160.8	150.3	150.3	150.3	139.2	139.2	139.2	
			SHC	74.1	106.7	139.3	71.0	103.6	136.1	67.7	100.2	132.7	64.1	96.5	128.9	60.2	92.6	124.9	
		76	TC	–	192.1	192.1	–	182.7	182.7	–	172.3	172.3	–	161.2	161.2	–	149.4	149.4	
			SHC	–	82.1	115.1	–	79.0	111.8	–	75.6	108.2	–	71.9	104.3	–	67.9	100.0	

* See Minimum – Maximum Airflow Ratings in Table 7. Do not operate outside these limits.

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

48HC14 (12.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN SUBCOOLING MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – CFM								
		3750/0.02			5000/0.04			6250/0.05		
		Air Entering Evaporator – Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	162.0	147.4	132.8	185.6	167.2	148.8	209.5	187.2	164.9
	SHC	85.0	101.4	117.4	96.9	113.0	129.0	106.5	122.4	138.4
	kW	7.70	7.60	7.30	7.90	7.70	7.40	8.10	7.80	7.50
85	TC	154.8	140.9	127.0	171.7	154.4	137.1	188.8	168.0	147.2
	SHC	70.2	90.4	110.6	83.1	103.2	123.2	93.4	113.4	133.3
	kW	8.80	8.70	8.30	8.90	8.70	8.40	9.10	8.80	8.50
95	TC	147.5	134.4	121.2	157.8	141.6	125.4	168.1	148.8	129.6
	SHC	55.5	79.7	103.9	69.3	93.4	117.5	80.4	104.3	128.3
	kW	9.80	9.70	9.30	9.90	9.70	9.50	10.10	9.80	9.60
105	TC	140.3	127.8	115.4	143.8	128.7	113.7	147.4	129.7	111.9
	SHC	40.9	69.0	97.2	55.5	83.6	111.7	67.3	95.3	111.9
	kW	10.80	10.70	10.30	10.90	10.70	10.50	11.10	10.80	10.60
115	TC	133.0	121.3	109.5	129.9	115.9	101.9	126.7	110.5	94.2
	SHC	26.2	58.3	90.4	41.8	73.8	101.9	54.2	86.2	94.2
	kW	11.80	11.70	11.40	11.90	11.70	11.60	12.10	11.80	11.70
125	TC	125.8	114.7	103.7	115.9	103.1	90.2	106.0	91.3	76.6
	SHC	11.5	47.6	83.7	28.0	64.0	90.2	41.2	77.2	76.6
	kW	12.80	12.70	12.40	12.90	12.70	12.60	13.10	12.80	12.70

48HC14 (12.5 TONS) – UNIT WITH HUMIDI–MIZER SYSTEM IN HOT GAS REHEAT MODE										
Temp (F) Air Entering Condenser (Edb)		AIR ENTERING EVAPORATOR – Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator – Cfm								
		3750	5000	6250	3750	5000	6250	3750	5000	6250
80	TC	57.70	60.00	66.40	60.20	66.80	69.50	64.30	69.10	72.30
	SHC	21.30	27.00	44.00	12.80	22.40	32.50	8.60	16.20	25.50
	kW	8.08	8.15	8.23	8.28	8.34	8.37	8.36	8.43	8.52
75	TC	59.00	61.20	67.90	61.40	68.10	71.00	65.80	70.70	73.70
	SHC	22.40	28.10	44.80	13.50	23.50	33.70	9.30	17.10	26.30
	kW	8.06	8.13	8.21	8.25	8.31	8.34	8.33	8.40	8.49
70	TC	60.40	62.90	69.20	63.10	69.40	72.50	67.00	72.00	75.00
	SHC	23.20	28.90	46.00	14.50	24.30	34.40	10.30	17.90	27.40
	kW	8.04	8.11	8.18	8.23	8.29	8.32	8.31	8.38	8.47
60	TC	63.40	65.70	72.00	65.90	72.30	75.20	70.00	74.80	77.80
	SHC	24.80	30.50	47.80	16.10	25.90	36.00	11.90	19.60	29.00
	kW	8.00	8.07	8.15	8.20	8.25	8.29	8.28	8.35	8.44
50	TC	66.20	68.60	74.30	68.80	74.60	78.20	72.80	77.80	80.70
	SHC	26.60	32.30	49.40	17.70	27.70	37.80	13.50	21.20	30.60
	kW	7.94	8.01	8.08	8.13	8.20	8.23	8.22	8.29	8.38
40	TC	69.10	71.60	77.80	71.80	78.00	81.00	75.70	80.60	83.70
	SHC	28.20	33.90	50.10	19.40	29.30	39.80	15.20	22.90	32.20
	kW	7.90	7.97	8.04	8.09	8.15	8.17	8.16	8.23	8.32

LEGEND

Edb – Entering Dry–Bulb
Ewb – Entering Wet–Bulb
kW – Compressor Motor Power Input
ldb – Leaving Dry–Bulb
lwb – Leaving Wet–Bulb
SHC – Sensible Heat Capacity (1000 Btuh) Gross
TC – Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet–bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil

Table 29 – STATIC PRESSURE ADDERS (IN. WG) (FACTORY OPTIONS AND/OR ACCESSORIES)

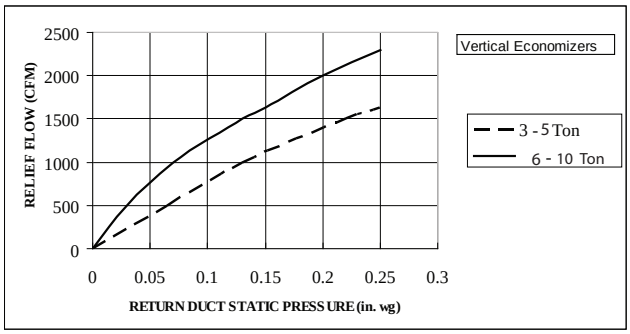
Humidi-MiZer

3–6 TONS									
CFM (in. wg)	1000	1250	1500	1750	2000	2250	2500	2750	3000
3 Tons	0.04	0.052	0.07	–	–	–	–	–	–
4 Tons	–	0.106	0.138	0.172	0.21	–	–	–	–
5 Tons	–	–	0.138	0.172	0.21	0.252	0.30	–	–
6 Tons	–	–	–	0.112	0.125	0.161	0.19	0.22	0.25

	7.5–12.5 TONS									
CFM (in. wg)	4000	4250	4500	4750	5000	5250	5500	5750	6000	6250
7.5 Tons	–	–	–	–	–	–	–	–	–	–
8.5 Tons	0.20	0.22	–	–	–	–	–	–	–	–
10 Tons	0.20	0.22	0.24	0.26	0.28	–	–	–	–	–
12.5 Tons	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12

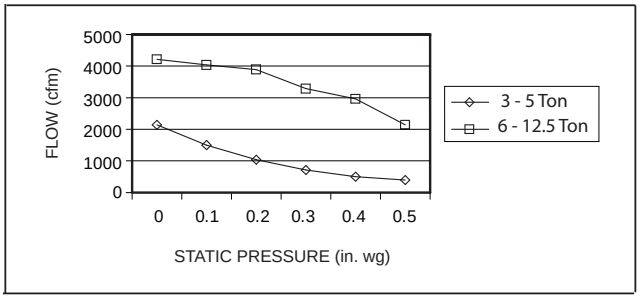
ECONOMIZER, BAROMETRIC RELIEF AND PE PERFORMANCE

Vertical Application



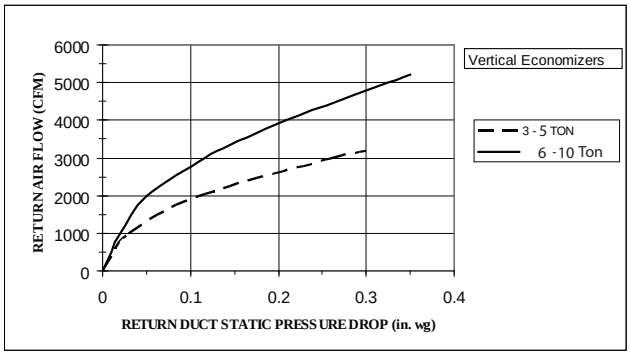
C10475

Fig. 16 – Barometric Relief Flow–Vertical 3–10 Ton



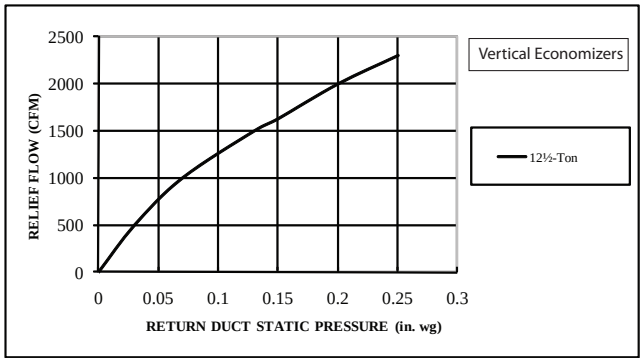
C10996

Fig. 18 – Vertical Power Exhaust Performance



C10477

Fig. 17 – Return Air Pressure Drop–Vertical 3–10 Ton

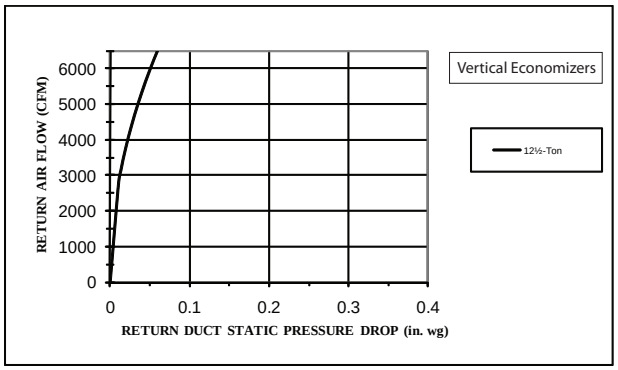


C101004

Fig. 19 – Barometric Relief Flow–Vertical 12.5 Ton

ECONOMIZER, BAROMETRIC RELIEF AND PE PERFORMANCE (cont.)

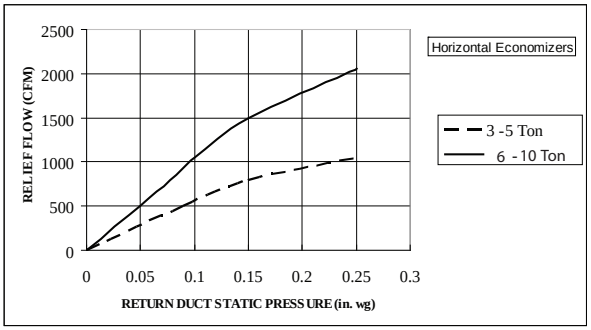
Vertical Application (cont.)



C101005

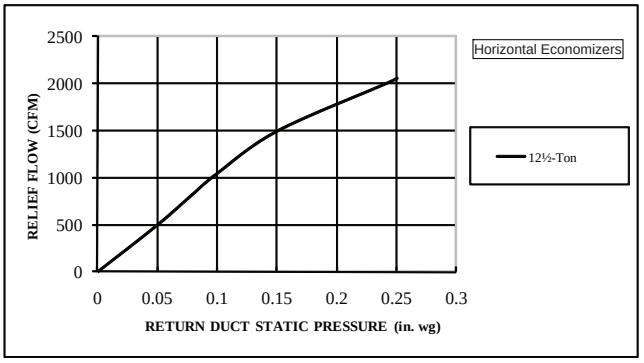
Fig. 20 – Return Air Pressure Drop–Vertical 12.5 Ton

Horizontal Application



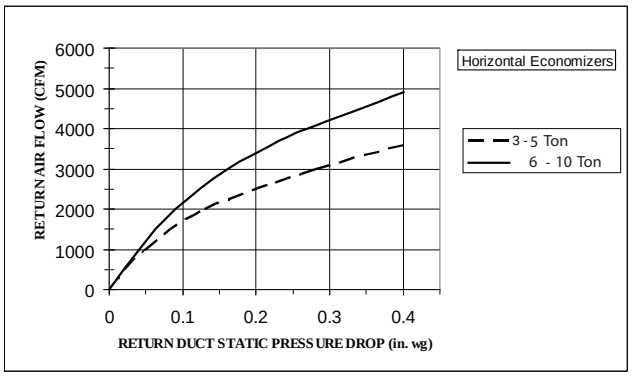
C10472

Fig. 21 – Barometric Relief Flow–Horizontal 3–10 Ton



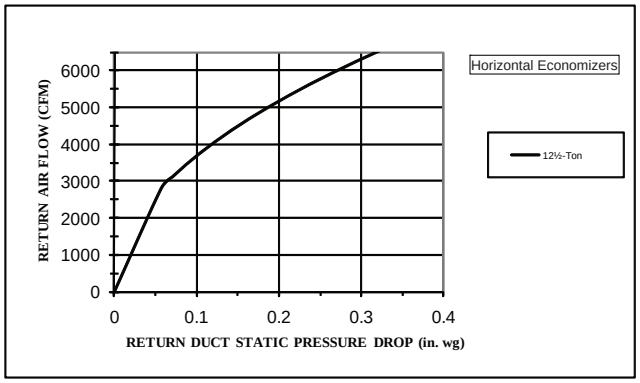
C101002

Fig. 23 – Barometric Relief Flow–Horizontal 12.5 Ton



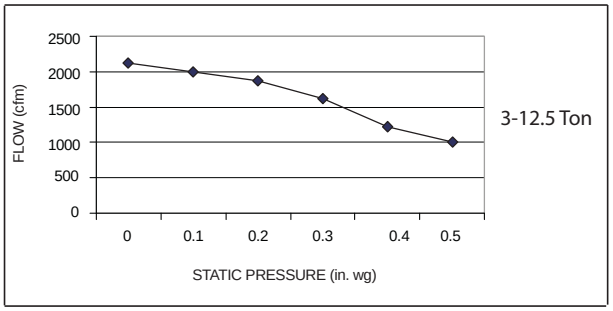
C10474

Fig. 22 – Return Air Pressure Drop–Horizontal 3–10 Ton



C101003

Fig. 24 – Return Air Pressure Drop–Horizontal–12.5 Ton



C10995

Fig. 25 – Horizontal Power Exhaust Performance

GENERAL FAN PERFORMANCE NOTES:

1. Interpolation is permissible. Do not extrapolate.
2. External static pressure is the static pressure difference between the return duct and the supply duct plus the static pressure caused by any FIOPs or accessories.
3. Tabular data accounts for pressure loss due to clean filters, unit casing, and wet coils. Factory options and accessories may add static pressure losses. Selection software is available, through your salesperson, to help you select the best motor/drive combination for your application.
4. The Fan Performance tables offer motor/drive recommendations. In cases when two motor/drive combinations would work, Carrier recommended the lower horsepower option.
5. For information on the electrical properties of Carrier motors, please see the Electrical information section of this book.
6. For more information on the performance limits of Carrier motors, see the application data section of this book.
7. The EPACT (Energy Policy Act of 1992) regulates energy requirements for specific types of indoor fan motors. Motors regulated by EPACT include any general purpose, T-frame (three-digit, 143 and larger), single-speed, foot mounted, polyphase, squirrel cage induction motors of NEMA (National Electrical Manufacturers Association) design A and B, manufactured for use in the United States. Ranging from 1 to 200 Hp, these continuous-duty motors operate on 230 and 460 volt, 60 Hz power. If a motor does not fit into these specifications, the motor does not have to be replaced by an EPACT compliant energy-efficient motor. Variable-speed motors are exempt from EPACT compliance requirements.

FAN PERFORMANCE (BELT DRIVE)

Table 30 – 48HC04 3 PHASE NON-HUMIDI-MIZER 3 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	**592**	**0.14**	**721**	**0.25**	826	0.38	916	0.53	997	0.69
975	**616**	**0.17**	**744**	**0.28**	847	0.41	936	0.56	1016	0.72
1050	**641**	**0.19**	**766**	**0.30**	868	0.44	957	0.59	1036	0.76
1125	**667**	**0.22**	790	0.33	890	0.47	978	0.63	1056	0.80
1200	**693**	**0.25**	813	0.37	913	0.51	999	0.67	1077	0.84
1275	**720**	**0.29**	837	0.41	935	0.55	1021	0.71	1098	0.88
1350	**747**	**0.33**	862	0.45	958	0.60	1043	0.76	1119	0.94
1425	775	0.37	887	0.50	982	0.65	1066	0.81	1141	0.99
1500	802	0.42	912	0.55	1006	0.70	1088	0.87	1163	1.05

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1070	0.88	1137	1.07	1201	1.29	1260	1.51	1317	1.75
975	1089	0.91	1156	1.11	1219	1.32	1279	1.54	1335	1.78
1050	1108	0.94	1175	1.14	1238	1.36	1297	1.58	1353	1.82
1125	1128	0.98	1195	1.18	1257	1.40	1316	1.62	1372	1.86
1200	1148	1.03	1214	1.23	1276	1.44	1335	1.67	1391	1.91
1275	1169	1.07	1235	1.28	1296	1.50	1354	1.72	1410	1.97
1350	1190	1.13	1255	1.33	1316	1.55	1374	1.78	1429	2.03
1425	1211	1.19	1276	1.39	1337	1.61	1394	1.85	1449	2.09
1500	1232	1.25	1297	1.46	1357	1.68	1415	1.91	**1469**	**2.16**

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Medium static 770–1175 RPM, 1.2 BHP max
High static 1035–1466 RPM, 2.4 BHP max

Table 31 – 48HC04 3 PHASE HUMIDI-MIZER 3 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	592	0.14	721	0.25	826	0.38	916	0.53	997	0.69
975	616	0.17	744	0.28	847	0.41	936	0.56	1016	0.72
1050	641	0.19	766	0.30	868	0.44	957	0.59	1036	0.76
1125	667	0.22	790	0.33	890	0.47	978	0.63	1056	0.80
1200	693	0.25	813	0.37	913	0.51	999	0.67	1077	0.84
1275	720	0.29	837	0.41	935	0.55	1021	0.71	1098	0.88
1350	747	0.33	862	0.45	958	0.60	1043	0.76	1119	0.94
1425	775	0.37	887	0.50	982	0.65	1066	0.81	1141	0.99
1500	802	0.42	912	0.55	1006	0.70	1088	0.87	1163	1.05

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1070	0.88	1137	1.07	1201	1.29	1260	1.51	1317	1.75
975	1089	0.91	1156	1.11	1219	1.32	1279	1.54	1335	1.78
1050	1108	0.94	1175	1.14	1238	1.36	1297	1.58	1353	1.82
1125	1128	0.98	1195	1.18	1257	1.40	1316	1.62	1372	1.86
1200	1148	1.03	1214	1.23	1276	1.44	1335	1.67	1391	1.91
1275	1169	1.07	1235	1.28	1296	1.50	1354	1.72	1410	1.97
1350	1190	1.13	1255	1.33	1316	1.55	1374	1.78	1429	2.03
1425	1211	1.19	1276	1.39	1337	1.61	1394	1.85	1449	2.09
1500	1232	1.25	1297	1.46	1357	1.68	1415	1.91	**1469**	**2.16**

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Standard static 560–854 RPM, 1.2 BHP max
Medium static 770–1175 RPM, 1.2 BHP max
High static 1035–1466 RPM, 2.4 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 32 – 48HC04 3 PHASE NON-HUMIDI-MIZER 3 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	**582**	**0.14**	**715**	**0.24**	825	0.35	921	0.48	1007	0.63
975	**606**	**0.16**	**735**	**0.26**	843	0.38	938	0.51	1023	0.66
1050	**630**	**0.18**	**756**	**0.29**	862	0.41	955	0.55	1040	0.70
1125	**655**	**0.21**	778	0.32	882	0.45	974	0.58	1057	0.74
1200	**681**	**0.24**	800	0.35	902	0.48	992	0.63	1074	0.78
1275	**708**	**0.27**	823	0.39	923	0.53	1012	0.67	1093	0.83
1350	**735**	**0.31**	847	0.43	945	0.57	1032	0.72	1112	0.88
1425	**762**	**0.35**	871	0.48	967	0.62	1053	0.77	1131	0.94
1500	790	0.40	896	0.53	990	0.67	1074	0.83	1151	1.00

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1086	0.79	1159	0.96	1228	1.14	1293	1.33	1354	1.53
975	1101	0.82	1174	0.99	1242	1.18	1306	1.37	1367	1.57
1050	1117	0.86	1189	1.03	1256	1.22	1320	1.41	1381	1.62
1125	1133	0.90	1204	1.08	1271	1.26	1335	1.46	1395	1.67
1200	1150	0.95	1221	1.13	1287	1.31	1350	1.51	1410	1.72
1275	1168	1.00	1237	1.18	1303	1.37	1365	1.57	1425	1.78
1350	1186	1.05	1255	1.24	1320	1.43	1382	1.63	1441	1.84
1425	1204	1.11	1272	1.30	1337	1.49	1398	1.70	1457	1.91
1500	1223	1.18	1291	1.36	1355	1.56	1415	1.77	**1473**	**1.99**

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Medium static 770–1175 RPM, 1.2 BHP max
High static 1035–1466 RPM, 2.4 BHP max

Table 33 – 48HC04 3 PHASE HUMIDI-MIZER 3 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	582	0.14	715	0.24	825	0.35	921	0.48	1007	0.63
975	606	0.16	735	0.26	843	0.38	938	0.51	1023	0.66
1050	630	0.18	756	0.29	862	0.41	955	0.55	1040	0.70
1125	655	0.21	778	0.32	882	0.45	974	0.58	1057	0.74
1200	681	0.24	800	0.35	902	0.48	992	0.63	1074	0.78
1275	708	0.27	823	0.39	923	0.53	1012	0.67	1093	0.83
1350	735	0.31	847	0.43	945	0.57	1032	0.72	1112	0.88
1425	762	0.35	871	0.48	967	0.62	1053	0.77	1131	0.94
1500	790	0.40	896	0.53	990	0.67	1074	0.83	1151	1.00

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1086	0.79	1159	0.96	1228	1.14	1293	1.33	1354	1.53
975	1101	0.82	1174	0.99	1242	1.18	1306	1.37	1367	1.57
1050	1117	0.86	1189	1.03	1256	1.22	1320	1.41	1381	1.62
1125	1133	0.90	1204	1.08	1271	1.26	1335	1.46	1395	1.67
1200	1150	0.95	1221	1.13	1287	1.31	1350	1.51	1410	1.72
1275	1168	1.00	1237	1.18	1303	1.37	1365	1.57	1425	1.78
1350	1186	1.05	1255	1.24	1320	1.43	1382	1.63	1441	1.84
1425	1204	1.11	1272	1.30	1337	1.49	1398	1.70	1457	1.91
1500	1223	1.18	1291	1.36	1355	1.56	1415	1.77	**1473**	**1.99**

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Standard static 560–864 RPM, 1.2 BHP max
Medium static 770–1175 RPM, 1.2 BHP max
High static 1035–1466 RPM, 2.4 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 34 – 48HC05 3 PHASE NON-HUMIDI-MIZER 4 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	**693**	**0.25**	**813**	**0.37**	**913**	**0.51**	999	0.67	1077	0.84
1300	**729**	**0.30**	**846**	**0.42**	943	0.57	1028	0.73	1105	0.90
1400	**765**	**0.35**	**879**	**0.48**	974	0.63	1058	0.79	1134	0.97
1500	**802**	**0.42**	**912**	**0.55**	1006	0.70	1088	0.87	1163	1.05
1600	**840**	**0.49**	947	0.63	1038	0.78	1119	0.95	1193	1.14
1700	**878**	**0.57**	982	0.71	1071	0.87	1151	1.05	1224	1.24
1800	**917**	**0.65**	1017	0.81	1105	0.97	1183	1.15	1255	1.35
1900	956	0.75	1053	0.91	1139	1.08	1216	1.27	1287	1.47
2000	995	0.86	1090	1.02	1173	1.20	1249	1.39	1319	1.59

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1148	1.03	1214	1.23	1276	1.44	1335	1.67	1391	1.91
1300	1176	1.09	1241	1.30	1303	1.51	1361	1.74	1416	1.98
1400	1204	1.17	1269	1.37	1330	1.59	1388	1.82	1442	2.07
1500	1232	1.25	1297	1.46	1357	1.68	1415	1.91	1469	2.16
1600	1262	1.34	1325	1.55	1385	1.78	1442	2.01	1496	2.26
1700	1291	1.44	1354	1.66	1414	1.89	1470	2.12	1524	2.37
1800	1322	1.55	1384	1.77	1443	2.00	1499	2.25	1552	2.50
1900	1352	1.68	1414	1.90	1472	2.13	1528	2.38	1580	2.63
2000	1384	1.81	1445	2.04	1502	2.27	1557	2.52	1609	2.78

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Medium static 920–1303 RPM, 1.7 BHP max
High static 1208–1639 RPM, 2.9 BHP max

Table 35 – 48HC05 3 PHASE HUMIDI-MIZER 4 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	693	0.25	813	0.37	913	0.51	999	0.67	1077	0.84
1300	729	0.30	846	0.42	943	0.57	1028	0.73	1105	0.90
1400	765	0.35	879	0.48	974	0.63	1058	0.79	1134	0.97
1500	802	0.42	912	0.55	1006	0.70	1088	0.87	1163	1.05
1600	840	0.49	947	0.63	1038	0.78	1119	0.95	1193	1.14
1700	878	0.57	982	0.71	1071	0.87	1151	1.05	1224	1.24
1800	917	0.65	1017	0.81	1105	0.97	1183	1.15	1255	1.35
1900	956	0.75	1053	0.91	1139	1.08	1216	1.27	1287	1.47
2000	995	0.86	1090	1.02	1173	1.20	1249	1.39	1319	1.59

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1148	1.03	1214	1.23	1276	1.44	1335	1.67	1391	1.91
1300	1176	1.09	1241	1.30	1303	1.51	1361	1.74	1416	1.98
1400	1204	1.17	1269	1.37	1330	1.59	1388	1.82	1442	2.07
1500	1232	1.25	1297	1.46	1357	1.68	1415	1.91	1469	2.16
1600	1262	1.34	1325	1.55	1385	1.78	1442	2.01	1496	2.26
1700	1291	1.44	1354	1.66	1414	1.89	1470	2.12	1524	2.37
1800	1322	1.55	1384	1.77	1443	2.00	1499	2.25	1552	2.50
1900	1352	1.68	1414	1.90	1472	2.13	1528	2.38	1580	2.63
2000	1384	1.81	1445	2.04	1502	2.27	1557	2.52	1609	2.78

NOTE: For more information, see General Fan Performance Notes.

Standard static 560–854 RPM, 1.2 BHP max
Medium static 770–1175 RPM, 1.7 BHP max
High static 1208–1639 RPM, 2.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 36 – 48HC05 3 PHASE NON-HUMIDI-MIZER 4 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	**681**	**0.24**	**800**	**0.35**	**902**	**0.48**	992	0.63	1074	0.78
1300	**717**	**0.29**	**831**	**0.41**	930	0.54	1019	0.69	1099	0.85
1400	**753**	**0.34**	**863**	**0.46**	959	0.60	1046	0.75	1125	0.92
1500	**790**	**0.40**	**896**	**0.53**	990	0.67	1074	0.83	1151	1.00
1600	**828**	**0.46**	930	0.60	1021	0.75	1103	0.91	1179	1.09
1700	**866**	**0.54**	964	0.68	1053	0.84	1133	1.01	1207	1.18
1800	**905**	**0.62**	1000	0.77	1085	0.94	1164	1.11	1236	1.29
1900	944	0.71	1036	0.87	1119	1.04	1195	1.22	1266	1.41
2000	984	0.82	1072	0.98	1153	1.15	1227	1.34	1297	1.53

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1150	0.95	1221	1.13	1287	1.31	1350	1.51	1410	1.72
1300	1173	1.02	1243	1.20	1309	1.39	1371	1.59	1430	1.80
1400	1198	1.09	1266	1.28	1331	1.47	1393	1.68	1451	1.89
1500	1223	1.18	1291	1.36	1355	1.56	1415	1.77	1473	1.99
1600	1249	1.27	1316	1.46	1379	1.66	1439	1.87	1496	2.09
1700	1277	1.37	1342	1.57	1404	1.77	1463	1.99	1520	2.21
1800	1305	1.48	1369	1.68	1430	1.89	1489	2.11	1545	2.34
1900	1333	1.60	1397	1.81	1457	2.02	1514	2.25	1570	2.48
2000	1363	1.73	1425	1.94	1484	2.16	1541	2.39	1596	2.63

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.
Medium static 920–1303 RPM, 1.7 BHP max
High static 1208–1639 RPM, 2.9 BHP max

Table 37 – 48HC05 3 PHASE HUMIDI-MIZER 4 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	681	0.24	800	0.35	902	0.48	992	0.63	1074	0.78
1300	717	0.29	831	0.41	930	0.54	1019	0.69	1099	0.85
1400	753	0.34	863	0.46	959	0.60	1046	0.75	1125	0.92
1500	790	0.40	896	0.53	990	0.67	1074	0.83	1151	1.00
1600	828	0.46	930	0.60	1021	0.75	1103	0.91	1179	1.09
1700	866	0.54	964	0.68	1053	0.84	1133	1.01	1207	1.18
1800	905	0.62	1000	0.77	1085	0.94	1164	1.11	1236	1.29
1900	944	0.71	1036	0.87	1119	1.04	1195	1.22	1266	1.41
2000	984	0.82	1072	0.98	1153	1.15	1227	1.34	1297	1.53

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1150	0.95	1221	1.13	1287	1.31	1350	1.51	1410	1.72
1300	1173	1.02	1243	1.20	1309	1.39	1371	1.59	1430	1.80
1400	1198	1.09	1266	1.28	1331	1.47	1393	1.68	1451	1.89
1500	1223	1.18	1291	1.36	1355	1.56	1415	1.77	1473	1.99
1600	1249	1.27	1316	1.46	1379	1.66	1439	1.87	1496	2.09
1700	1277	1.37	1342	1.57	1404	1.77	1463	1.99	1520	2.21
1800	1305	1.48	1369	1.68	1430	1.89	1489	2.11	1545	2.34
1900	1333	1.60	1397	1.81	1457	2.02	1514	2.25	1570	2.48
2000	1363	1.73	1425	1.94	1484	2.16	1541	2.39	1596	2.63

NOTE: For more information, see General Fan Performance Notes.
Standard static 560–854 RPM, 1.2 BHP max
Medium static 770–1175 RPM, 1.7 BHP max
High static 1208–1639 RPM, 2.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 38 – 48HC06** **3 PHASE NON-HUMIDI-MIZER** **5 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	**847**	**0.41**	966	0.55	1067	0.68	1158	0.81	1240	0.93
1625	**896**	**0.50**	1010	0.65	1109	0.79	1198	0.93	1278	1.07
1750	**947**	**0.59**	1056	0.76	1152	0.92	1238	1.07	1318	1.22
1875	**998**	**0.70**	1103	0.88	1196	1.05	1280	1.22	1358	1.38
2000	1049	0.82	1151	1.02	1241	1.20	1323	1.38	1399	1.56
2125	1102	0.96	1199	1.17	1287	1.37	1367	1.56	1441	1.75
2250	1154	1.11	1248	1.33	1333	1.55	1411	1.75	1484	1.96
2375	1208	1.28	1298	1.52	1381	1.74	1457	1.96	1528	2.18
2500	1261	1.47	1349	1.72	1429	1.96	1503	2.19	1572	2.42

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1316	1.05	1387	1.17	1454	1.28	1517	1.39	1578	1.50
1625	1353	1.20	1423	1.33	1489	1.46	1552	1.58	1611	1.70
1750	1391	1.36	1460	1.51	1525	1.65	1587	1.78	1646	1.91
1875	1430	1.54	1498	1.70	1562	1.85	1623	2.00	1681	2.14
2000	1470	1.73	1537	1.90	1600	2.06	1660	2.23	**1718**	**2.38**
2125	1511	1.93	1576	2.12	1639	2.29	**1698**	**2.47**	**1755**	**2.64**
2250	1552	2.15	1617	2.35	1678	2.54	**1737**	**2.73**	1793	2.92
2375	1595	2.39	1658	2.60	**1718**	**2.80**	1776	3.01	–	–
2500	1638	2.64	**1700**	**2.87**	1760	3.08	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.
Medium static 1035–1466 RPM, 2.4 BHP max
High static 1303 – 1687 RPM, 2.9 BHP max

Table 39 – 48HC06** **3 PHASE HUMIDI-MIZER** **5 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	847	0.41	966	0.55	1067	0.68	1158	0.81	1240	0.93
1625	896	0.50	1010	0.65	1109	0.79	1198	0.93	1278	1.07
1750	947	0.59	1056	0.76	1152	0.92	1238	1.07	1318	1.22
1875	998	0.70	1103	0.88	1196	1.05	1280	1.22	1358	1.38
2000	1049	0.82	1151	1.02	1241	1.20	1323	1.38	1399	1.56
2125	1102	0.96	1199	1.17	1287	1.37	1367	1.56	1441	1.75
2250	1154	1.11	1248	1.33	1333	1.55	1411	1.75	1484	1.96
2375	1208	1.28	1298	1.52	1381	1.74	1457	1.96	1528	2.18
2500	1261	1.47	1349	1.72	1429	1.96	1503	2.19	1572	2.42

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1316	1.05	1387	1.17	1454	1.28	1517	1.39	1578	1.50
1625	1353	1.20	1423	1.33	1489	1.46	1552	1.58	1611	1.70
1750	1391	1.36	1460	1.51	1525	1.65	1587	1.78	1646	1.91
1875	1430	1.54	1498	1.70	1562	1.85	1623	2.00	1681	2.14
2000	1470	1.73	1537	1.90	1600	2.06	1660	2.23	**1718**	**2.38**
2125	1511	1.93	1576	2.12	1639	2.29	**1698**	**2.47**	**1755**	**2.64**
2250	1552	2.15	1617	2.35	1678	2.54	**1737**	**2.73**	**1793**	**2.92**
2375	1595	2.39	1658	2.60	**1718**	**2.80**	**1776**	**3.01**	**–**	**–**
2500	1638	2.64	**1700**	**2.87**	**1760**	**3.08**	**–**	**–**	**–**	**–**

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.
Standard static 770–1175 RPM, 1.2 BHP max
Medium static 1035–1466 RPM, 2.4 BHP max
High static 1303–1687 RPM, 2.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 40 – 48HC06 3 PHASE NON-HUMIDI-MIZER 5 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	**798**	**0.41**	906	0.55	1002	0.71	1088	0.87	1167	1.05
1625	**845**	**0.50**	949	0.65	1041	0.81	1125	0.98	1202	1.17
1750	**893**	**0.60**	993	0.76	1081	0.93	1163	1.11	1238	1.30
1875	**942**	**0.71**	1037	0.88	1123	1.06	1202	1.25	1275	1.44
2000	**992**	**0.84**	1083	1.02	1166	1.21	1242	1.40	1313	1.61
2125	1043	0.98	1129	1.17	1209	1.37	1283	1.57	1353	1.79
2250	1093	1.14	1177	1.34	1254	1.55	1325	1.76	1393	1.98
2375	1145	1.32	1225	1.53	1299	1.74	1369	1.97	1434	2.20
2500	1196	1.51	1273	1.73	1345	1.96	1413	2.19	1477	2.43

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1241	1.23	1310	1.42	1375	1.63	1438	1.84	1497	2.06
1625	1274	1.36	1342	1.56	1406	1.77	1467	1.98	1526	2.21
1750	1308	1.50	1375	1.70	1438	1.92	1498	2.14	1555	2.37
1875	1344	1.65	1409	1.86	1471	2.09	1530	2.32	1586	2.55
2000	1380	1.82	1444	2.04	1505	2.27	1563	2.51	1619	2.75
2125	1418	2.01	1481	2.24	1540	2.47	1597	2.72	**1652**	**2.97**
2250	1457	2.21	1518	2.45	1576	2.69	**1632**	**2.94**	**1686**	**3.20**
2375	1497	2.43	1556	2.68	**1614**	**2.93**	**1669**	**3.19**	–	–
2500	1538	2.68	**1596**	**2.93**	**1652**	**3.19**	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.
Medium static 1035–1466 RPM, 2.4 BHP max
High static 1303–1687 RPM, 2.9 BHP max

Table 41 – 48HC06 3 PHASE HUMIDI-MIZER 5 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	798	0.41	906	0.55	1002	0.71	1088	0.87	1167	1.05
1625	845	0.50	949	0.65	1041	0.81	1125	0.98	1202	1.17
1750	893	0.60	993	0.76	1081	0.93	1163	1.11	1238	1.30
1875	942	0.71	1037	0.88	1123	1.06	1202	1.25	1275	1.44
2000	992	0.84	1083	1.02	1166	1.21	1242	1.40	1313	1.61
2125	1043	0.98	1129	1.17	1209	1.37	1283	1.57	1353	1.79
2250	1093	1.14	1177	1.34	1254	1.55	1325	1.76	1393	1.98
2375	1145	1.32	1225	1.53	1299	1.74	1369	1.97	1434	2.20
2500	1196	1.51	1273	1.73	1345	1.96	1413	2.19	1477	2.43

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1241	1.23	1310	1.42	1375	1.63	1438	1.84	1497	2.06
1625	1274	1.36	1342	1.56	1406	1.77	1467	1.98	1526	2.21
1750	1308	1.50	1375	1.70	1438	1.92	1498	2.14	1555	2.37
1875	1344	1.65	1409	1.86	1471	2.09	1530	2.32	1586	2.55
2000	1380	1.82	1444	2.04	1505	2.27	1563	2.51	1619	2.75
2125	1418	2.01	1481	2.24	1540	2.47	1597	2.72	1652	2.97
2250	1457	2.21	1518	2.45	1576	2.69	1632	2.94	**1686**	**3.20**
2375	1497	2.43	1556	2.68	1614	2.93	**1669**	**3.19**	–	–
2500	1538	2.68	1596	2.93	**1652**	**3.19**	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.
Standard static 770–1175 RPM, 1.2 BHP max
Medium static 1035–1466 RPM, 2.4 BHP max
High static 1303–1687 RPM, 2.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 42 – 48HC07** **3 PHASE** **6 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	**449**	**0.34**	539	0.53	615	0.75	681	0.99	742	1.26
1950	**470**	**0.40**	557	0.60	631	0.83	696	1.08	756	1.35
2100	491	0.47	576	0.68	648	0.91	712	1.17	771	1.45
2250	513	0.54	595	0.76	665	1.01	728	1.27	786	1.56
2400	536	0.63	615	0.86	684	1.11	745	1.39	802	1.68
2550	558	0.72	635	0.97	702	1.23	763	1.51	818	1.81
2700	582	0.83	656	1.08	721	1.35	781	1.65	835	1.95
2850	605	0.94	677	1.21	741	1.49	799	1.79	853	2.11
3000	629	1.07	699	1.35	761	1.64	818	1.95	871	2.28

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	797	1.54	848	1.84	896	2.16	942	2.49	985	2.84
1950	810	1.64	861	1.94	909	2.26	954	2.60	997	2.96
2100	824	1.74	875	2.06	922	2.38	967	2.73	1009	3.09
2250	839	1.86	889	2.18	935	2.52	980	2.87	1022	3.23
2400	854	1.99	903	2.32	950	2.66	993	3.02	1035	3.39
2550	870	2.13	918	2.46	964	2.81	1008	3.18	1049	3.55
2700	886	2.28	934	2.62	979	2.98	1022	3.35	1063	3.74
2850	903	2.44	950	2.79	995	3.16	1037	3.54	1078	3.93
3000	920	2.62	966	2.98	1010	3.35	1052	3.74	1093	4.14

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Standard static 489 – 747 RPM, 1.7 BHP max
Medium static 733 – 949 RPM, 2.9 BHP max
High static 909 – 1102 RPM, 4.7 BHP max

Table 43 – 48HC07** **3 PHASE** **6 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	**441**	**0.33**	533	0.51	611	0.72	681	0.96	745	1.23
1950	**462**	**0.38**	550	0.58	626	0.80	694	1.04	757	1.31
2100	**483**	**0.45**	567	0.65	641	0.88	708	1.13	769	1.40
2250	505	0.52	586	0.73	657	0.97	722	1.22	782	1.50
2400	528	0.60	605	0.82	674	1.07	738	1.33	796	1.62
2550	550	0.69	625	0.92	692	1.17	754	1.45	811	1.74
2700	574	0.80	645	1.03	710	1.29	770	1.57	826	1.88
2850	597	0.91	666	1.16	729	1.43	788	1.71	843	2.02
3000	621	1.03	688	1.29	749	1.57	806	1.87	859	2.18

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	804	1.51	860	1.82	912	2.15	961	2.49	1008	2.85
1950	815	1.60	869	1.91	920	2.24	969	2.59	1016	2.96
2100	826	1.70	880	2.01	930	2.35	978	2.70	1024	3.07
2250	838	1.81	891	2.12	941	2.46	988	2.82	1033	3.19
2400	851	1.92	903	2.25	952	2.59	999	2.95	1043	3.33
2550	865	2.05	916	2.38	964	2.73	1010	3.10	1054	3.48
2700	879	2.19	929	2.53	976	2.88	1022	3.25	1066	3.64
2850	894	2.35	943	2.69	990	3.05	1035	3.43	1078	3.82
3000	910	2.51	958	2.86	1004	3.23	1048	3.61	1090	4.01

NOTE: For more information, see General Fan Performance Notes.
Boldface indicates field–supplied drive is required.

Standard static 489 – 747 RPM, 1.7 BHP max
Medium static 733 – 949 RPM, 2.9 BHP max
High static 909 – 1102 RPM, 4.7 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 44 – 48HC08** **3 PHASE** **7.5 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	505	0.39	595	0.54	676	0.69	750	0.86	819	1.03
2438	532	0.47	617	0.63	694	0.79	766	0.97	833	1.15
2625	559	0.56	640	0.73	714	0.90	783	1.08	848	1.28
2813	588	0.67	664	0.84	735	1.03	801	1.22	864	1.42
3000	616	0.79	689	0.97	757	1.16	821	1.36	882	1.57
3188	646	0.92	715	1.11	780	1.31	842	1.52	901	1.74
3375	675	1.06	742	1.27	804	1.48	864	1.70	920	1.93
3563	705	1.23	769	1.44	829	1.66	886	1.89	941	2.13
3750	736	1.41	797	1.63	855	1.86	910	2.10	963	2.35

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	884	1.21	945	1.40	1003	1.60	1059	1.80	1112	2.01
2438	896	1.34	955	1.54	1012	1.74	1066	1.95	1118	2.17
2625	909	1.47	967	1.68	1022	1.89	1075	2.11	1126	2.34
2813	923	1.62	980	1.84	1034	2.06	1086	2.29	1136	2.52
3000	939	1.79	994	2.01	1047	2.24	1098	2.47	1147	2.71
3188	956	1.97	1010	2.20	1061	2.43	1111	2.68	1159	2.93
3375	975	2.16	1027	2.40	1077	2.65	1125	2.90	1172	3.15
3563	994	2.37	1044	2.62	1093	2.87	1141	3.13	1186	3.40
3750	1014	2.60	1063	2.86	1111	3.12	1157	3.39	1202	3.66

NOTE: For more information, see General Fan Performance Notes.

Standard static 518 – 733 RPM, 1.7 BHP max
Medium static 690 – 936 RPM, 2.4 BHP max
High static 838 – 1084 RPM, 3.7 BHP max

Table 45 – 48HC08** **3 PHASE** **7.5 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	482	0.36	577	0.51	659	0.66	732	0.82	799	0.98
2438	505	0.43	597	0.59	676	0.75	748	0.92	813	1.09
2625	529	0.51	617	0.68	694	0.85	764	1.03	827	1.22
2813	554	0.60	638	0.78	713	0.97	781	1.16	843	1.35
3000	579	0.70	660	0.89	732	1.09	799	1.29	860	1.50
3188	604	0.81	683	1.02	753	1.23	817	1.44	877	1.65
3375	630	0.94	706	1.15	774	1.37	836	1.60	895	1.82
3563	657	1.08	729	1.31	795	1.54	856	1.77	913	2.01
3750	683	1.23	753	1.47	817	1.71	877	1.96	933	2.21

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	860	1.14	917	1.31	971	1.48	1022	1.66	1071	1.84
2438	873	1.27	929	1.45	983	1.63	1033	1.81	1081	2.00
2625	887	1.40	942	1.59	995	1.78	1045	1.98	1092	2.18
2813	901	1.55	956	1.75	1008	1.95	1057	2.15	1104	2.36
3000	917	1.70	970	1.91	1021	2.13	1070	2.34	1117	2.56
3188	933	1.87	986	2.09	1036	2.32	1084	2.54	1130	2.77
3375	950	2.05	1002	2.29	1051	2.52	1098	2.76	1144	3.00
3563	967	2.25	1018	2.49	1067	2.74	1113	2.99	1158	3.24
3750	985	2.46	1035	2.71	1083	2.97	1129	3.23	1173	3.49

NOTE: For more information, see General Fan Performance Notes.

Standard static 518 – 733 RPM, 1.7 BHP max
Medium static 690 – 936 RPM, 2.4 BHP max
High static 838 – 1084 RPM, 3.7 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 46 – 48HC09** **3 PHASE** **8.5 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	505	0.39	595	0.54	676	0.69	750	0.86	819	1.03
2438	532	0.47	617	0.63	694	0.79	766	0.97	833	1.15
2625	559	0.56	640	0.73	714	0.90	783	1.08	848	1.28
2813	588	0.67	664	0.84	735	1.03	801	1.22	864	1.42
3000	616	0.79	689	0.97	757	1.16	821	1.36	882	1.57
3188	646	0.92	715	1.11	780	1.31	842	1.52	901	1.74
3375	675	1.06	742	1.27	804	1.48	864	1.70	920	1.93
3563	705	1.23	769	1.44	829	1.66	886	1.89	941	2.13
3750	736	1.41	797	1.63	855	1.86	910	2.10	963	2.35

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	884	1.21	945	1.40	1003	1.60	1059	1.80	1112	2.01
2438	896	1.34	955	1.54	1012	1.74	1066	1.95	1118	2.17
2625	909	1.47	967	1.68	1022	1.89	1075	2.11	1126	2.34
2813	923	1.62	980	1.84	1034	2.06	1086	2.29	1136	2.52
3000	939	1.79	994	2.01	1047	2.24	1098	2.47	1147	2.71
3188	956	1.97	1010	2.20	1061	2.43	1111	2.68	1159	2.93
3375	975	2.16	1027	2.40	1077	2.65	1125	2.90	1172	3.15
3563	994	2.37	1044	2.62	1093	2.87	1141	3.13	1186	3.40
3750	1014	2.60	1063	2.86	1111	3.12	1157	3.39	1202	3.66

NOTE: For more information, see General Fan Performance Notes.

Standard static 518 – 733 RPM, 1.7 BHP max
Medium static 690 – 936 RPM, 2.4 BHP max
High static 838 – 1084 RPM, 3.7 BHP max

Table 47 – 48HC09** **3 PHASE** **8.5 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	520	0.47	609	0.64	687	0.81	757	0.99	821	1.16
2438	547	0.57	633	0.75	708	0.94	776	1.12	839	1.31
2625	575	0.68	657	0.88	730	1.07	796	1.27	857	1.48
2813	604	0.81	683	1.02	753	1.23	817	1.44	877	1.65
3000	634	0.95	709	1.17	777	1.40	839	1.62	897	1.85
3188	664	1.11	736	1.35	801	1.58	862	1.82	919	2.06
3375	694	1.29	763	1.54	826	1.79	885	2.04	941	2.29
3563	725	1.49	791	1.75	852	2.01	909	2.28	963	2.54
3750	756	1.71	819	1.98	879	2.26	934	2.53	987	2.81

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	881	1.35	937	1.53	990	1.72	1040	1.91	1088	2.11
2438	897	1.51	952	1.70	1004	1.90	1054	2.11	1101	2.31
2625	915	1.68	968	1.89	1020	2.10	1068	2.32	1115	2.53
2813	933	1.87	986	2.09	1036	2.32	1084	2.54	1130	2.77
3000	952	2.08	1004	2.31	1053	2.55	1100	2.79	1145	3.03
3188	972	2.30	1023	2.55	1071	2.80	1118	3.05	1162	3.30
3375	993	2.55	1043	2.81	1090	3.07	1136	3.33	1179	3.59
3563	1014	2.81	1063	3.08	1110	3.36	1154	3.63	1198	3.91
3750	1037	3.09	1084	3.38	1130	3.66	1174	3.95	1216	4.24

NOTE: For more information, see General Fan Performance Notes.

Standard static 518 – 733 RPM, 1.7 BHP max
Medium static 690 – 936 RPM, 2.4 BHP max
High static 838 – 1084 RPM, 3.7 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 48 – 48HC11** **3 PHASE** **10 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	616	0.79	689	0.97	757	1.16	821	1.36	882	1.57
3250	655	0.96	724	1.16	788	1.37	849	1.58	907	1.80
3500	695	1.17	760	1.38	821	1.60	879	1.83	934	2.06
3750	736	1.41	797	1.63	855	1.86	910	2.10	963	2.35
4000	777	1.68	834	1.91	889	2.16	942	2.41	993	2.67
4250	818	1.98	873	2.23	925	2.49	976	2.75	1025	3.02
4500	860	2.32	912	2.58	962	2.85	1010	3.13	1057	3.41
4750	902	2.69	951	2.97	999	3.26	1046	3.55	1091	3.84
5000	944	3.11	991	3.40	1037	3.70	1082	4.00	1125	4.31

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	939	1.79	994	2.01	1047	2.24	1098	2.47	1147	2.71
3250	962	2.03	1015	2.26	1066	2.50	1115	2.75	1163	3.00
3500	987	2.30	1038	2.54	1088	2.80	1135	3.05	1181	3.32
3750	1014	2.60	1063	2.86	1111	3.12	1157	3.39	1202	3.66
4000	1042	2.93	1090	3.20	1136	3.48	1180	3.76	1224	4.04
4250	1072	3.30	1118	3.58	1162	3.87	1205	4.16	1247	4.46
4500	1103	3.70	1147	4.00	1190	4.29	1232	4.60	–	–
4750	1135	4.14	1177	4.45	–	–	–	–	–	–
5000	1167	4.63	–	–	–	–	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 591 – 838 RPM, 2.4 BHP max
Medium static 838 – 1084 RPM, 3.7 BHP max
High static 1022 – 1240 RPM, 4.9 BHP max

Table 49 – 48HC11** **3 PHASE** **10 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	579	0.70	660	0.89	732	1.09	799	1.29	860	1.50
3250	613	0.85	690	1.06	760	1.27	823	1.49	883	1.71
3500	648	1.03	721	1.25	788	1.48	850	1.71	907	1.95
3750	683	1.23	753	1.47	817	1.71	877	1.96	933	2.21
4000	719	1.45	786	1.71	848	1.97	905	2.23	959	2.50
4250	756	1.71	819	1.98	879	2.26	934	2.53	987	2.81
4500	792	1.99	853	2.28	910	2.57	964	2.87	1015	3.16
4750	830	2.31	888	2.62	943	2.92	995	3.23	1044	3.54
5000	867	2.66	923	2.98	976	3.30	1026	3.63	1074	3.95

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	917	1.70	970	1.91	1021	2.13	1070	2.34	1117	2.56
3250	938	1.93	991	2.16	1041	2.38	1089	2.61	1134	2.85
3500	961	2.18	1013	2.42	1062	2.66	1108	2.91	1153	3.15
3750	985	2.46	1035	2.71	1083	2.97	1129	3.23	1173	3.49
4000	1011	2.76	1059	3.03	1106	3.30	1151	3.58	1194	3.85
4250	1037	3.09	1084	3.38	1130	3.66	1174	3.95	1216	4.24
4500	1064	3.46	1110	3.76	1155	4.06	1198	4.36	1239	4.66
4750	1091	3.85	1137	4.16	1180	4.48	–	–	–	–
5000	1120	4.28	1164	4.61	–	–	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 591 – 838 RPM, 2.4 BHP max
Medium static 838 – 1084 RPM, 3.7 BHP max
High static 1022 – 1240 RPM, 4.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 50 – 48HC12** **3 PHASE** **10 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	616	0.79	689	0.97	757	1.16	821	1.36	882	1.57
3250	655	0.96	724	1.16	788	1.37	849	1.58	907	1.80
3500	695	1.17	760	1.38	821	1.60	879	1.83	934	2.06
3750	736	1.41	797	1.63	855	1.86	910	2.10	963	2.35
4000	777	1.68	834	1.91	889	2.16	942	2.41	993	2.67
4250	818	1.98	873	2.23	925	2.49	976	2.75	1025	3.02
4500	860	2.32	912	2.58	962	2.85	1010	3.13	1057	3.41
4750	902	2.69	951	2.97	999	3.26	1046	3.55	1091	3.84
5000	944	3.11	991	3.40	1037	3.70	1082	4.00	1125	4.31

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	939	1.79	994	2.01	1047	2.24	1098	2.47	1147	2.71
3250	962	2.03	1015	2.26	1066	2.50	1115	2.75	1163	3.00
3500	987	2.30	1038	2.54	1088	2.80	1135	3.05	1181	3.32
3750	1014	2.60	1063	2.86	1111	3.12	1157	3.39	1202	3.66
4000	1042	2.93	1090	3.20	1136	3.48	1180	3.76	1224	4.04
4250	1072	3.30	1118	3.58	1162	3.87	1205	4.16	1247	4.46
4500	1103	3.70	1147	4.00	1190	4.29	1232	4.60	–	–
4750	1135	4.14	1177	4.45	–	–	–	–	–	–
5000	1167	4.63	–	–	–	–	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 591 – 838 RPM, 2.4 BHP max
Medium static 838 – 1084 RPM, 3.7 BHP max
High static 1022 – 1240 RPM, 4.9 BHP max

Table 51 – 48HC12** **3 PHASE** **10 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	579	0.70	660	0.89	732	1.09	799	1.29	860	1.50
3250	613	0.85	690	1.06	760	1.27	823	1.49	883	1.71
3500	648	1.03	721	1.25	788	1.48	850	1.71	907	1.95
3750	683	1.23	753	1.47	817	1.71	877	1.96	933	2.21
4000	719	1.45	786	1.71	848	1.97	905	2.23	959	2.50
4250	756	1.71	819	1.98	879	2.26	934	2.53	987	2.81
4500	792	1.99	853	2.28	910	2.57	964	2.87	1015	3.16
4750	830	2.31	888	2.62	943	2.92	995	3.23	1044	3.54
5000	867	2.66	923	2.98	976	3.30	1026	3.63	1074	3.95

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3000	917	1.70	970	1.91	1021	2.13	1070	2.34	1117	2.56
3250	938	1.93	991	2.16	1041	2.38	1089	2.61	1134	2.85
3500	961	2.18	1013	2.42	1062	2.66	1108	2.91	1153	3.15
3750	985	2.46	1035	2.71	1083	2.97	1129	3.23	1173	3.49
4000	1011	2.76	1059	3.03	1106	3.30	1151	3.58	1194	3.85
4250	1037	3.09	1084	3.38	1130	3.66	1174	3.95	1216	4.24
4500	1064	3.46	1110	3.76	1155	4.06	1198	4.36	1239	4.66
4750	1091	3.85	1137	4.16	1180	4.48	–	–	–	–
5000	1120	4.28	1164	4.61	–	–	–	–	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 591 – 838 RPM, 2.4 BHP max
Medium static 838 – 1084 RPM, 3.7 BHP max
High static 1022 – 1240 RPM, 4.9 BHP max

FAN PERFORMANCE (BELT DRIVE) cont.

Table 52 – 48HC14** **3 PHASE** **12.5 TON VERTICAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3438	431	0.59	504	0.81	574	1.08	643	1.40	706	1.74
3750	456	0.71	524	0.95	589	1.22	653	1.54	715	1.90
4063	481	0.86	546	1.11	606	1.39	666	1.71	725	2.07
4375	507	1.03	569	1.30	626	1.59	681	1.91	736	2.27
4688	533	1.22	593	1.51	647	1.81	698	2.13	750	2.49
5000	560	1.44	617	1.74	669	2.05	718	2.39	766	2.75
5313	587	1.68	642	2.00	691	2.33	738	2.67	784	3.04
5625	614	1.95	667	2.29	715	2.63	760	2.99	804	3.36
5938	642	2.25	692	2.60	739	2.97	782	3.34	824	3.72
6250	670	2.58	718	2.95	763	3.33	805	3.72	846	4.11

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3438	763	2.10	815	2.46	862	2.82	905	3.18	946	3.55
3750	772	2.28	825	2.66	873	3.05	918	3.45	959	3.84
4063	781	2.46	834	2.87	883	3.29	929	3.71	971	4.14
4375	790	2.66	843	3.09	892	3.53	938	3.98	982	4.43
4688	801	2.89	852	3.32	901	3.78	947	4.25	991	4.73
5000	814	3.15	863	3.58	910	4.04	956	4.53	999	5.03
5313	830	3.44	875	3.87	920	4.33	965	4.83	1008	5.34
5625	847	3.77	890	4.20	933	4.66	975	5.15	1017	5.67
5938	865	4.13	906	4.56	947	5.03	987	5.52	1028	6.04
6250	885	4.53	924	4.97	962	5.43	1001	5.92	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 440 – 609 RPM, 2.9 BHP max

Medium static 609 – 778 RPM, 3.7 BHP max

High static 776 – 955 RPM, 6.1 BHP max

Table 53 – 48HC14** **3 PHASE** **12.5 TON HORIZONTAL SUPPLY**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3438	421	0.57	493	0.78	561	1.02	627	1.30	688	1.62
3750	445	0.69	512	0.91	576	1.17	638	1.45	697	1.77
4063	470	0.84	533	1.07	593	1.33	651	1.62	707	1.94
4375	496	1.00	555	1.25	612	1.52	666	1.82	720	2.14
4688	522	1.19	579	1.46	632	1.74	683	2.04	734	2.37
5000	549	1.41	602	1.68	653	1.98	702	2.29	750	2.62
5313	576	1.64	627	1.94	675	2.24	721	2.57	767	2.91
5625	603	1.91	652	2.22	698	2.54	742	2.87	786	3.23
5938	630	2.20	677	2.53	721	2.87	764	3.21	805	3.57
6250	657	2.53	702	2.87	745	3.22	786	3.58	826	3.96

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3438	746	1.96	799	2.32	849	2.70	896	3.09	940	3.50
3750	753	2.12	806	2.48	856	2.88	903	3.28	947	3.70
4063	761	2.29	813	2.67	862	3.07	909	3.48	953	3.92
4375	771	2.50	821	2.88	869	3.28	916	3.70	960	4.15
4688	783	2.73	831	3.11	878	3.52	923	3.95	966	4.40
5000	797	2.99	843	3.37	888	3.78	931	4.22	974	4.67
5313	812	3.28	856	3.67	899	4.08	941	4.52	983	4.98
5625	828	3.60	870	3.99	912	4.41	953	4.85	993	5.31
5938	846	3.95	886	4.36	926	4.78	965	5.22	1004	5.69
6250	865	4.35	904	4.75	942	5.18	979	5.63	–	–

NOTE: For more information, see General Fan Performance Notes.

Standard static 440 – 609 RPM, 2.9 BHP max

Medium static 609 – 778 RPM, 3.7 BHP max

High static 776 – 955 RPM, 6.1 BHP max

FAN PERFORMANCE (cont.)

X13 MULTI-SPEED/TORQUE MOTOR

Table 54 – 48HC*A04 Vertical Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	900	0.30	0.19
	975	0.17	0.17
	1050	0.06	0.16
	1125	–	–
	1200	–	–
	1275	–	–
	1350	–	–
	1425	–	–
	1500	–	–
2	900	0.48	0.25
	975	0.34	0.23
	1050	0.20	0.22
	1125	0.07	0.20
	1200	–	–
	1275	–	–
	1350	–	–
	1425	–	–
	1500	–	–
3	900	0.84	0.38
	975	0.69	0.36
	1050	0.53	0.33
	1125	0.38	0.32
	1200	0.24	0.31
	1275	0.10	0.31
	1350	–	–
	1425	–	–
	1500	–	–
4	900	0.99	0.43
	975	0.88	0.43
	1050	0.75	0.43
	1125	0.61	0.43
	1200	0.47	0.42
	1275	0.33	0.40
	1350	0.19	0.38
	1425	–	–
	1500	–	–
5	900	1.10	0.47
	975	1.02	0.49
	1050	0.75	0.51
	1125	0.61	0.54
	1200	0.81	0.56
	1275	0.74	0.58
	1350	0.67	0.61
	1425	0.60	0.63
	1500	0.52	0.66

Table 55 – 48HC*A04 Horizontal Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	900	0.45	0.23
	975	0.33	0.22
	1050	0.22	0.20
	1125	0.12	0.19
	1200	0.05	0.17
	1275	–	–
	1350	–	–
	1425	–	–
	1500	–	–
2	900	0.66	0.30
	975	0.52	0.28
	1050	0.39	0.27
	1125	0.27	0.26
	1200	0.16	0.24
	1275	0.05	0.23
	1350	–	–
	1425	–	–
	1500	–	–
3	900	1.01	0.43
	975	0.88	0.41
	1050	0.73	0.39
	1125	0.59	0.38
	1200	0.46	0.36
	1275	0.33	0.36
	1350	0.21	0.33
	1425	0.09	0.31
	1500	–	–
4	900	1.13	0.46
	975	1.03	0.46
	1050	0.92	0.46
	1125	0.81	0.46
	1200	0.69	0.46
	1275	0.57	0.45
	1350	0.44	0.44
	1425	0.31	0.42
	1500	0.18	0.40
5	900	1.20	0.49
	975	1.14	0.51
	1050	0.92	0.53
	1125	0.81	0.55
	1200	0.95	0.57
	1275	0.90	0.60
	1350	0.84	0.62
	1425	0.78	0.65
	1500	0.72	0.68

FAN PERFORMANCE (cont.)

X13 MULTI-SPEED/TORQUE MOTOR (cont.)

Table 56 – 48HC*A05 Vertical Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	1200	0.38	0.30
	1300	0.24	0.28
	1400	0.12	0.27
	1500	0.01	0.26
	1600	–	–
	1700	–	–
	1800	–	–
	1900	–	–
	2000	–	–
2	1200	0.49	0.34
	1300	0.34	0.32
	1400	0.20	0.31
	1500	0.05	0.29
	1600	–	–
	1700	–	–
	1800	–	–
	1900	–	–
	2000	–	–
3	1200	0.87	0.56
	1300	0.74	0.57
	1400	0.60	0.59
	1500	0.44	0.56
	1600	0.29	0.50
	1700	0.14	0.47
	1800	0.02	0.46
	1900	–	–
	2000	–	–
4	1200	0.93	0.57
	1300	0.83	0.60
	1400	0.72	0.63
	1500	0.60	0.63
	1600	0.48	0.62
	1700	0.35	0.62
	1800	0.21	0.61
	1900	0.06	0.58
	2000	–	–
5	1200	0.97	0.58
	1300	0.89	0.61
	1400	0.72	0.65
	1500	0.60	0.68
	1600	0.64	0.72
	1700	0.55	0.75
	1800	0.46	0.79
	1900	0.35	0.82
	2000	0.25	0.86

Table 57 – 48HC*A05 Horizontal Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	1200	0.49	0.35
	1300	0.34	0.33
	1400	0.20	0.31
	1500	0.06	0.29
	1600	–	–
	1700	–	–
	1800	–	–
	1900	–	–
	2000	–	–
2	1200	0.60	0.40
	1300	0.45	0.38
	1400	0.30	0.36
	1500	0.16	0.34
	1600	0.01	0.32
	1700	–	–
	1800	–	–
	1900	–	–
	2000	–	–
3	1200	0.94	0.59
	1300	0.83	0.61
	1400	0.71	0.63
	1500	0.59	0.61
	1600	0.46	0.59
	1700	0.33	0.56
	1800	0.19	0.53
	1900	0.07	0.49
	2000	–	–
4	1200	0.98	0.59
	1300	0.89	0.62
	1400	0.81	0.65
	1500	0.72	0.66
	1600	0.62	0.67
	1700	0.52	0.68
	1800	0.40	0.68
	1900	0.27	0.66
	2000	0.12	0.61
5	1200	1.02	0.60
	1300	0.95	0.63
	1400	0.81	0.67
	1500	0.72	0.70
	1600	0.74	0.74
	1700	0.67	0.78
	1800	0.59	0.82
	1900	0.51	0.86
	2000	0.42	0.89

FAN PERFORMANCE (cont.)

X13 MULTI-SPEED/TORQUE MOTOR (cont.)

Table 58 – 48HC*A06 Vertical Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	1500	0.27	0.45
	1625	0.08	0.43
	1750	–	–
	1875	–	–
	2000	–	–
	2125	–	–
	2250	–	–
	2375	–	–
	2500	–	–
2	1500	0.48	0.57
	1625	0.26	0.55
	1750	0.08	0.53
	1875	–	–
	2000	–	–
	2125	–	–
	2250	–	–
	2375	–	–
	2500	–	–
3	1500	0.91	0.82
	1625	0.72	0.82
	1750	0.52	0.81
	1875	0.31	0.78
	2000	0.11	0.77
	2125	–	–
	2250	–	–
	2375	–	–
	2500	–	–
4	1500	0.98	0.85
	1625	0.82	0.89
	1750	0.66	0.92
	1875	0.50	0.90
	2000	0.32	0.92
	2125	0.13	0.86
	2250	–	–
	2375	–	–
	2500	–	–
5	1500	1.00	–
	1625	0.86	0.91
	1750	0.66	0.95
	1875	0.50	0.98
	2000	0.41	1.01
	2125	0.25	0.88
	2250	0.06	1.01
	2375	–	–
	2500	–	–

Table 59 – 48HC*A06 Horizontal Unit-Direct Drive

Speed (Torque) Tap	CFM	ESP	BHP
1	1500	0.40	0.50
	1625	0.20	0.48
	1750	0.04	0.45
	1875	–	–
	2000	–	–
	2125	–	–
	2250	–	–
	2375	–	–
	2500	–	–
2	1500	0.62	0.62
	1625	0.39	0.60
	1750	0.19	0.57
	1875	0.03	0.53
	2000	–	–
	2125	–	–
	2250	–	–
	2375	–	–
	2500	–	–
3	1500	1.04	0.87
	1625	0.87	0.88
	1750	0.68	0.88
	1875	0.48	0.84
	2000	0.28	0.84
	2125	0.07	0.84
	2250	–	–
	2375	–	–
	2500	–	–
4	1500	1.10	0.90
	1625	0.96	0.94
	1750	0.81	0.98
	1875	0.65	0.95
	2000	0.47	1.00
	2125	0.27	0.94
	2250	0.05	0.96
	2375	–	–
	2500	–	–
5	1500	1.12	0.92
	1625	1.00	0.96
	1750	0.81	1.00
	1875	0.65	1.04
	2000	0.56	1.08
	2125	0.39	0.95
	2250	0.19	1.09
	2375	–	–
	2500	–	–

FAN PERFORMANCE (cont.)

Table 60 – PULLEY ADJUSTMENT

UNIT		Motor/Drive Combo	Motor Pulley turns open										
			0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
04	1 Phase	Standard Static	854	825	795	766	736	707	678	648	619	589	560
		Medium Static	1175	1135	1094	1054	1013	973	932	892	851	811	770
	3 Phase	Standard Static*	854	825	795	766	736	707	678	648	619	589	560
		Medium Static*	1175	1135	1094	1054	1013	973	932	892	851	811	770
		High Static	1466	1423	1380	1337	1294	1251	1207	1164	1121	1078	1035
05	1 Phase	Standard Static	854	825	795	766	736	707	678	648	619	589	560
		Medium Static	1175	1135	1094	1054	1013	973	932	892	851	811	770
	3 Phase	Standard Static*	854	825	795	766	736	707	678	648	619	589	560
		Medium Static*	1175	1135	1094	1054	1013	973	932	892	851	811	770
		Medium Static	1303	1265	1226	1188	1150	1112	1073	1035	997	958	920
		High Static	1639	1596	1553	1510	1467	1424	1380	1337	1294	1251	1208
06	1 Phase	Standard Static	1175	1135	1094	1054	1013	973	932	892	851	811	770
		Medium Static	1466	1423	1380	1337	1294	1251	1207	1164	1121	1078	1035
	3 Phase	Standard Static*	1175	1135	1094	1054	1013	973	932	892	851	811	770
		Medium Static*	1466	1423	1380	1337	1294	1251	1207	1164	1121	1078	1035
		High Static	1687	1649	1610	1572	1533	1495	1457	1418	1380	1341	1303
07	3 Phase	Standard Static	747	721	695	670	644	618	592	566	541	515	489
		Medium Static	949	927	906	884	863	841	819	798	776	755	733
		High Static	1102	1083	1063	1044	1025	1006	986	967	948	928	909
08	3 Phase	Standard Static	733	712	690	669	647	626	604	583	561	540	518
		Medium Static	936	911	887	862	838	813	788	764	739	715	690
		High Static	1084	1059	1035	1010	986	961	936	912	887	863	838
09	3 Phase	Standard Static	733	712	690	669	647	626	604	583	561	540	518
		Medium Static	936	911	887	862	838	813	788	764	739	715	690
		High Static	1084	1059	1035	1010	986	961	936	912	887	863	838
11	3 Phase	Standard Static	838	813	789	764	739	715	690	665	640	616	591
		Medium Static	1084	1059	1035	1010	986	961	936	912	887	863	838
		High Static	1240	1218	1196	1175	1153	1131	1109	1087	1066	1044	1022
12	3 Phase	Standard Static	838	813	789	764	739	715	690	665	640	616	591
		Medium Static	1084	1059	1035	1010	986	961	936	912	887	863	838
		High Static	1240	1218	1196	1175	1153	1131	1109	1087	1066	1044	1022
14	3 Phase	Standard Static	609	592	575	558	541	525	508	491	474	457	440
		Medium Static	778	761	744	727	710	694	677	660	643	626	609
		High Static	955	973	951	929	907	886	864	842	820	798	776

– Factory settings

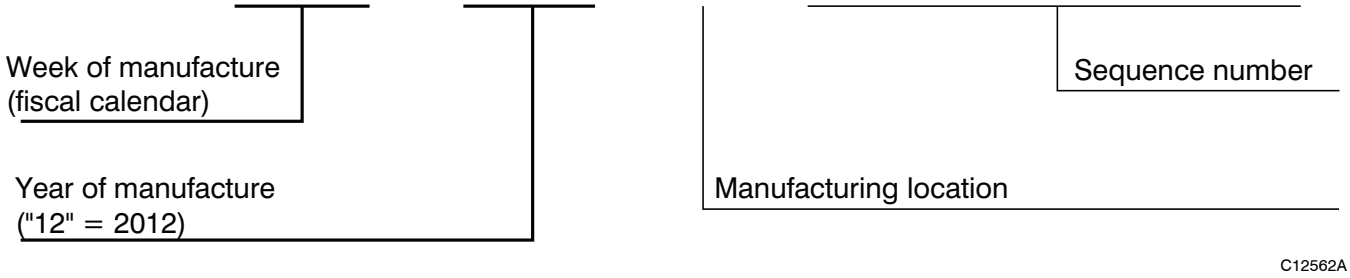
* Humidi–MiZer models only

ELECTRICAL DATA FOR UNITS PRODUCED ON OR AFTER JULY 30, 2012

NOTE: Check the serial number of unit to verify production date.

To confirm the date of manufacture, locate the unit nameplate and check the first four digits of the Serial Number. If the number listed in the first 4 digits of the Serial Number is 3112 or higher, the unit was produced on or after July 30, 2012.

Position:	1	2	3	4	5	6	7	8	9	10
Example:	3	1	1	2	U	1	2	3	4	5



C12562A

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012)

Table 61 – 48HC04 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	16.6	79	190	1.0	DD–STD	78%	7.4
					190	1.0	STD	67%	4.9
					190	1.0	MED	67%	4.9
230–1–60	187	253	16.6	79	190	1.0	DD–STD	78%	7.4
					190	1.0	STD	67%	4.9
					190	1.0	MED	67%	4.9
208–3–60	187	253	10.4	73	190	1.0	DD–STD	78%	7.4
					190	1.0	STD	75%	5.2
					190	1.0	MED	75%	5.2
					190	1.0	HIGH	87%	6.9
230–3–60	187	253	10.4	73	190	1.0	DD–STD	78%	7.4
					190	1.0	STD	75%	5.2
					190	1.0	MED	75%	5.2
					190	1.0	HIGH	87%	6.7
460–3–60	414	506	5.8	38	190	0.5	DD–STD	78%	4.0
					190	0.5	STD	75%	2.6
					190	0.5	MED	75%	2.6
					190	0.5	HIGH	87%	3.4
575–3–60	518	633	3.8	37	190	0.5	DD–STD	78%	4.0
					190	0.5	STD	73%	1.2
					190	0.5	MED	73%	1.2
					190	0.5	HIGH	78%	2.0

Table 62 – 48HC05 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	21.8	117	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	67%	4.9
					325	1.4	MED	67%	4.9
230–1–60	187	253	21.8	117	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	67%	4.9
					325	1.4	MED	67%	4.9
208–3–60	187	253	13.7	83	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	75%	5.2
					325	1.4	MED	87%	5.2
					325	1.4	HIGH	89%	8.4
230–3–60	187	253	13.7	83	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	75%	5.2
					325	1.4	MED	87%	4.9
					325	1.4	HIGH	89%	8.3
460–3–60	414	506	6.2	41	325	0.9	DD–STD	78%	4.0
					325	0.9	STD	75%	2.6
					325	0.9	MED	87%	2.5
					325	0.9	HIGH	89%	4.2
575–3–60	518	633	4.8	33	325	0.9	DD–STD	78%	4.0
					325	0.9	STD	73%	1.2
					325	0.9	MED	72%	1.6
					325	0.9	HIGH	77%	2.8

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012)

Table 63 – 48HC06 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	25.0	134	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	67%	4.9
					325	1.4	MED	76%	7.0
230–1–60	187	253	25.0	134	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	67%	4.9
					325	1.4	MED	76%	7.0
208–3–60	187	253	15.9	110	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	75%	5.2
					325	1.4	MED	87%	6.9
					325	1.4	HIGH	89%	8.4
230–3–60	187	253	15.9	110	325	1.4	DD–STD	78%	7.4
					325	1.4	STD	75%	5.2
					325	1.4	MED	87%	6.7
					325	1.4	HIGH	89%	8.3
460–3–60	414	506	7.0	52	325	0.9	DD–STD	78%	4.0
					325	0.9	STD	75%	2.6
					325	0.9	MED	87%	3.4
					325	0.9	HIGH	89%	4.2
575–3–60	518	633	5.1	40	325	0.9	DD–STD	78%	4.0
					325	0.9	STD	73%	1.2
					325	0.9	MED	78%	2.0
					325	0.9	HIGH	77%	2.8

Table 64 – 48HC07 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	325	1.5	STD	87%	5.2
					325	1.5	MED	89%	8.4
					325	1.5	HIGH	83%	13.6
230–3–60	187	253	19.0	123	325	1.5	STD	87%	4.9
					325	1.5	MED	89%	8.3
					325	1.5	HIGH	83%	12.7
460–3–60	414	506	9.7	62	325	0.8	STD	87%	2.5
					325	0.8	MED	89%	4.2
					325	0.8	HIGH	83%	6.4
575–3–60	518	633	7.4	50	325	0.6	STD	72%	1.6
					325	0.6	MED	77%	2.8
					325	0.6	HIGH	81%	5.6

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012)

Table 65 – 48HC08** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	87%	5.2
							325	1.5	MED	87%	6.9
							325	1.5	HIGH	87%	10.6
230–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	87%	4.9
							325	1.5	MED	87%	6.7
							325	1.5	HIGH	87%	10.6
460–3–60	414	506	6.1	41	6.1	41	325	0.8	STD	87%	2.5
							325	0.8	MED	87%	3.4
							325	0.8	HIGH	87%	5.3
575–3–60	518	633	4.2	33	4.2	33	325	0.6	STD	72%	1.6
							325	0.6	MED	78%	2
							325	0.6	HIGH	77%	2.8

Table 66 – 48HC09** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	87%	5.2
							325	1.5	MED	87%	6.9
							325	1.5	HIGH	87%	10.6
230–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	87%	4.9
							325	1.5	MED	87%	6.7
							325	1.5	HIGH	87%	10.6
460–3–60	414	506	6.2	41	6.2	41	325	0.8	STD	87%	2.5
							325	0.8	MED	87%	3.4
							325	0.8	HIGH	87%	5.3
575–3–60	518	633	4.8	33	4.8	33	325	0.6	STD	72%	1.6
							325	0.6	MED	78%	2
							325	0.6	HIGH	77%	2.8

Table 67 – 48HC11** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	610	7.4	STD	87%	6.9
							610	7.4	MED	87%	10.6
							610	7.4	HIGH	83%	13.6
230–3–60	187	253	15.9	110	15.9	110	610	7.4	STD	87%	6.7
							610	7.4	MED	87%	10.6
							610	7.4	HIGH	83%	12.7
460–3–60	414	506	7.0	52	7.0	52	610	3.6	STD	87%	3.4
							610	3.6	MED	87%	5.3
							610	3.6	HIGH	83%	6.4
575–3–60	518	633	5.1	40	5.1	40	610	3.6	STD	78%	2
							610	3.6	MED	77%	2.8
							610	3.6	HIGH	81%	5.6

ELECTRICAL INFORMATION
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Table 68 – 48HC12** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	87%	6.9
							1070	6.2	MED	87%	10.6
							1070	6.2	HIGH	83%	13.6
230–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	87%	6.7
							1070	6.2	MED	87%	10.6
							1070	6.2	HIGH	83%	12.7
460–3–60	414	506	7.7	52	7.7	52	1070	3.1	STD	87%	3.4
							1070	3.1	MED	87%	5.3
							1070	3.1	HIGH	83%	6.4
575–3–60	518	633	5.7	39	5.7	39	1070	2.5	STD	78%	2
							1070	2.5	MED	77%	2.8
							1070	2.5	HIGH	81%	5.6

Table 69 – 48HC14** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	89%	8.4
							280	1.5	MED	87%	10.6
							280	1.5	HIGH	90%	20.4
230–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	89%	8.3
							280	1.5	MED	87%	10.6
							280	1.5	HIGH	90%	20.4
460–3–60	414	506	9.7	62	9.7	62	280	0.8	STD	89%	4.2
							280	0.8	MED	87%	5.3
							280	0.8	HIGH	90%	10.2
575–3–60	518	633	7.4	50	7.4	50	280	0.7	STD	77%	2.8
							280	0.7	MED	77%	2.8
							280	0.7	HIGH	94%	9

ELECTRICAL INFORMATION
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Table 70 – 48HC08** **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	84%	5.8
							325	1.5	MED	77%	7.1
							325	1.5	HIGH	82%	10.8
230–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	84%	5.6
							325	1.5	MED	77%	6.8
							325	1.5	HIGH	82%	9.8
460–3–60	414	506	6.1	41	6.1	41	325	0.8	STD	79%	2.9
							325	0.8	MED	77%	3.8
							325	0.8	HIGH	82%	4.9
575–3–60	518	633	4.2	33	4.2	33	325	0.6	STD	81%	2.8
							325	0.6	MED	80%	3.5
							325	0.6	HIGH	84%	4.5

Table 71 – 48HC09** **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	84%	5.8
							325	1.5	MED	77%	7.1
							325	1.5	HIGH	82%	10.8
230–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	84%	5.6
							325	1.5	MED	77%	6.8
							325	1.5	HIGH	82%	9.8
460–3–60	414	506	6.2	41	6.2	41	325	0.8	STD	79%	2.9
							325	0.8	MED	77%	3.8
							325	0.8	HIGH	82%	4.9
575–3–60	518	633	4.8	33	4.8	33	325	0.6	STD	81%	2.8
							325	0.6	MED	80%	3.5
							325	0.6	HIGH	84%	4.5

Table 72 – 48HC11** **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	610	7.4	STD	77%	7.1
							610	7.4	MED	82%	10.8
							610	7.4	HIGH	84%	13.6
230–3–60	187	253	15.9	110	15.9	110	610	7.4	STD	77%	6.8
							610	7.4	MED	82%	9.8
							610	7.4	HIGH	84%	12.7
460–3–60	414	506	7.0	52	7.0	52	610	3.6	STD	77%	3.8
							610	3.6	MED	82%	4.9
							610	3.6	HIGH	84%	6.4
575–3–60	518	633	5.1	40	5.1	40	610	3.6	STD	80%	3.5
							610	3.6	MED	84%	4.5
							610	3.6	HIGH	83%	6.2

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012)

Table 73 – 48HC12** **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	77%	7.1
							1070	6.2	MED	82%	10.8
							1070	6.2	HIGH	84%	13.6
230–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	77%	6.8
							1070	6.2	MED	82%	9.8
							1070	6.2	HIGH	84%	12.7
460–3–60	414	506	7.7	52	7.7	52	1070	3.1	STD	77%	3.8
							1070	3.1	MED	82%	4.9
							1070	3.1	HIGH	84%	6.4
575–3–60	518	633	5.7	39	5.7	39	1070	2.5	STD	80%	3.5
							1070	2.5	MED	84%	4.5
							1070	2.5	HIGH	83%	6.2

Table 74 – 48HC14** **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	85%	8.6
							280	1.5	MED	82%	10.8
							280	1.5	HIGH	90%	20.4
230–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	85%	7.8
							280	1.5	MED	82%	9.8
							280	1.5	HIGH	90%	20.4
460–3–60	414	506	9.7	62	9.7	62	280	0.8	STD	85%	3.8
							280	0.8	MED	82%	4.9
							280	0.8	HIGH	90%	10.2
575–3–60	518	633	7.4	50	7.4	50	280	0.7	STD	84%	4.5
							280	0.7	MED	84%	4.5
							280	0.7	HIGH	94%	9

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 75 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A04	208/230–1–60	DD–STD	30	45	29	88	32	45	31	90	34	50	34	93	36	50	36	95
		STD	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
		MED	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
	208/230–3–60	DD–STD	22	30	22	82	24	30	24	84	27	30	27	87	29	35	29	89
		STD	20	25	19	94	22	30	21	96	24	30	25	99	26	30	27	101
		MED	20	25	19	94	22	30	21	96	24	30	25	99	26	30	27	101
		HIGH	21/21	30/30	21/21	132	23/23	30/30	23/23	134	26/26	30/30	27/26	137	28/28	35/35	29/29	139
	460–3–60	DD–STD	12	15	12	43	13	15	13	44	14	20	14	45	15	20	16	46
		STD	11	15	10	48	12	15	11	49	13	15	13	50	14	20	14	51
		MED	11	15	10	48	12	15	11	49	13	15	13	50	14	20	14	51
		HIGH	12	15	11	67	13	15	12	68	14	15	14	69	15	20	15	70
	575–3–60	DD–STD	10	15	10	42	12	15	12	44	11	15	12	44	13	15	14	46
		STD	7	15	6	45	9	15	9	47	9	15	8	47	11	15	10	49
		MED	7	15	6	45	9	15	9	47	9	15	8	47	11	15	10	49
		HIGH	8	15	7	49	10	15	9	51	9	15	9	51	11	15	11	53
48HC*A05	208/230–1–60	DD–STD	37	50	35	127	38	50	37	129	41	60	41	132	43	60	43	134
		STD	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
		MED	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
	208/230–3–60	DD–STD	26	30	26	93	28	40	28	95	31	40	31	98	33	45	34	100
		STD	24	30	23	105	26	30	26	107	29	40	29	110	31	40	31	112
		MED	24/24	30/30	23/23	122	26/26	30/30	26/25	124	29/29	40/40	29/29	127	31/31	40/40	31/31	129
		HIGH	27/27	40/40	27/27	158	29/29	40/40	29/29	160	32/32	45/45	33/32	163	34/34	45/45	35/35	165
	460–3–60	DD–STD	13	15	13	47	14	20	14	48	15	20	15	49	16	20	16	50
		STD	12	15	11	52	13	15	12	53	14	20	14	54	15	20	15	55
		MED	12	15	11	61	13	15	12	62	14	15	14	63	15	20	15	64
		HIGH	13	15	13	79	14	20	14	80	16	20	16	81	17	20	17	82
	575–3–60	DD–STD	11	15	11	39	13	15	13	41	13	15	13	41	15	20	15	43
		STD	9	15	8	42	10	15	10	44	10	15	10	44	12	15	12	46
		MED	9	15	8	42	11	15	11	44	11	15	10	44	13	15	13	46
		HIGH	10	15	10	57	12	15	12	59	12	15	12	59	14	15	14	61

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 75 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A06	208/230–1–60	DD–STD	41	60	39	144	42	60	41	146	45	60	44	149	47	60	47	151
		STD	38	60	36	149	40	60	38	151	43	60	42	154	45	60	44	156
		MED	40	60	38	174	42	60	41	176	45	60	44	179	47	60	46	181
	208/230–3–60	DD–STD	29	40	28	120	31	45	31	122	34	45	34	125	36	50	36	127
		STD	27	40	26	132	29	40	28	134	32	45	31	137	34	45	34	139
		MED	29/28	40/40	28/28	170	31/30	45/45	30/30	172	33/33	45/45	33/33	175	35/35	50/50	36/35	177
		HIGH	30/30	45/45	30/29	185	32/32	45/45	32/32	187	35/35	50/50	35/35	190	37/37	50/50	37/37	192
	460–3–60	DD–STD	14	20	14	58	15	20	15	59	16	20	16	60	17	20	17	61
		STD	13	15	12	63	14	20	13	64	15	20	15	65	16	20	16	66
		MED	14	20	13	82	15	20	14	83	16	20	16	84	17	20	17	85
		HIGH	14	20	14	90	15	20	15	91	17	20	16	92	18	20	18	93
	575–3–60	DD–STD	12	15	12	46	14	15	14	48	13	15	13	48	15	20	16	50
		STD	9	15	8	49	11	15	10	51	11	15	10	51	13	15	12	53
		MED	10	15	9	53	12	15	11	55	11	15	11	55	13	15	13	57
		HIGH	11	15	10	64	12	15	12	66	12	15	12	66	14	15	14	68
48HC*A07	208/230–3–60	STD	32/32	50/50	31/31	165	36/36	50/50	36/35	169	37/37	50/50	37/36	170	41/41	50/50	41/41	174
		MED	36/36	50/50	35/35	201	39/39	50/50	39/39	205	40/40	50/50	40/40	206	44/44	60/60	45/45	210
		HIGH	41/40	50/50	41/40	217	45/44	60/60	45/44	221	46/45	60/60	46/45	222	49/49	60/60	51/50	226
	460–3–60	STD	17	25	16	84	18	25	18	86	19	25	18	86	21	25	20	88
		MED	18	25	18	102	20	25	20	104	21	25	20	104	22	30	22	106
		HIGH	21	25	20	110	22	30	22	112	23	30	23	112	25	30	25	114
	575–3–60	STD	13	15	12	61	16	20	16	65	14	20	14	63	18	20	18	67
		MED	14	20	13	76	18	20	17	80	15	20	15	78	19	25	19	82
		HIGH	17	20	16	90	20	25	21	94	18	25	18	92	22	25	23	96
48HC*D08	208/230–3–60	STD	39/39	50/50	41/40	208	43/43	50/50	45/45	212	44/44	50/50	46/46	213	48/48	60/60	51/50	217
		MED	41/41	50/50	43/42	229	45/45	50/50	47/47	233	46/46	50/50	48/48	234	50/49	60/60	53/52	238
		HIGH	45	50	47	258	48	60	51	262	49	60	52	263	53	60	57	267
	460–3–60	STD	18	20	19	104	20	25	21	106	20	25	21	106	22	25	23	108
		MED	19	25	20	114	21	25	22	116	21	25	22	116	23	25	24	118
		HIGH	21	25	22	129	23	25	24	131	23	25	24	131	25	30	27	133
	575–3–60	STD	13	15	13	77	17	20	17	81	14	15	15	79	18	20	19	83
		MED	13	15	13	81	17	20	18	85	15	20	15	83	19	20	20	87
		HIGH	14	15	14	92	18	20	19	96	16	20	16	94	19	25	21	98

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 75 - UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D09	208/230–3–60	STD	39/39	50/50	41/41	208	43/43	50/50	45/45	212	44/44	50/50	46/46	213	48/48	60/60	51/50	217
		MED	41/41	50/50	43/43	229	45/45	50/50	47/47	233	46/46	50/50	48/48	234	50/50	60/60	53/53	238
		HIGH	45	50	47	258	49	60	52	262	50	60	53	263	53	60	57	267
	460–3–60	STD	19	20	19	104	20	25	21	106	21	25	22	106	23	25	24	108
		MED	19	25	20	114	21	25	22	116	22	25	23	116	23	25	25	118
		HIGH	21	25	22	129	23	25	24	131	24	25	25	131	25	30	27	133
	575–3–60	STD	14	15	14	77	18	20	19	81	16	20	16	79	20	25	21	83
		MED	14	20	15	81	18	20	19	85	16	20	17	83	20	25	21	87
		HIGH	15	20	16	92	19	20	20	96	17	20	18	94	21	25	22	98
48HC*D11	208/230–3–60	STD	51/50	60/60	53/53	284	54/54	60/60	57/57	288	55/55	60/60	59/58	289	59/59	70/70	63/63	293
		MED	54	60	57	313	58	70	62	317	59	70	63	318	63	70	67	322
		HIGH	57/56	70/60	61/60	315	61/60	70/70	65/64	319	62/61	70/70	66/65	320	66/65	80/80	71/70	324
	460–3–60	STD	23	25	24	136	25	30	26	138	25	30	27	138	27	30	29	140
		MED	25	30	26	151	27	30	28	153	27	30	29	153	29	35	31	155
		HIGH	26	30	28	152	28	30	30	154	28	30	30	154	30	35	32	156
	575–3–60	STD	18	20	18	95	21	25	23	99	19	25	20	97	23	25	24	101
		MED	18	20	19	106	22	25	23	110	20	25	21	108	24	25	25	112
		HIGH	21	25	22	120	25	30	27	124	23	25	24	122	27	30	29	126
48HC*D12	208/230–3–60	STD	49/49	60/60	52/51	309	53/53	60/60	56/56	313	54/54	60/60	57/57	314	58/58	70/70	62/61	318
		MED	53	60	56	338	57	70	60	342	58	70	61	343	62	70	66	347
		HIGH	56/55	60/60	59/58	340	60/59	70/70	64/63	344	61/60	70/70	65/64	345	65/64	80/70	69/68	349
	460–3–60	STD	24	30	25	148	26	30	27	150	26	30	28	150	28	30	30	152
		MED	26	30	27	163	28	30	29	165	28	30	30	165	30	35	32	167
		HIGH	27	30	29	164	29	35	31	166	29	35	31	166	31	35	33	168
	575–3–60	STD	18	20	18	105	22	25	23	109	19	25	20	107	23	25	25	111
		MED	19	20	19	116	22	25	24	120	20	25	21	118	24	30	26	122
		HIGH	21	25	22	130	25	30	27	134	23	25	24	132	27	30	29	136
48HC*D14	208/230–3–60	STD	56/56	70/70	59/58	330	60/60	70/70	63/63	334	61/61	70/70	64/64	335	65/65	80/80	68/68	339
		MED	58	70	61	344	62	80	65	348	63	80	67	349	67	80	71	353
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	29	35	30	166	31	35	32	168	31	40	32	168	33	40	35	170
		MED	30	35	31	173	32	40	33	175	32	40	34	175	34	40	36	177
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		MED	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 76 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A04	208/230–1–60	DD–STD	30	45	29	88	32	45	31	90	34	50	34	93	36	50	36	95
		STD	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
		MED	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
	208/230–3–60	DD–STD	22	30	22	82	24	30	24	84	27	30	27	87	29	35	29	89
		STD	20	25	19	94	22	30	21	96	24	30	25	99	26	30	27	101
		MED	20	25	19	94	22	30	21	96	24	30	25	99	26	30	27	101
		HIGH	21/21	30/30	21/21	132	23/23	30/30	23/23	134	26/26	30/30	27/26	137	28/28	35/35	29/29	139
	460–3–60	DD–STD	12	15	12	43	13	15	13	44	14	20	14	45	15	20	16	46
		STD	11	15	10	48	12	15	11	49	13	15	13	50	14	20	14	51
		MED	11	15	10	48	12	15	11	49	13	15	13	50	14	20	14	51
		HIGH	12	15	11	67	13	15	12	68	14	15	14	69	15	20	15	70
	575–3–60	DD–STD	10	15	10	42	12	15	12	44	11	15	12	44	13	15	14	46
		STD	7	15	6	45	9	15	9	47	9	15	8	47	11	15	10	49
		MED	7	15	6	45	9	15	9	47	9	15	8	47	11	15	10	49
		HIGH	8	15	7	49	10	15	9	51	9	15	9	51	11	15	11	53
48HC*A05	208/230–1–60	DD–STD	37	50	35	127	38	50	37	129	41	60	41	132	43	60	43	134
		STD	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
		MED	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
	208/230–3–60	DD–STD	26	30	26	93	28	40	28	95	31	40	31	98	33	45	34	100
		STD	24	30	23	105	26	30	26	107	29	40	29	110	31	40	31	112
		MED	24/24	30/30	23/23	122	26/26	30/30	26/25	124	29/29	40/40	29/29	127	31/31	40/40	31/31	129
		HIGH	27/27	40/40	27/27	158	29/29	40/40	29/29	160	32/32	45/45	33/32	163	34/34	45/45	35/35	165
	460–3–60	DD–STD	13	15	13	47	14	20	14	48	15	20	15	49	16	20	16	50
		STD	12	15	11	52	13	15	12	53	14	20	14	54	15	20	15	55
		MED	12	15	11	61	13	15	12	62	14	15	14	63	15	20	15	64
		HIGH	13	15	13	79	14	20	14	80	16	20	16	81	17	20	17	82
	575–3–60	DD–STD	11	15	11	39	13	15	13	41	13	15	13	41	15	20	15	43
		STD	9	15	8	42	10	15	10	44	10	15	10	44	12	15	12	46
		MED	9	15	8	42	11	15	11	44	11	15	10	44	13	15	13	46
		HIGH	10	15	10	57	12	15	12	59	12	15	12	59	14	15	14	61

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 76 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A06	208/230–1–60	DD–STD	41	60	39	144	42	60	41	146	45	60	44	149	47	60	47	151
		STD	38	60	36	149	40	60	38	151	43	60	42	154	45	60	44	156
		MED	40	60	38	174	42	60	41	176	45	60	44	179	47	60	46	181
	208/230–3–60	DD–STD	29	40	28	120	31	45	31	122	34	45	34	125	36	50	36	127
		STD	27	40	26	132	29	40	28	134	32	45	31	137	34	45	34	139
		MED	29/29	40/40	28/28	170	31/31	45/45	30/30	172	33/33	45/45	33/33	175	35/35	50/50	36/35	177
		HIGH	30/30	45/45	30/29	185	32/32	45/45	32/32	187	35/35	50/50	35/35	190	37/37	50/50	37/37	192
	460–3–60	DD–STD	14	20	14	58	15	20	15	59	16	20	16	60	17	20	17	61
		STD	13	15	12	63	14	20	13	64	15	20	15	65	16	20	16	66
		MED	14	20	13	82	15	20	14	83	16	20	16	84	17	20	17	85
		HIGH	14	20	14	90	15	20	15	91	17	20	16	92	18	20	18	93
	575–3–60	DD–STD	12	15	12	46	14	15	14	48	13	15	13	48	15	20	16	50
		STD	9	15	8	49	11	15	10	51	11	15	10	51	13	15	12	53
		MED	10	15	9	53	12	15	11	55	11	15	11	55	13	15	13	57
		HIGH	11	15	10	64	12	15	12	66	12	15	12	66	14	15	14	68
48HC*A07	208/230–3–60	STD	32/32	50/50	31/31	165	36/36	50/50	36/35	169	37/37	50/50	37/36	170	41/41	50/50	41/41	174
		MED	36/36	50/50	35/35	201	39/39	50/50	39/39	205	40/40	50/50	40/40	206	44/44	60/60	45/45	210
		HIGH	41/41	50/50	41/40	217	45/45	60/60	45/44	221	46/46	60/60	46/45	222	49/49	60/60	51/50	226
	460–3–60	STD	17	25	16	84	18	25	18	86	19	25	18	86	21	25	20	88
		MED	18	25	18	102	20	25	20	104	21	25	20	104	22	30	22	106
		HIGH	21	25	20	110	22	30	22	112	23	30	23	112	25	30	25	114
	575–3–60	STD	13	15	12	61	16	20	16	65	14	20	14	63	18	20	18	67
		MED	14	20	13	76	18	20	17	80	15	20	15	78	19	25	19	82
		HIGH	17	20	16	90	20	25	21	94	18	25	18	92	22	25	23	96
48HC*D08	208/230–3–60	STD	39/39	50/50	41/40	208	43/43	50/50	45/45	212	44/44	50/50	46/46	213	48/48	60/60	51/50	217
		MED	41/41	50/50	43/42	229	45/45	50/50	47/47	233	46/46	50/50	48/48	234	50/50	60/60	53/52	238
		HIGH	45	50	47	258	48	60	51	262	49	60	52	263	53	60	57	267
	460–3–60	STD	18	20	19	104	20	25	21	106	20	25	21	106	22	25	23	108
		MED	19	25	20	114	21	25	22	116	21	25	22	116	23	25	24	118
		HIGH	21	25	22	129	23	25	24	131	23	25	24	131	25	30	27	133
	575–3–60	STD	13	15	13	77	17	20	17	81	14	15	15	79	18	20	19	83
		MED	13	15	13	81	17	20	18	85	15	20	15	83	19	20	20	87
		HIGH	14	15	14	92	18	20	19	96	16	20	16	94	19	25	21	98

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 76 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D09	208/230–3–60	STD	39/39	50/50	41/41	208	43/43	50/50	45/45	212	44/44	50/50	46/46	213	48/48	60/60	51/50	217
		MED	41/41	50/50	43/43	229	45/45	50/50	47/47	233	46/46	50/50	48/48	234	50/50	60/60	53/53	238
		HIGH	45	50	47	258	49	60	52	262	50	60	53	263	53	60	57	267
	460–3–60	STD	19	20	19	104	20	25	21	106	21	25	22	106	23	25	24	108
		MED	19	25	20	114	21	25	22	116	22	25	23	116	23	25	25	118
		HIGH	21	25	22	129	23	25	24	131	24	25	25	131	25	30	27	133
	575–3–60	STD	14	15	14	77	18	20	19	81	16	20	16	79	20	25	21	83
		MED	14	20	15	81	18	20	19	85	16	20	17	83	20	25	21	87
		HIGH	15	20	16	92	19	20	20	96	17	20	18	94	21	25	22	98
48HC*D11	208/230–3–60	STD	51/51	60/60	53/53	284	54/54	60/60	57/57	288	55/55	60/60	59/58	289	59/59	70/70	63/63	293
		MED	54	60	57	313	58	70	62	317	59	70	63	318	63	70	67	322
		HIGH	57/57	70/70	61/60	315	61/61	70/70	65/64	319	62/62	70/70	66/65	320	66/66	80/80	71/70	324
	460–3–60	STD	23	25	24	136	25	30	26	138	25	30	27	138	27	30	29	140
		MED	25	30	26	151	27	30	28	153	27	30	29	153	29	35	31	155
		HIGH	26	30	28	152	28	30	30	154	28	30	30	154	30	35	32	156
	575–3–60	STD	18	20	18	95	21	25	23	99	19	25	20	97	23	25	24	101
		MED	18	20	19	106	22	25	23	110	20	25	21	108	24	25	25	112
		HIGH	21	25	22	120	25	30	27	124	23	25	24	122	27	30	29	126
48HC*D12	208/230–3–60	STD	49/49	60/60	52/51	309	53/53	60/60	56/56	313	54/54	60/60	57/57	314	58/58	70/70	62/61	318
		MED	53	60	56	338	57	70	60	342	58	70	61	343	62	70	66	347
		HIGH	56/56	60/60	59/58	340	60/60	70/70	64/63	344	61/61	70/70	65/64	345	65/65	80/80	69/68	349
	460–3–60	STD	24	30	25	148	26	30	27	150	26	30	28	150	28	30	30	152
		MED	26	30	27	163	28	30	29	165	28	30	30	165	30	35	32	167
		HIGH	27	30	29	164	29	35	31	166	29	35	31	166	31	35	33	168
	575–3–60	STD	18	20	18	105	22	25	23	109	19	25	20	107	23	25	25	111
		MED	19	20	19	116	22	25	24	120	20	25	21	118	24	30	26	122
		HIGH	21	25	22	130	25	30	27	134	23	25	24	132	27	30	29	136
48HC*D14	208/230–3–60	STD	56/56	70/70	59/58	330	60/60	70/70	63/63	334	61/61	70/70	64/64	335	65/65	80/80	68/68	339
		MED	58	70	61	344	62	80	65	348	63	80	67	349	67	80	71	353
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	29	35	30	166	31	35	32	168	31	40	32	168	33	40	35	170
		MED	30	35	31	173	32	40	33	175	32	40	34	175	34	40	36	177
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		MED	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 77 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED 2 SPEED INDOOR FAN OPTION

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D08	208/230–3–60	STD	40/40	50/50	41/41	195	44/43	50/50	46/46	199	45/44	50/50	47/47	200	48/48	60/60	51/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	48/48	204	50/49	60/60	53/52	208
		HIGH	45/44	50/50	47/46	249	49/48	60/60	52/50	253	50/49	60/60	53/52	254	53/52	60/60	57/56	258
	460–3–60	STD	19	20	19	97	20	25	21	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	21	25	22	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	22	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	14	15	14	79	18	20	19	83	16	20	16	81	19	25	21	85
		MED	15	20	15	83	18	20	19	87	16	20	17	85	20	25	21	89
		HIGH	16	20	16	92	19	25	21	96	17	20	18	94	21	25	23	98
48HC*D09	208/230–3–60	STD	40/40	50/50	42/41	195	44/44	50/50	46/46	199	45/45	50/50	47/47	200	49/48	60/60	52/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	49/48	204	50/50	60/60	53/53	208
		HIGH	45/44	50/50	47/46	249	49/48	60/60	52/51	253	50/49	60/60	53/52	254	54/53	60/60	57/56	258
	460–3–60	STD	19	25	19	97	21	25	22	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	22	25	23	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	23	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	15	20	16	79	19	20	20	83	17	20	18	81	21	25	22	85
		MED	16	20	16	83	20	25	21	87	18	20	18	85	21	25	23	89
		HIGH	17	20	18	92	21	25	22	96	19	20	20	94	22	25	24	98
48HC*D11	208/230–3–60	STD	51/50	60/60	53/53	254	55/54	60/60	58/57	258	56/55	60/60	59/58	259	59/59	70/70	63/63	263
		MED	54/53	60/60	58/56	304	58/57	70/70	62/61	308	59/58	70/70	63/62	309	63/62	70/70	67/66	313
		HIGH	57/56	70/60	61/60	315	61/60	70/70	65/64	319	62/61	70/70	66/65	320	66/65	80/80	71/70	324
	460–3–60	STD	24	30	25	122	25	30	27	124	26	30	27	124	28	30	29	126
		MED	25	30	26	147	27	30	28	149	27	30	28	149	29	35	30	151
		HIGH	26	30	28	152	28	30	30	154	28	30	30	154	30	35	32	156
	575–3–60	STD	19	20	20	97	23	25	24	101	21	25	22	99	25	30	26	103
		MED	20	25	21	106	24	25	25	110	22	25	23	108	26	30	27	112
		HIGH	22	25	23	120	26	30	27	124	24	25	25	122	28	30	29	126

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 77 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED 2 SPEED INDOOR FAN OPTION (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D12	208/230–3–60	STD	50/49	60/60	52/52	279	53/53	60/60	56/56	283	54/54	60/60	57/57	284	58/58	70/70	62/61	288
		MED	53/52	60/60	56/55	329	57/56	70/60	60/59	333	58/57	70/70	62/60	334	62/61	70/70	66/65	338
		HIGH	56/55	60/60	59/58	340	60/59	70/70	64/63	344	61/60	70/70	65/64	345	65/64	80/70	69/68	349
	460–3–60	STD	25	30	26	134	26	30	28	136	27	30	28	136	29	35	30	138
		MED	26	30	27	159	28	30	29	161	28	30	29	161	30	35	32	163
		HIGH	27	30	29	164	29	35	31	166	29	35	31	166	31	35	33	168
	575–3–60	STD	19	25	20	107	23	25	24	111	21	25	22	109	25	30	26	113
		MED	20	25	21	116	24	30	26	120	22	25	23	118	26	30	27	122
		HIGH	22	25	23	130	26	30	27	134	24	25	25	132	28	30	29	136
48HC*D14	208/230–3–60	STD	56/56	70/60	59/58	311	60/59	70/70	63/62	315	61/60	70/70	64/63	316	65/64	80/80	69/68	320
		MED	59/58	70/70	61/60	335	62/61	80/70	66/65	339	63/62	80/80	67/66	340	67/66	80/80	71/70	344
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	28	35	29	157	30	35	32	159	31	35	32	159	32	40	34	161
		MED	30	35	31	169	31	40	33	171	32	40	33	171	34	40	35	173
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		MED	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 78 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER AND 2 SPEED INDOOR FAN OPTION

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
48HC*D08	208/230–3–60	STD	40/40	50/50	41/41	195	44/44	50/50	46/46	199	45/45	50/50	47/47	200	48/48	60/60	51/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	48/48	204	50/50	60/60	53/52	208
		HIGH	45/45	50/50	47/46	249	49/49	60/60	52/50	253	50/50	60/60	53/52	254	53/53	60/60	57/56	258
	460–3–60	STD	19	20	19	97	20	25	21	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	21	25	22	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	22	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	14	15	14	79	18	20	19	83	16	20	16	81	19	25	21	85
		MED	15	20	15	83	18	20	19	87	16	20	17	85	20	25	21	89
		HIGH	16	20	16	92	19	25	21	96	17	20	18	94	21	25	23	98
48HC*D09	208/230–3–60	STD	40/40	50/50	42/41	195	44/44	50/50	46/46	199	45/45	50/50	47/47	200	49/49	60/60	52/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	49/48	204	50/50	60/60	53/53	208
		HIGH	45/45	50/50	47/46	249	49/49	60/60	52/51	253	50/50	60/60	53/52	254	54/54	60/60	57/56	258
	460–3–60	STD	19	25	19	97	21	25	22	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	22	25	23	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	23	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	15	20	16	79	19	20	20	83	17	20	18	81	21	25	22	85
		MED	16	20	16	83	20	25	21	87	18	20	18	85	21	25	23	89
		HIGH	17	20	18	92	21	25	22	96	19	20	20	94	22	25	24	98
48HC*D11	208/230–3–60	STD	51/51	60/60	53/53	254	55/55	60/60	58/57	258	56/56	60/60	59/58	259	59/59	70/70	63/63	263
		MED	54/54	60/60	58/56	304	58/58	70/70	62/61	308	59/59	70/70	63/62	309	63/63	70/70	67/66	313
		HIGH	57/57	70/70	61/60	315	61/61	70/70	65/64	319	62/62	70/70	66/65	320	66/66	80/80	71/70	324
	460–3–60	STD	24	30	25	122	25	30	27	124	26	30	27	124	28	30	29	126
		MED	25	30	26	147	27	30	28	149	27	30	28	149	29	35	30	151
		HIGH	26	30	28	152	28	30	30	154	28	30	30	154	30	35	32	156
	575–3–60	STD	19	20	20	97	23	25	24	101	21	25	22	99	25	30	26	103
		MED	20	25	21	106	24	25	25	110	22	25	23	108	26	30	27	112
		HIGH	22	25	23	120	26	30	27	124	24	25	25	122	28	30	29	126

ELECTRICAL INFORMATION
(UNITS PRODUCED ON OR AFTER JULY 30, 2012) cont.

Table 78 - UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER AND 2 SPEED INDOOR FAN OPTION (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D12	208/230–3–60	STD	50/50	60/60	52/52	279	53/53	60/60	56/56	283	54/54	60/60	57/57	284	58/58	70/70	62/61	288
		MED	53/53	60/60	56/55	329	57/57	70/70	60/59	333	58/58	70/70	62/60	334	62/62	70/70	66/65	338
		HIGH	56/56	60/60	59/58	340	60/60	70/70	64/63	344	61/61	70/70	65/64	345	65/65	80/80	69/68	349
	460–3–60	STD	25	30	26	134	26	30	28	136	27	30	28	136	29	35	30	138
		MED	26	30	27	159	28	30	29	161	28	30	29	161	30	35	32	163
		HIGH	27	30	29	164	29	35	31	166	29	35	31	166	31	35	33	168
	575–3–60	STD	19	25	20	107	23	25	24	111	21	25	22	109	25	30	26	113
		MED	20	25	21	116	24	30	26	120	22	25	23	118	26	30	27	122
		HIGH	22	25	23	130	26	30	27	134	24	25	25	132	28	30	29	136
48HC*D14	208/230–3–60	STD	56/56	70/70	59/58	311	60/60	70/70	63/62	315	61/61	70/70	64/63	316	65/65	80/80	69/68	320
		MED	59/59	70/70	61/60	335	62/62	80/80	66/65	339	63/63	80/80	67/66	340	67/67	80/80	71/70	344
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	28	35	29	157	30	35	32	159	31	35	32	159	32	40	34	161
		MED	30	35	31	169	31	40	33	171	32	40	33	171	34	40	35	173
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		MED	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

LEGEND:

BRKR	–	Circuit breaker
CO	–	Convenience outlet
DISC	–	Disconnect
FLA	–	Full load amps
IFM	–	Indoor fan motor
LRA	–	Locked rotor amps
MCA	–	Minimum circuit amps
MOCP	–	MAX FUSE or HACR Breaker
PE	–	Power exhaust
PWRD CO	–	Powered convenient outlet
UNPWR CO	–	Unpowered convenient outlet

NOTES:

1. In compliance with NEC requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker. Canadian units may be fuse or circuit breaker.
2. **Unbalanced 3-Phase Supply Voltage**
   Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

Example: Supply voltage is 230-3-60



AB = 224 v
BC = 231 v
AC = 226 v

$$\text{Average Voltage} = \frac{(224 + 231 + 226)}{3} = \frac{681}{3}$$

$$= 227$$

Determine maximum deviation from average voltage.
(AB) 227 – 224 = 3 v
(BC) 231 – 227 = 4 v
(AC) 227 – 226 = 1 v
Maximum deviation is 4 v.
Determine percent of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{4}{227}$$

$$= 1.76\%$$

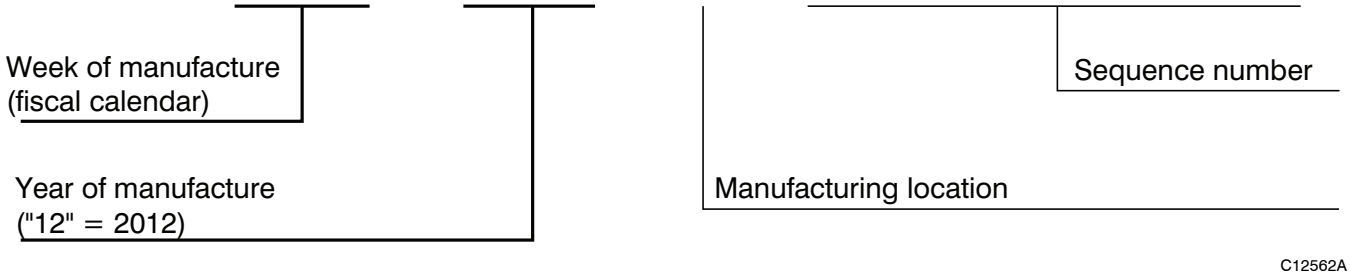
This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.
IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

ELECTRICAL DATA FOR UNITS PRODUCED PRIOR TO JULY 30, 2012

NOTE: Check the serial number of unit to verify production date.

To confirm the date of manufacture, locate the unit nameplate and check the first four digits of the Serial Number. If the number listed in the first 4 digits of the Serial Number is 3012 or lower, the unit was produced prior to July 30, 2012.

Position:	1	2	3	4	5	6	7	8	9	10
Example:	3	1	1	2	U	1	2	3	4	5



C12562A

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 79 – 48HC*04 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	16.6	79	190	1.0	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
230–1–60	187	253	16.6	79	190	1.0	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
208–3–60	187	253	10.4	73	190	1.0	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
							HIGH	80%	5.2
230–3–60	187	253	10.4	73	190	1.0	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
							HIGH	80%	5.2
460–3–60	414	506	5.8	38	190	0.5	DD–STD	84%	4.0
							BD–STD	70%	2.1
							MED	70%	2.1
							HIGH	80%	2.6
575–3–60	518	633	3.8	37	190	0.5	DD–STD	84%	4.0
							BD–STD	71%	1.9
							MED	71%	1.9
							HIGH	80%	2.0

Table 80 – 48HC05 SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	21.8	117	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
230–1–60	187	253	21.8	117	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
208–3–60	187	253	13.7	83	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
							HIGH	80%	5.2
230–3–60	187	253	13.7	83	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	4.9
							HIGH	80%	5.2
460–3–60	414	506	6.2	41	325	0.9	DD–STD	84%	4.0
							BD–STD	70%	2.1
							MED	70%	2.1
							HIGH	80%	2.6
575–3–60	518	633	4.8	33	325	0.9	DD–STD	84%	4.0
							BD–STD	71%	1.9
							MED	71%	1.9
							HIGH	80%	2.0

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Table 81 – 48HC06** **SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–1–60	187	253	25.0	134	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	7.0
230–1–60	187	253	25.0	134	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	70%	7.0
208–3–60	187	253	15.9	110	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	80%	5.2
							HIGH	81%	7.5
230–3–60	187	253	15.9	110	325	1.4	DD–STD	84%	7.4
							BD–STD	70%	4.9
							MED	80%	5.2
							HIGH	81%	7.5
460–3–60	414	506	7.0	52	325	0.9	DD–STD	84%	4.0
							BD–STD	70%	2.1
							MED	80%	2.6
							HIGH	81%	3.4
575–3–60	518	633	5.1	40	325	0.9	DD–STD	84%	4.0
							BD–STD	71%	1.9
							MED	81%	2.0
							HIGH	81%	2.8

Table 82 – 48HC07** **SINGLE STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	325	1.5	STD	80%	5.2
							MED	81%	7.5
							HIGH	81%	15.0
230–3–60	187	253	19.0	123	325	1.5	STD	80%	5.2
							MED	81%	7.5
							HIGH	81%	15.0
460–3–60	414	506	9.7	62	325	0.8	STD	80%	2.6
							MED	81%	3.4
							HIGH	81%	7.4
575–3–60	518	633	7.4	50	325	0.6	STD	80%	2.4
							MED	81%	2.8
							HIGH	81%	5.6

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Table 83 – 48HC08** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	80%	5.2
									MED	81%	7.5
									HIGH	81%	15.0
230–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	80%	5.2
									MED	81%	7.5
									HIGH	81%	15.0
460–3–60	414	506	6.1	41	6.1	41	325	0.8	STD	80%	2.6
									MED	81%	3.4
									HIGH	81%	7.4
575–3–60	518	633	4.2	33	4.2	33	325	0.6	STD	80%	2.4
									MED	81%	2.8
									HIGH	81%	5.6

Table 84 – 48HC09** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	80%	5.2
									MED	80%	5.2
									HIGH	80%	10.0
230–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	80%	5.2
									MED	80%	5.2
									HIGH	80%	10.0
460–3–60	414	506	6.2	41	6.2	41	325	0.8	STD	80%	2.6
									MED	80%	2.6
									HIGH	80%	4.4
575–3–60	518	633	4.8	37	4.8	37	325	0.6	STD	80%	2.4
									MED	80%	2.0
									HIGH	81%	2.8

Table 85 – 48HC11** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208-3-60	187	253	15.9	110.0	15.9	110.0	610	7.4	STD	80%	5.2
									MED	81%	10.0
									HIGH	81%	15.0
230-3-60	187	253	15.9	110.0	15.9	110.0	610	7.4	STD	80%	5.2
									MED	81%	10.0
									HIGH	81%	15.0
460-3-60	414	506	7.1	52.0	7.1	52.0	610	3.6	STD	80%	2.6
									MED	81%	4.4
									HIGH	81%	7.4
575-3-60	518	633	5.1	39.5	5.1	39.5	610	3.6	STD	80%	2.0
									MED	81%	2.8
									HIGH	81%	5.6

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Table 86 – 48HC12** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	80%	5.2
									MED	81%	10.0
									HIGH	81%	15.0
230–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	80%	5.2
									MED	81%	10.0
									HIGH	81%	15.0
460–3–60	414	506	7.7	52	7.7	52	1070	3.1	STD	80%	2.6
									MED	81%	4.4
									HIGH	81%	7.4
575–3–60	518	633	5.7	39	5.7	39	1070	2.5	STD	80%	2.0
									MED	81%	2.8
									HIGH	81%	5.6

Table 87 – 48HC14** **2-STAGE COOLING WITH SINGLE SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	19.0	123	1288	1.5	STD	81%	7.5
									MED	81%	10.0
									HIGH	89.5%	20.4
230–3–60	187	253	19.0	123	19.0	123	1288	1.5	STD	81%	7.5
									MED	81%	10.0
									HIGH	89.5%	20.4
460–3–60	414	506	9.7	62	9.7	62	1288	0.8	STD	81%	3.4
									MED	81%	4.4
									HIGH	89.5%	10.2
575–3–60	518	633	7.4	50	7.4	50	1288	0.7	STD	81%	2.8
									MED	81%	2.8
									HIGH	89.5%	9.0

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Table 88 – 48HC08** — **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	84%	5.8
							325	1.5	MED	77%	7.1
							325	1.5	HIGH	82%	10.8
230–3–60	187	253	13.6	83	13.6	83	325	1.5	STD	84%	5.6
							325	1.5	MED	77%	6.8
							325	1.5	HIGH	82%	9.8
460–3–60	414	506	6.1	41	6.1	41	325	0.8	STD	79%	2.9
							325	0.8	MED	77%	3.8
							325	0.8	HIGH	82%	4.9
575–3–60	518	633	4.2	33	4.2	33	325	0.6	STD	81%	2.8
							325	0.6	MED	80%	3.5
							325	0.6	HIGH	84%	4.5

Table 89 – 48HC09** — **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	84%	5.8
							325	1.5	MED	77%	7.1
							325	1.5	HIGH	82%	10.8
230–3–60	187	253	13.7	83	13.7	83	325	1.5	STD	84%	5.6
							325	1.5	MED	77%	6.8
							325	1.5	HIGH	82%	9.8
460–3–60	414	506	6.2	41	6.2	41	325	0.8	STD	79%	2.9
							325	0.8	MED	77%	3.8
							325	0.8	HIGH	82%	4.9
575–3–60	518	633	4.8	33	4.8	33	325	0.6	STD	81%	2.8
							325	0.6	MED	80%	3.5
							325	0.6	HIGH	84%	4.5

Table 90 – 48HC11** — **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208-3-60	187	253	15.9	110	15.9	110	610	7.4	STD	77%	7.1
							610	7.4	MED	82%	10.8
							610	7.4	HIGH	84%	13.6
230-3-60	187	253	15.9	110	15.9	110	610	7.4	STD	77%	6.8
							610	7.4	MED	82%	9.8
							610	7.4	HIGH	84%	12.7
460-3-60	414	506	7.0	52	7.0	52	610	3.6	STD	77%	3.8
							610	3.6	MED	82%	4.9
							610	3.6	HIGH	84%	6.4
575-3-60	518	633	5.1	40	5.1	40	610	3.6	STD	80%	3.5
							610	3.6	MED	84%	4.5
							610	3.6	HIGH	83%	6.2

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Table 91 – 48HC12** — **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	77%	7.1
							1070	6.2	MED	82%	10.8
							1070	6.2	HIGH	84%	13.6
230–3–60	187	253	15.9	110	15.9	110	1070	6.2	STD	77%	6.8
							1070	6.2	MED	82%	9.8
							1070	6.2	HIGH	84%	12.7
460–3–60	414	506	7.7	52	7.7	52	1070	3.1	STD	77%	3.8
							1070	3.1	MED	82%	4.9
							1070	3.1	HIGH	84%	6.4
575–3–60	518	633	5.7	39	5.7	39	1070	2.5	STD	80%	3.5
							1070	2.5	MED	84%	4.5
							1070	2.5	HIGH	83%	6.2

Table 92 – 48HC14** — **2-STAGE COOLING WITH 2-SPEED INDOOR FAN MOTOR**

V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM		
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFF at Full Load	FLA
208–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	85%	8.6
							280	1.5	MED	82%	10.8
							280	1.5	HIGH	90%	20.4
230–3–60	187	253	19.0	123	19.0	123	280	1.5	STD	85%	7.8
							280	1.5	MED	82%	9.8
							280	1.5	HIGH	90%	20.4
460–3–60	414	506	9.7	62	9.7	62	280	0.8	STD	85%	3.8
							280	0.8	MED	82%	4.9
							280	0.8	HIGH	90%	10.2
575–3–60	518	633	7.4	50	7.4	50	280	0.7	STD	84%	4.5
							280	0.7	MED	84%	4.5
							280	0.7	HIGH	94%	9.0

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Table 93 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A/B/F04	208/230–1–60‡	DD–STD	30	45	29	88	32	45	31	90	34	50	34	93	36	50	36	95
		BD–STD†	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
		MED†	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
	208/230–3–60	DD–STD	22	30	22	82	24	30	24	84	27	30	27	87	29	35	29	89
		BD–STD†	19	25	19	87	21	30	21	89	24	30	24	92	26	30	26	94
		MED	19	25	19	87	21	30	21	89	24	30	24	92	26	30	26	94
		HIGH	20	25	19	105	22	30	21	107	24	30	25	110	26	30	27	112
	460–3–60	DD–STD	12	15	12	43	13	15	13	44	14	20	14	45	15	20	16	46
		BD–STD†	10	15	10	45	11	15	11	46	13	15	12	47	14	15	13	48
		MED	10	15	10	45	11	15	11	46	13	15	12	47	14	15	13	48
		HIGH	11	15	10	54	12	15	11	55	13	15	13	56	14	20	14	57
	575–3–60	DD–STD	10	15	10	42	12	15	12	44	11	15	12	44	13	15	14	46
		BD–STD†	8	15	7	43	10	15	9	45	9	15	9	45	11	15	11	47
		MED	8	15	7	43	10	15	9	45	9	15	9	45	11	15	11	47
		HIGH	8	15	7	49	10	15	9	51	9	15	9	51	11	15	11	53
48HC*A/B/F05	208/230–1–60‡	DD–STD	37	50	35	127	38	50	37	129	41	60	41	132	43	60	43	134
		BD–STD†	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
		MED†	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
	208/230–3–60	DD–STD	26	30	26	93	28	40	28	95	31	40	31	98	33	45	34	100
		BD–STD†	24	30	23	98	26	30	25	100	29	40	29	103	31	40	31	105
		MED	24	30	23	105	26	30	26	107	29	40	29	110	31	40	31	112
		HIGH	26	30	26	142	28	40	28	144	31	40	32	147	33	45	34	149
	460–3–60	DD–STD	13	15	13	47	14	20	14	48	15	20	15	49	16	20	16	50
		BD–STD†	11	15	11	49	12	15	12	50	13	15	13	51	14	20	14	52
		MED	12	15	11	52	13	15	12	53	14	20	14	54	15	20	15	55
		HIGH	13	15	12	71	14	15	13	72	15	20	15	73	16	20	16	74
	575–3–60	DD–STD	11	15	11	39	13	15	13	41	13	15	13	41	15	20	15	43
		BD–STD†	9	15	9	40	11	15	11	42	11	15	11	42	13	15	13	44
		MED	9	15	8	42	11	15	11	44	11	15	10	44	13	15	13	46
		HIGH	10	15	10	57	12	15	12	59	12	15	12	59	14	15	14	61

† Drive package is only available on Humidi–MiZer® equipped units

‡ Single phase models are not available with factory–installed powered convenience outlet.

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Table 93 - UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A/b/f06	208/230–1–60‡	DD–STD	41	60	39	144	42	60	41	146	45	60	44	149	47	60	47	151
		BD–STD†	38	60	36	149	40	60	38	151	43	60	42	154	45	60	44	156
		MED†	40	60	38	174	42	60	41	176	45	60	44	179	47	60	46	181
	208/230–3–60	DD–STD	29	40	28	120	31	45	31	122	34	45	34	125	36	50	36	127
		BD–STD†	27	40	26	125	29	40	28	127	31	45	31	130	33	45	33	132
		MED	27	40	26	143	29	40	28	145	32	45	31	148	34	45	34	150
		HIGH	29	40	29	169	31	45	31	171	34	45	34	174	36	50	36	176
	460–3–60	DD–STD	14	20	14	58	15	20	15	59	16	20	16	60	17	20	17	61
		BD–STD†	12	15	12	60	13	15	13	61	14	20	14	62	15	20	15	63
		MED	13	15	12	69	14	20	13	70	15	20	15	71	16	20	16	72
		HIGH	14	20	13	82	15	20	14	83	16	20	16	84	17	20	17	85
	575–3–60	DD–STD	12	15	12	46	14	15	14	48	13	15	13	48	15	20	16	50
		BD–STD†	10	15	9	47	12	15	11	49	11	15	11	49	13	15	13	51
		MED	10	15	9	53	12	15	11	55	11	15	11	55	13	15	13	57
		HIGH	11	15	10	64	12	15	12	66	12	15	12	66	14	15	14	68

† Drive package is only available on Humidi–MiZer® equipped units
‡ Single phase models are not available with factory–installed powered convenience outlet.

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Table 94 – UNIT WIRE SIZING DATA WITH FACTORY-INSTALLED HACR BREAKER

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A/B/F04	208/230–1–60‡	DD–STD	30	45	29	88	32	45	31	90	34	50	34	93	36	50	36	95
		STD	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
		MED	27	40	26	93	29	45	28	95	32	45	31	98	34	45	34	100
	208/230–3–60	DD–STD	22	30	22	82	24	30	24	84	27	30	27	87	29	35	29	89
		STD	19	25	19	87	21	30	21	89	24	30	24	92	26	30	26	94
		MED	19	25	19	87	21	30	21	89	24	30	24	92	26	30	26	94
		HIGH	20	25	19	105	22	30	21	107	24	30	25	110	26	30	27	112
	460–3–60	DD–STD	12	15	12	43	13	15	13	44	14	20	14	45	15	20	16	46
		STD	10	15	10	45	11	15	11	46	13	15	12	47	14	15	13	48
		MED	10	15	10	45	11	15	11	46	13	15	12	47	14	15	13	48
		HIGH	11	15	10	54	12	15	11	55	13	15	13	56	14	20	14	57
	575–3–60	DD–STD	10	15	10	42	12	15	12	44	11	15	12	44	13	15	14	46
		STD	8	15	7	43	10	15	9	45	9	15	9	45	11	15	11	47
		MED	8	15	7	43	10	15	9	45	9	15	9	45	11	15	11	47
		HIGH	8	15	7	49	10	15	9	51	9	15	9	51	11	15	11	53
48HC*A/B/F05	208/230–1–60‡	DD–STD	37	50	35	127	38	50	37	129	41	60	41	132	43	60	43	134
		STD	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
		MED	34	50	32	132	36	50	35	134	39	60	38	137	41	60	40	139
	208/230–3–60	DD–STD	26	30	26	93	28	40	28	95	31	40	31	98	33	45	34	100
		STD	24	30	23	98	26	30	25	100	29	40	29	103	31	40	31	105
		MED	24	30	23	105	26	30	26	107	29	40	29	110	31	40	31	112
		HIGH	26	30	26	142	28	40	28	144	31	40	32	147	33	45	34	149
	460–3–60	DD–STD	13	15	13	47	14	20	14	48	15	20	15	49	16	20	16	50
		STD	11	15	11	49	12	15	12	50	13	15	13	51	14	20	14	52
		MED	12	15	11	52	13	15	12	53	14	20	14	54	15	20	15	55
		HIGH	13	15	12	71	14	15	13	72	15	20	15	73	16	20	16	74
	575–3–60	DD–STD	11	15	11	39	13	15	13	41	13	15	13	41	15	20	15	43
		STD	9	15	9	40	11	15	11	42	11	15	11	42	13	15	13	44
		MED	9	15	8	42	11	15	11	44	11	15	10	44	13	15	13	46
		HIGH	10	15	10	57	12	15	12	59	12	15	12	59	14	15	14	61

‡ Single phase models are not available with factory–installed powered convenience outlet.

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 94 – UNIT WIRE SIZING DATA WITH FACTORY-INSTALLED HACR BREAKER (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A/B/F06	208/230–1–60‡	DD–STD	41	60	39	144	42	60	41	146	45	60	44	149	47	60	47	151
		STD	38	60	36	149	40	60	38	151	43	60	42	154	45	60	44	156
		MED	40	60	38	174	42	60	41	176	45	60	44	179	47	60	46	181
	208/230–3–60	DD–STD	29	40	28	120	31	45	31	122	34	45	34	125	36	50	36	127
		STD	27	40	26	125	29	40	28	127	31	45	31	130	33	45	33	132
		MED	27	40	26	143	29	40	28	145	32	45	31	148	34	45	34	150
		HIGH	29	40	29	169	31	45	31	171	34	45	34	174	36	50	36	176
	460–3–60	DD–STD	14	20	14	58	15	20	15	59	16	20	16	60	17	20	17	61
		STD	12	15	12	60	13	15	13	61	14	20	14	62	15	20	15	63
		MED	13	15	12	69	14	20	13	70	15	20	15	71	16	20	16	72
		HIGH	14	20	13	82	15	20	14	83	16	20	16	84	17	20	17	85
	575–3–60	DD–STD	12	15	12	46	14	15	14	48	13	15	13	48	15	20	16	50
		STD	10	15	9	47	12	15	11	49	11	15	11	49	13	15	13	51
		MED	10	15	9	53	12	15	11	55	11	15	11	55	13	15	13	57
		HIGH	11	15	10	64	12	15	12	66	12	15	12	66	14	15	14	68

‡ Single phase models are not available with factory–installed powered convenience outlet.

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 95 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A07	208/230–3–60	STD	32	50	31	148	36	50	36	152	37	50	37	153	41	50	41	157
		MED	35	50	34	185	39	50	38	189	40	50	39	190	43	60	44	194
		HIGH	42	60	43	211	46	60	47	215	47	60	48	216	51	60	52	220
	460–3–60	STD	17	25	16	75	19	25	18	77	19	25	19	77	21	30	21	79
		MED	18	25	17	94	19	25	19	96	20	25	19	96	22	30	22	98
		HIGH	22	30	22	107	23	30	24	109	24	30	24	109	26	30	26	111
	575–3–60	STD	12	15	11	61	16	20	16	65	14	20	13	63	18	20	18	67
		MED	14	20	13	76	18	20	17	80	15	20	15	78	19	25	19	82
		HIGH	17	20	16	90	20	25	21	94	18	25	18	92	22	25	23	96
48HC*D08	208/230–3–60	STD	39	50	41	191	43	50	45	195	44	50	46	196	48	60	51	200
		MED	39	50	41	202	43	50	45	206	44	50	46	207	48	60	51	211
		HIGH	44	50	46	245	48	60	51	249	49	60	52	250	53	60	56	254
	460–3–60	STD	18	20	19	95	20	25	21	97	21	25	21	97	22	25	23	99
		MED	18	20	19	101	20	25	21	103	21	25	21	103	22	25	23	105
		HIGH	20	25	21	123	22	25	23	125	22	25	23	125	24	30	26	127
	575–3–60	STD	12	15	12	77	16	20	17	81	14	15	14	79	18	20	19	83
		MED	13	15	13	81	17	20	18	85	15	20	15	83	19	20	20	87
		HIGH	14	15	14	92	18	20	19	96	16	20	16	94	19	25	21	98
48HC*D09	208/230–3–60	STD	39	50	41	191	43	50	45	195	44	50	46	196	48	60	51	200
		MED	39	50	41	202	43	50	45	206	44	50	46	207	48	60	51	211
		HIGH	44	50	46	245	48	60	51	249	49	60	52	250	53	60	56	254
	460–3–60	STD	19	20	19	95	20	25	21	97	21	25	22	97	23	25	24	99
		MED	19	20	19	101	20	25	21	103	21	25	22	103	23	25	24	105
		HIGH	20	25	21	123	22	25	23	125	23	25	24	125	24	30	26	127
	575–3–60	STD	14	15	14	77	17	20	18	81	15	20	16	79	19	20	20	83
		MED	14	20	15	81	18	20	19	85	16	20	17	83	20	25	21	87
		HIGH	15	20	16	92	19	20	20	96	17	20	18	94	21	25	22	98

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 95 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D11	208/230–3–60	STD	49	60	51	257	53	60	55	261	54	60	57	262	57	70	61	266
		MED	54	60	57	300	57	70	61	304	58	70	62	305	62	70	66	309
		HIGH	59	70	62	309	62	70	67	313	63	70	68	314	67	80	72	318
	460–3–60	STD	22	25	23	123	24	30	25	125	25	30	26	125	26	30	28	127
		MED	24	30	25	145	26	30	27	147	26	30	28	147	28	30	30	149
		HIGH	27	30	29	149	29	35	31	151	30	35	31	151	31	35	33	153
	575–3–60	STD	18	20	18	95	21	25	23	99	19	25	20	97	23	25	24	101
		MED	18	20	19	106	22	25	23	110	20	25	21	108	24	25	25	112
		HIGH	21	25	22	120	25	30	27	124	23	25	24	122	27	30	29	126
48HC*D12	208/230–3–60	STD	48	60	50	282	51	60	54	286	52	60	55	287	56	60	60	291
		MED	52	60	55	325	56	60	60	329	57	70	61	330	61	70	65	334
		HIGH	57	70	61	334	61	70	65	338	62	70	66	339	66	80	71	343
	460–3–60	STD	23	30	24	135	25	30	26	137	26	30	27	137	27	30	29	139
		MED	25	30	26	157	27	30	28	159	27	30	29	159	29	35	31	161
		HIGH	28	30	30	161	30	35	32	163	30	35	32	163	32	35	34	165
	575–3–60	STD	18	20	18	105	22	25	23	109	19	25	20	107	23	25	25	111
		MED	19	20	19	116	22	25	24	120	20	25	21	118	24	30	26	122
		HIGH	21	25	22	130	25	30	27	134	23	25	24	132	27	30	29	136

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 96 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*A07	208/230–3–60	STD	32	50	31	148	36	50	36	152	37	50	37	153	41	50	41	157
		MED	35	50	34	185	39	50	38	189	40	50	39	190	43	60	44	194
		HIGH	42	60	43	211	46	60	47	215	47	60	48	216	51	60	52	220
	460–3–60	STD	17	25	16	75	19	25	18	77	19	25	19	77	21	30	21	79
		MED	18	25	17	94	19	25	19	96	20	25	19	96	22	30	22	98
		HIGH	22	30	22	107	23	30	24	109	24	30	24	109	26	30	26	111
	575–3–60	STD	12	15	11	61	16	20	16	65	14	20	13	63	18	20	18	67
		MED	14	20	13	76	18	20	17	80	15	20	15	78	19	25	19	82
		HIGH	17	20	16	90	20	25	21	94	18	25	18	92	22	25	23	96
48HC*D08	208/230–3–60	STD	39	50	41	191	43	50	45	195	44	50	46	196	48	60	51	200
		MED	39	50	41	202	43	50	45	206	44	50	46	207	48	60	51	211
		HIGH	44	50	46	245	48	60	51	249	49	60	52	250	53	60	56	254
	460–3–60	STD	18	20	19	95	20	25	21	97	21	25	21	97	22	25	23	99
		MED	18	20	19	101	20	25	21	103	21	25	21	103	22	25	23	105
		HIGH	20	25	21	123	22	25	23	125	22	25	23	125	24	30	26	127
	575–3–60	STD	12	15	12	77	16	20	17	81	14	15	14	79	18	20	19	83
		MED	13	15	13	81	17	20	18	85	15	20	15	83	19	20	20	87
		HIGH	14	15	14	92	18	20	19	96	16	20	16	94	19	25	21	98
48HC*D09	208/230–3–60	STD	39	50	41	191	43	50	45	195	44	50	46	196	48	60	51	200
		MED	39	50	41	202	43	50	45	206	44	50	46	207	48	60	51	211
		HIGH	44	50	46	245	48	60	51	249	49	60	52	250	53	60	56	254
	460–3–60	STD	19	20	19	95	20	25	21	97	21	25	22	97	23	25	24	99
		MED	19	20	19	101	20	25	21	103	21	25	22	103	23	25	24	105
		HIGH	20	25	21	123	22	25	23	125	23	25	24	125	24	30	26	127
	575–3–60	STD	14	15	14	77	17	20	18	81	15	20	16	79	19	20	20	83
		MED	14	20	15	81	18	20	19	85	16	20	17	83	20	25	21	87
		HIGH	15	20	16	92	19	20	20	96	17	20	18	94	21	25	22	98

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 96 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D11	208/230–3–60	STD	49	60	51	257	53	60	55	261	54	60	57	262	57	70	61	266
		MED	54	60	57	300	57	70	61	304	58	70	62	305	62	70	66	309
		HIGH	59	70	62	309	62	70	67	313	63	70	68	314	67	80	72	318
	460–3–60	STD	22	25	23	123	24	30	25	125	25	30	26	125	26	30	28	127
		MED	24	30	25	145	26	30	27	147	26	30	28	147	28	30	30	149
		HIGH	27	30	29	149	29	35	31	151	30	35	31	151	31	35	33	153
	575–3–60	STD	18	20	18	95	21	25	23	99	19	25	20	97	23	25	24	101
		MED	18	20	19	106	22	25	23	110	20	25	21	108	24	25	25	112
		HIGH	21	25	22	120	25	30	27	124	23	25	24	122	27	30	29	126
48HC*D12	208/230–3–60	STD	48	60	50	282	51	60	54	286	52	60	55	287	56	60	60	291
		MED	52	60	55	325	56	60	60	329	57	70	61	330	61	70	65	334
		HIGH	57	70	61	334	61	70	65	338	62	70	66	339	66	80	71	343
	460–3–60	STD	23	30	24	135	25	30	26	137	26	30	27	137	27	30	29	139
		MED	25	30	26	157	27	30	28	159	27	30	29	159	29	35	31	161
		HIGH	28	30	30	161	30	35	32	163	30	35	32	163	32	35	34	165
	575–3–60	STD	18	20	18	105	22	25	23	109	19	25	20	107	23	25	25	111
		MED	19	20	19	116	22	25	24	120	20	25	21	118	24	30	26	122
		HIGH	21	25	22	130	25	30	27	134	23	25	24	132	27	30	29	136

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 97 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER AND 2 SPEED INDOOR FAN OPTION

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D08	208/230–3–60	STD	40/40	50/50	41/41	195	44/44	50/50	46/46	199	45/45	50/50	47/47	200	48/48	60/60	51/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	48/48	204	50/50	60/60	53/52	208
		HIGH	45/45	50/50	47/46	249	49/49	60/60	52/50	253	50/50	60/60	53/52	254	53/53	60/60	57/56	258
	460–3–60	STD	19	20	19	97	20	25	21	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	21	25	22	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	22	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	14	15	14	79	18	20	19	83	16	20	16	81	19	25	21	85
		MED	15	20	15	83	18	20	19	87	16	20	17	85	20	25	21	89
		HIGH	16	20	16	92	19	25	21	96	17	20	18	94	21	25	23	98
48HC*D09	208/230–3–60	STD	40/40	50/50	42/41	195	44/44	50/50	46/46	199	45/45	50/50	47/47	200	49/49	60/60	52/51	204
		MED	41/41	50/50	43/43	199	45/45	50/50	47/47	203	46/46	50/50	49/48	204	50/50	60/60	53/53	208
		HIGH	45/45	50/50	47/46	249	49/49	60/60	52/51	253	50/50	60/60	53/52	254	54/54	60/60	57/56	258
	460–3–60	STD	19	25	19	97	21	25	22	99	21	25	22	99	23	25	24	101
		MED	20	25	20	100	22	25	23	102	22	25	23	102	24	25	25	104
		HIGH	21	25	22	125	23	25	24	127	23	25	24	127	25	30	26	129
	575–3–60	STD	15	20	16	79	19	20	20	83	17	20	18	81	21	25	22	85
		MED	16	20	16	83	20	25	21	87	18	20	18	85	21	25	23	89
		HIGH	17	20	18	92	21	25	22	96	19	20	20	94	22	25	24	98

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 97 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER AND 2 SPEED INDOOR FAN OPTION (cont)

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D11	208/230–3–60	STD	51/51	60/60	53/53	254	55/55	60/60	58/57	258	56/56	60/60	59/58	259	59/59	70/70	63/63	263
		MED	54/54	60/60	58/56	304	58/58	70/70	62/61	308	59/59	70/70	63/62	309	63/63	70/70	67/66	313
		HIGH	57/57	70/70	61/60	315	61/61	70/70	65/64	319	62/62	70/70	66/65	320	66/66	80/80	71/70	324
	460–3–60	STD	24	30	25	122	25	30	27	124	26	30	27	124	28	30	29	126
		MED	25	30	26	147	27	30	28	149	27	30	28	149	29	35	30	151
		HIGH	26	30	28	152	28	30	30	154	28	30	30	154	30	35	32	156
	575–3–60	STD	19	20	20	97	23	25	24	101	21	25	22	99	25	30	26	103
		MED	20	25	21	106	24	25	25	110	22	25	23	108	26	30	27	112
		HIGH	22	25	23	120	26	30	27	124	24	25	25	122	28	30	29	126
48HC*D12	208/230–3–60	STD	50/50	60/60	52/52	279	53/53	60/60	56/56	283	54/54	60/60	57/57	284	58/58	70/70	62/61	288
		MED	53/53	60/60	56/55	329	57/57	70/70	60/59	333	58/58	70/70	62/60	334	62/62	70/70	66/65	338
		HIGH	56/56	60/60	59/58	340	60/60	70/70	64/63	344	61/61	70/70	65/64	345	65/65	80/80	69/68	349
	460–3–60	STD	25	30	26	134	26	30	28	136	27	30	28	136	29	35	30	138
		MED	26	30	27	159	28	30	29	161	28	30	29	161	30	35	32	163
		HIGH	27	30	29	164	29	35	31	166	29	35	31	166	31	35	33	168
	575–3–60	STD	19	25	20	107	23	25	24	111	21	25	22	109	25	30	26	113
		MED	20	25	21	116	24	30	26	120	22	25	23	118	26	30	27	122
		HIGH	22	25	23	130	26	30	27	134	24	25	25	132	28	30	29	136

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 98 – UNIT WIRE/FUSE OR HACR BREAKER SIZING DATA

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE		MCA	MAX FUSE or HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D14	208/230–3–60	STD	55	60	58	314	59	70	62	318	60	70	63	319	64	80	67	323
		MED	58	70	60	331	62	80	65	335	63	80	66	336	66	80	70	340
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	28	35	29	158	30	35	31	160	30	35	32	160	32	40	34	162
		MED	29	35	30	167	31	40	32	169	31	40	33	169	33	40	35	171
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		MED	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

Table 99 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D14	208/230–3–60	STD	55	60	58	314	59	70	62	318	60	70	63	319	64	80	67	323
		MED	58	70	60	331	62	80	65	335	63	80	66	336	66	80	70	340
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	28	35	29	158	30	35	31	160	30	35	32	160	32	40	34	162
		MED	29	35	30	167	31	40	32	169	31	40	33	169	33	40	35	171
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		MED	22	25	23	128	26	30	27	132	24	30	25	130	28	30	29	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

ELECTRICAL INFORMATION
(UNITS PRODUCED PRIOR TO JULY 30, 2012)

Table 100 – UNIT WIRE SIZING DATA WITH FACTORY INSTALLED HACR BREAKER AND 2 SPEED INDOOR FAN OPTION

UNIT	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			NO P.E.				w/ P.E. (pwrd fr/ unit)				NO P.E.				w/ P.E. (pwrd fr/ unit)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
48HC*D14	208/230–3–60	STD	56/56	70/70	59/58	311	60/60	70/70	63/62	315	61/61	70/70	64/63	316	65/65	80/80	69/68	320
		MED	59/59	70/70	61/60	335	62/62	80/80	66/65	339	63/63	80/80	67/66	340	67/67	80/80	71/70	344
		HIGH	68	80	72	350	72	80	77	354	73	80	78	355	77	90	82	359
	460–3–60	STD	28	35	29	157	30	35	32	159	31	35	32	159	32	40	34	161
		MED	30	35	31	169	31	40	33	171	32	40	33	171	34	40	35	173
		HIGH	35	40	37	176	37	45	39	178	37	45	39	178	39	45	41	180
	575–3–60	STD	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		MED	24	30	25	128	28	30	29	132	25	30	27	130	29	35	31	134
		HIGH	29	35	30	140	32	40	34	144	30	35	32	142	34	40	36	146

LEGEND:

BRKR – Circuit breaker
CO – Convenience outlet
DISC – Disconnect
FLA – Full load amps
IFM – Indoor fan motor
LRA – Locked rotor amps
MCA – Minimum circuit amps
MOCP – MAX FUSE or HACR Breaker
PE – Power exhaust
PWRD CO – Powered convenient outlet
UNPWR CO – Unpowered convenient outlet

NOTES:

1. In compliance with NEC requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker. Canadian units may be fuse or circuit breaker.
2. **Unbalanced 3-Phase Supply Voltage**
   Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance.

$$\%\ \text{Voltage Imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

Example: Supply voltage is 230-3-60



AB = 224 v
BC = 231 v
AC = 226 v

$$\text{Average Voltage} = \frac{(224 + 231 + 226)}{3} = \frac{681}{3} = 227$$

Determine maximum deviation from average voltage.
(AB) 227 – 224 = 3 v
(BC) 231 – 227 = 4 v
(AC) 227 – 226 = 1 v
Maximum deviation is 4 v.
Determine percent of voltage imbalance.

$$\%\ \text{Voltage Imbalance} = 100 \times \frac{4}{227} = 1.76\%$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.

IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

SEQUENCE OF OPERATION

General

The sequence below describes the sequence of operation for an electro-mechanical unit with and without a factory installed EconoMi$er™ IV and X (called "economizer" in this sequence). For information regarding a direct digital controller, see the start-up, operations, and troubleshooting manual for the applicable controller.

Electro-mechanical units with no economizer

Cooling (Single speed indoor fan motor) —

When the thermostat calls for cooling, terminals G and Y1 are energized. As a result, the indoor-fan contactor (IFC) and the compressor contactor (C1) are energized, causing the indoor-an motor (IFM), compressor #1, and outdoor fan to start. If the unit has 2 stages of cooling, the thermostat will additionally energize Y2. The Y2 signal will energize compressor contactor #2 (C2), causing compressor #2 to start. Regardless of the number of stages, the outdoor-fan motor runs continuously while unit is cooling.

Cooling (2-speed indoor fan motor) —

Per ASHRAE 90.1 2010 standard section 6.4.3.10.b, during the first stage of cooling operation the VFD will adjust the fan motor to provide 2/3rd of the total cfm established for the unit. When a call for the second stage of cooling is required, the VFD will allow the total cfm for the unit established (100%).

Heating

NOTE: WeatherMaster (48HC) units have either 1 or 2 stages of gas heat.

When the thermostat calls for heating, power is sent to W on the Integrated Gas Controller (IGC) board. An LED (light-emitting diode) on the IGC board turns on and remains on during normal operation. A check is made to ensure that the rollout switch and limit switch are closed. If the check was successful, the induced-draft motor is energized, and when its speed is satisfactory, as proven by the "hall effect" sensor, the ignition activation period begins. The burners will ignite within 5 seconds. If the burners do not light, there is a 22-second delay before another 5-second attempt. This sequence is repeated for 15 minutes or until the burners light. If, after the 15 minutes, the burners still have not lit, heating is locked out. To reset the control, break 24-v power to the thermostat.

When ignition occurs, the IGC board will continue to monitor the condition of the rollout switch, the limit switches, the "hall effect" sensor, as well as the flame sensor. 45 seconds after ignition occurs, assuming the unit is controlled through a room thermostat set for fan auto, the indoor-fan motor will energize (and the outdoor-air dampers will open to their minimum position). If, for some reason, the over-temperature limit opens prior to the start of the indoor fan blower, the unit will shorten the 45-second delay to 5 seconds less than the time from initiation of heat to when the limit tripped. Gas will not be interrupted to the burners and heating will continue. Once the fan-on delay has been modified, it will not change back to 45 seconds until power is reset to the control.

On units with 2 stages of heat, when additional heat is required, W2 closes and initiates power to the second stage of the main gas valve. When the thermostat is satisfied, W1 and W2 open and the gas valve closes, interrupting the flow of gas to the main burners.

If the call for W1 lasted less than 1 minute, the heating cycle will not terminate until 1 minute after W1 became active. If the unit is controlled through a room thermostat set for fan auto, the indoor-fan motor will continue to operate for an additional 45 seconds then stop. If the over-temperature limit opens after the indoor motor is stopped, but within 10 minutes of W1 becoming inactive, on the next cycle the time will be extended by 15 seconds. The maximum delay is 3 minutes. Once modified, the fan off delay will not change back to 45 seconds unless power is reset to the control. A LED indicator is provided on the IGC to monitor operation.

Electro-mechanical units with an economizer

Cooling —

When free cooling is not available, the compressors will be controlled by the zone thermostat. When free cooling is available, the outdoor-air damper is modulated by the EconoMi$er IV and X control to provide a 50°F (10°C) to 55°F (13°C) mixed-air temperature into the zone. As the mixed air temperature fluctuates above 55°F (13°C)or below 50°F (10°C) dampers will be modulated (open or close) to bring the mixed-air temperature back within control. If mechanical cooling is utilized with free cooling, the outdoor-air damper will maintain its current position at the time the compressor is started. If the increase in cooling capacity causes the mixed-air temperature to drop below 45°F (7°C), then the outdoor-air damper position will be decreased to the minimum position. If the mixed-air temperature continues to fall, the outdoor-air damper will close. Control returns to normal once the mixed-air temperature rises above 48°F (9°C). The power exhaust fans will be energized and de-energized, if installed, as the outdoor-air damper opens and closes.

If field-installed accessory CO_2 sensors are connected to the EconoMi$er IV and X control, a demand controlled ventilation strategy will begin to operate. As the CO_2 level in the zone increases above the CO_2 setpoint, the minimum position of the damper will be increased proportionally. As the CO_2 level decreases because of the increase in fresh air, the outdoor-air damper will be proportionally closed. For EconoMi$er IV and X operation, there must be a thermostat call for the fan (G). If the unit is occupied and the fan is on, the damper will operate at minimum position. Otherwise, the damper will be closed.

SEQUENCE OF OPERATION (cont.)

When the EconoMi$er IV and X control is in the occupied mode and a call for cooling exists (Y1 on the thermostat), the control will first check for indoor fan operation. If the fan is not on, then cooling will not be activated. If the fan is on, then the control will open the EconoMi$er IV and X damper to the minimum position.

On the initial power to the EconoMi$er IV and X control, it will take the damper up to 2 1/2 minutes before it begins to position itself. After the initial power-up, further changes in damper position can take up to 30 seconds to initiate. Damper movement from full closed to full open (or vice versa) will take between 1 1/2 and 2 1/2 minutes. If free cooling can be used as determined from the appropriate changeover command (switch, dry bulb, enthalpy curve, differential dry bulb, or differential enthalpy), then the control will modulate the dampers open to maintain the mixed-air temperature setpoint at 50°F (10°C) to 55°F (13°C). If there is a further demand for cooling (cooling second stage - Y2 is energized), then the control will bring on compressor stage 1 to maintain the mixed-air temperature setpoint. The EconoMi$er IV and X damper will be open at maximum position. EconoMi$er IV and X operation is limited to a single compressor.

2-Speed Note: When operating in ventilation mode only, the indoor fan motor will automatically adjust to 2/3rd of the total cfm established.

Heating

The sequence of operation for the heating is the same as an electromechanical unit with no economizer. The only difference is how the economizer acts. The economizer will stay at the Economizer Minimum Position while the evaporator fan is operating. The outdoor-air damper is closed when the indoor fan is not operating.

Optional Humidi-MiZer Dehumidification System

Units with the factory equipped Humidi-MiZer option are capable of providing multiple modes of improved dehumidification as a variation of the normal cooling cycle. The Humidi-MiZer option includes additional valves in the liquid line and discharge line of each refrigerant circuit, a small reheat condenser coil downstream of the evaporator, and Motormaster variable-speed control of some or all outdoor fans. Operation of the revised refrigerant circuit for each mode is described below.

The Humidi-MiZer system provides three sub-modes of operation: Cool, Reheat1, and Reheat2.

Cool mode - provides a normal ratio of Sensible and Latent Cooling effect from the evaporator coil.

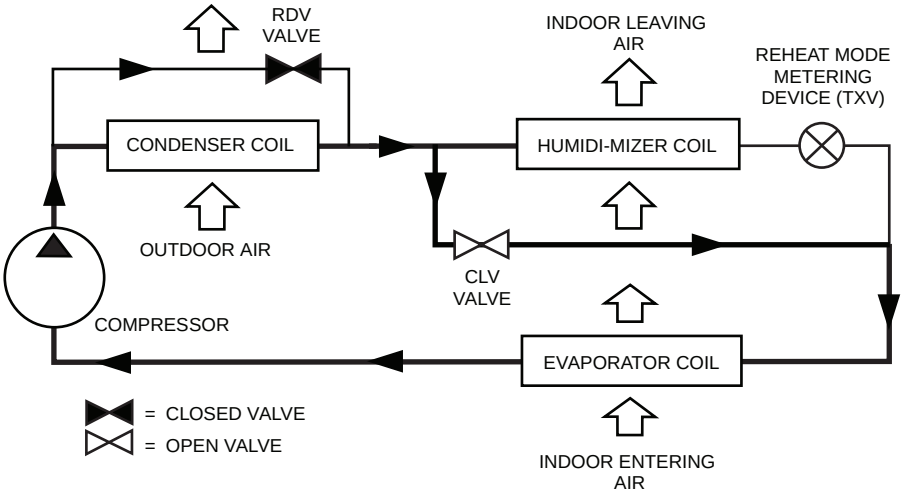
Reheat1 - provides increased Latent Cooling while slightly reducing the Sensible Cooling effect.

Reheat2 - provides normal Latent Cooling but with null or minimum Sensible Cooling effect delivered to the space.

The Reheat1 and Reheat2 modes are available when the unit is not in a Heating mode and when the Low Ambient Lockout switch is closed.

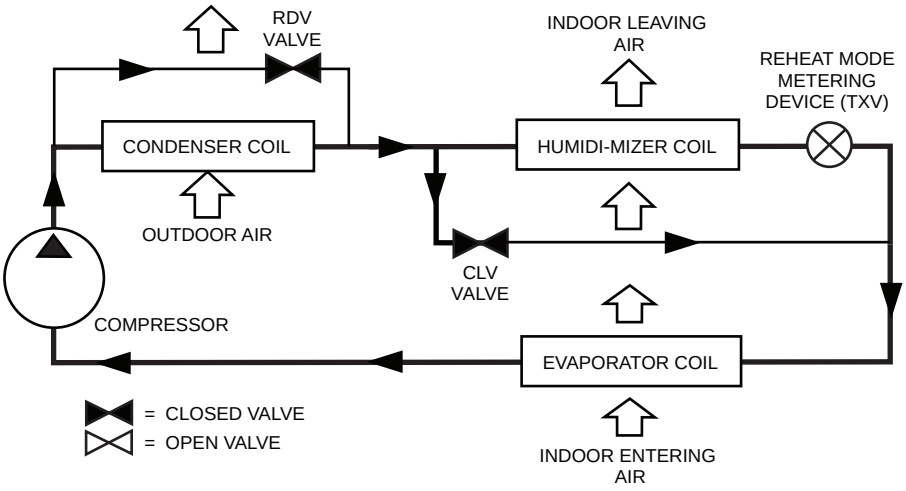
The following diagrams depict piping for Single Stage cooling units.

SEQUENCE OF OPERATION (cont.)



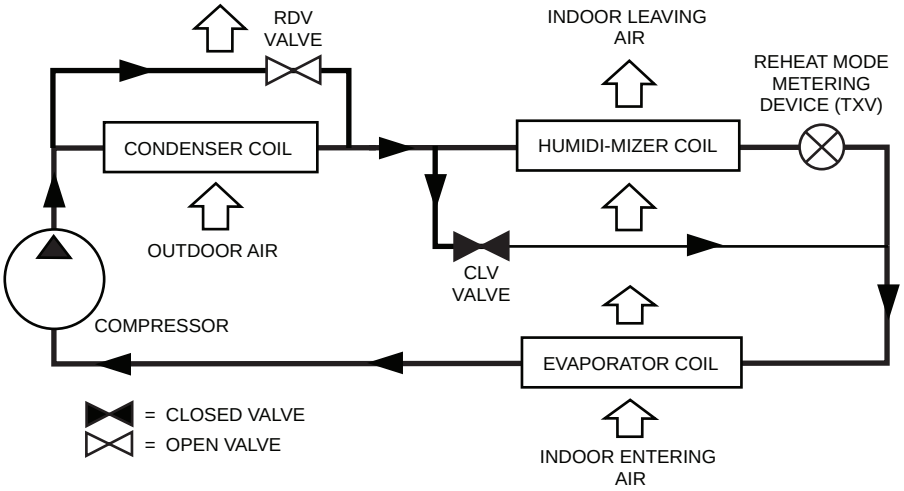
C12702

Normal Cooling Mode – Humidi–MiZer System with Single Stage Cooling



C12703

Subcooling Mode (Reheat 1) – Humidi–MiZer System with Single Stage Cooling



C12704

Hot Gas Reheat Mode (Reheat2) – Humidi–MiZer System with Single Stage Cooling

GUIDE SPECIFICATIONS – 48HC**04–14

Note about this specification:

This specification is in the “Masterformat” as published by the Construction Specification Institute. Please feel free to copy this specification directly into your building spec.

Gas Heat/Electric Cooling Packaged Rooftop

HVAC Guide Specifications

Size Range: **3 to 12.5 Nominal Tons**

Section **Description**

23 06 80 Schedules for Decentralized HVAC Equipment

23 06 80.13 Decentralized Unitary HVAC Equipment Schedule

23 06 80.13.A. Rooftop unit schedule

1. Schedule is per the project specification requirements.

23 07 16 HVAC Equipment Insulation

23 07 16.13 Decentralized, Rooftop Units:

23 07 16.13.A. Evaporator fan compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1/2–in. thick, minimum 1 1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

23 07 16.13.B. Gas heat compartment:

1. Aluminum foil–faced fiberglass insulation shall be used.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

23 09 13 Instrumentation and Control Devices for HVAC

23 09 13.23 Sensors and Transmitters

23 09 13.23.A. Thermostats

1. Thermostat must
   a. energize both “W” and “G” when calling for heat.
   b. have capability to energize 2 different stages of cooling, and 2 different stages of heating.
   c. include capability for occupancy scheduling.

23 09 23 Direct–digital Control system for HVAC

23 09 23.13 Decentralized, Rooftop Units:

23 09 23.13.A. PremierLink™ controller

1. Shall be ASHRAE 62–2001 compliant.
2. Shall accept 18–32 VAC input power.
3. Shall have an operating temperature range from –40°F (–40°C) to 158°F (70°C), 10% – 95% RH (non–condensing).
4. Shall include an integrated economizer controller to support an economizer with 4 to 20 mA actuator input and no microprocessor controller.
5. Controller shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, indoor relative humidity, compressor lock–out, fire shutdown, enthalpy, fan status, remote time clock/door switch.
6. Shall accept a CO_2 sensor in the conditioned space, and be Demand Control Ventilation (DCV) ready.
7. Shall provide the following outputs: economizer, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, heat stage 3/ exhaust/ reversing valve/ dehumidify/ occupied.
8. Unit shall provide surge protection for the controller through a circuit breaker.
9. Shall be Internet capable, and communicate at a Baud rate of 38.4K or faster.

10. Shall have an LED display independently showing the status of activity on the communication bus, and processor operation.
11. Shall include an EIA-485 protocol communication port, an access port for connection of either a computer or a Carrier technician tool, an EIA-485 port for network communication to intelligent space sensors and displays, and a port to connect an optional LonWorks plug-in communications card.
12. Shall have built-in Carrier Comfort Network™ (CCN) protocol, and be compatible with other CCN devices, including ComfortLink™ and ComfortVIEW™ controllers.
13. Shall have built-in support for Carrier technician tool.
14. Software upgrades will be accomplished by local download. Software upgrades through chip replacements are not allowed.
15. Shall be shock resistant in all planes to 5G peak, 11ms during operation, and 100G peak, 11ms during storage.
16. Shall be vibration resistant in all planes to 1.5G @ 20-300 Hz.
17. Shall support a bus length of 4000 ft (1219m) max, 60 devices per 1000 ft (305m) section, and 1 RS-485 repeater per 1000 ft (305m) sections.

23 09 23.13.B. ComfortLink Unit Controls shall contain:

1. Four button detailed English scrolling marquee display.
2. CCN (Carrier Comfort Network) capable.
3. Unit control with standard suction pressure transducers and condensing temperature thermistors.
4. Shall provide a 5°F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
5. Shall provide and display a current alarm list and an alarm history list.
6. Service run test capability.
7. Shall accept input from a CO_2 sensor (both indoor and outdoor).
8. Configurable alarm light shall be provided which activates when certain types of alarms occur.
9. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
10. Service diagnostic mode.
11. Economizer control (optional).
12. Control multi capacity stages
13. Unit shall be complete with self-contained low voltage control circuit.
14. Unit shall have 0°F low ambient cooling operation.

23 09 23.13.C. RTU Open - multi-protocol, direct digital controller:

1. Shall be ASHRAE 62-2001 compliant.
2. Shall accept 18-30VAC, 50-60Hz, and consumer 15VA or less power.
3. Shall have an operating temperature range from -40°F (-40°C) to 130°F (54°C), 10% - 90% RH (non-condensing).
4. Shall include built-in protocol for BACNET (MS/TP and PTP modes), Modbus (RTU and ASCII), Johnson N2 and LonWorks. LonWorks Echelon processor required for all Lon applications shall be contained in separate communication board.
5. Shall allow access of up to 62 network variables (SNVT). Shall be compatible with all open controllers
6. Baud rate Controller shall be selectable using a dipswitch.
7. Shall have an LED display independently showing the status of serial communication, running, errors, power, all digital outputs, and all analog inputs.
8. Shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, compressor lock-out, fire shutdown, enthalpy switch, and fan status/filter status/ humidity/ remote occupancy.
9. Shall provide the following outputs: economizer, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, heat stage 3/ exhaust/ reversing valve.
10. Shall have built-in surge protection circuitry through solid state polyswitches. Polyswitches shall be used on incoming power and network connections. Polyswitches will return to normal when the “trip” condition clears.
11. Shall have a battery back-up capable of a minimum of 10,000 hours of data and time clock retention during power outages.
12. Shall have built-in support for Carrier technician tool.
13. Shall include an EIA-485 protocol communication port, an access port for connection of either a computer or a Carrier technician tool, an EIA-485 port for network communication to intelligent space sensors and displays, and a port to connect an optional LonWorks communications card.

14. Software upgrades will be accomplished by either local or remote download. No software upgrades through chip replacements are allowed.

23 09 33 Electric and Electronic Control System for HVAC

23 09 33.13 Decentralized, Rooftop Units:

23 09 33.13.A. General:

1. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
2. Shall utilize color-coded wiring.
3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches.
4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
5. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

23 09 33.23.B. Safeties:

1. Compressor over-temperature, over-current. High internal pressure differential.
2. Low-pressure switch.
   a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
3. High-pressure switch.
   a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
4. Automatic reset, motor thermal overload protector.
5. Heating section shall be provided with the following minimum protections:
   a. High-temperature limit switches.
   b. Induced draft motor speed sensor.
   c. Flame rollout switch.
   d. Flame proving controls.

23 09 93 Sequence of Operations for HVAC Controls

23 09 93.13 Decentralized, Rooftop Units:

23 09 93.13 INSERT SEQUENCE OF OPERATION

23 40 13 Panel Air Filters

23 40 13.13 Decentralized, Rooftop Units:

23 40 13.13.A. Standard filter section

1. Shall consist of factory-installed, low velocity, disposable 2-in. thick fiberglass filters of commercially available sizes.
2. Unit shall use only one filter size. Multiple sizes are not acceptable.
3. Filters shall be accessible through an access panel with “no-tool” removal as described in the unit cabinet section of this specification (23 81 19.13.H).

23 81 19 Self-Contained Air Conditioners

23 81 19.13 Small-Capacity Self-Contained Air Conditioners (48HC**04-14)

23 81 19.13.A. General

1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
3. Unit shall use environmentally sound, Puron® refrigerant.
4. Unit shall be installed in accordance with the manufacturer’s instructions.

5. Unit must be selected and installed in compliance with local, state, and federal codes.

23 81 19.13.B. Quality Assurance

1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
2. 3-phase units are Energy Star certified.
3. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
4. Unit shall be designed to conform to ASHRAE 15, 2001.
5. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.
6. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
7. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
8. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
9. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.
10. Roof curb shall be designed to conform to NRCA Standards.
11. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
12. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
13. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
14. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
15. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

23 81 19.13.C. Delivery, Storage, and Handling

1. Unit shall be stored and handled per manufacturer's recommendations.
2. Lifted by crane requires either shipping top panel or spreader bars.
3. Unit shall only be stored or positioned in the upright position.

23 81 19.13.E. Project Conditions

1. As specified in the contract.

23 81 19.13.F. Operating Characteristics

1. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at ± 10% voltage.
2. Compressor with standard controls shall be capable of operation down to 35°F (2°C), ambient outdoor temperatures. Accessory low ambient kits shall be available if operation below 35°F (2°C), is required. See below for head pressure control package or winter start kit.
3. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
4. Unit shall be factory configured for vertical supply & return configurations.
5. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required on 04-12 models. Supply duct kit required for 14 size model only.
6. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

23 81 19.13.G. Electrical Requirements

1. Main power supply voltage, phase, and frequency must match those required by the manufacturer.

23 81 19.13.H. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F / 16°C): 60, Hardness: H-2H Pencil hardness.
3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the gas heat compartment.
4. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections (factory installed or field installed), standard.

5. Base Rail
    a. Unit shall have base rails on a minimum of 4 sides.
    b. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
    c. Holes shall be provided in the base rail for moving the rooftop by fork truck.
    d. Base rail shall be a minimum of 16 gauge thickness.
6. Condensate pan and connections:
    a. Shall be an internally sloped condensate drain pan made of a non-corrosive material.
    b. Shall comply with ASHRAE Standard 62.
    c. Shall use a 3/4" -14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.
7. Top panel:
    a. Shall be a single piece top panel on 04 thru 12 sizes, two piece on 14 size.
8. Gas Connections:
    a. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).
    b. Thru-the-base capability
        (1.) Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
        (2.) Optional, factory-approved, water-tight connection method must be used for thru-the-base gas connections.
        (3.) No basepan penetration, other than those authorized by the manufacturer, is permitted.
9. Electrical Connections
    a. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
    b. Thru-the-base capability.
        (1.) Standard unit shall have a thru-the-base electrical location (s) using a raised, embossed portion of the unit basepan.
        (2.) Optional, factory-approved, water-tight connection method must be used for thru-the-base electrical connections.
        (3.) No basepan penetration, other than those authorized by the manufacturer, is permitted.
10. Component access panels (standard)
    a. Cabinet panels shall be easily removable for servicing.
    b. Unit shall have one factory installed, tool-less, removable, filter access panel.
    c. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have a molded composite handles.
    d. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.
    e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
    f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

23 81 19.13.I. Gas Heat

1. General
    a. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
    b. Shall incorporate a direct-spark ignition system and redundant main gas valve.
    c. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
    a. IGC board shall notify users of fault using an LED (light-emitting diode).
    b. The LED shall be visible without removing the control box access panel.
    c. IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.
    d. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.
3. Standard Heat Exchanger construction
    a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.

b. Burners shall be of the in-shot type constructed of aluminum-coated steel.
c. Burners shall incorporate orifices for rated heat output up to 2000 ft (610m) elevation. Additional accessory kits may be required for applications above 2000 ft (610m) elevation, depending on local gas supply conditions.
d. Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.

4. Optional Stainless Steel Heat Exchanger construction
   a. Use energy saving, direct-spark ignition system.
   b. Use a redundant main gas valve.
   c. Burners shall be of the in-shot type constructed of aluminum-coated steel.
   d. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
   e. The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.
   f. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
   g. Complete stainless steel heat exchanger allows for greater application flexibility.
5. Optional Low NO_x Heat Exchanger construction
   a. Low NO_x reduction shall be provided to reduce nitrous oxide emissions to meet California's Air Quality Management District (SCAQMD) low-NO_x emissions requirement of 40 nanograms per joule or less.
   b. Primary tubes and vestibule plates on low NO_x units shall be 409 stainless steel. Other components shall be aluminized steel.
6. Induced draft combustion motor and blower
   a. Shall be a direct-drive, single inlet, forward-curved centrifugal type.
   b. Shall be made from steel with a corrosion-resistant finish.
   c. Shall have permanently lubricated sealed bearings.
   d. Shall have inherent thermal overload protection.
   e. Shall have an automatic reset feature.

23 81 19.13.J. Coils

1. Standard Aluminum Fin/Copper Tube Coils:
   a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
   b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
   c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.
2. Optional Pre-coated aluminum-fin condenser coils (3-phase models only):
   a. Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments.
   b. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube.
   c. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.
3. Optional Copper-fin evaporator and condenser coils(3-phase models only) :
   a. Shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets.
   b. Galvanized steel tube sheets shall not be acceptable.
   c. A polymer strip shall prevent coil assembly from contacting the sheet metal coil pan to minimize potential for galvanic corrosion between coil and pan.
4. Optional E-coated aluminum-fin evaporator and condenser coils (3-phase models only):
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.
   b. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.
   c. Color shall be high gloss black with gloss per ASTM D523-89.
   d. Uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges.
   e. Superior hardness characteristics of 2H per ASTM D3363-92A and cross-hatch adhesion of 4B-5B per ASTM D3359-93.
   f. Impact resistance shall be up to 160 in.-lb (ASTM D2794-93).
   g. Humidity and water immersion resistance shall be up to minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92).

h. Corrosion durability shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.

5. Optional E-coated aluminum-fin, aluminum tube condenser coils:
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil external surface areas without material bridging between fins or louvers.
   b. Coating process shall ensure complete coil encapsulation, including all exposed fin edges.
   c. E-coat thickness of 0.8 to 1.2 mil with top coat having a uniform dry film thickness from 1.0 to 2.0 mil on all external coil surface areas, including fin edges, shall be provided.
   d. Shall have superior hardness characteristics of 2H per ASTM D3363-00 and cross-hatch adhesion of 4B-5B per ASTM D3359-02.
   e. Shall have superior impact resistance with no cracking, chipping or peeling per NSF/ANSI 51-2002 Method 10.2.

23 81 19.13.K. Refrigerant Components

1. Refrigerant circuit shall include the following control, safety, and maintenance features:
   a. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
   b. Refrigerant filter drier - Solid core design.
   c. Service gauge connections on suction and discharge lines.
   d. Pressure gauge access through a specially designed access port in the top panel of the unit.
2. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
   a. The plug shall be easy to remove and replace.
   b. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
   c. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
   d. The plug shall be made of a leak proof, UV-resistant, composite material.
3. Compressors
   a. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
   b. Models shall be available with single compressor/single stage cooling designs on 04 – 07 sizes models, and 2 compressor/2-stage cooling models on 08 – 14 sizes.
   c. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
   d. Compressors shall be internally protected from high discharge temperature conditions.
   e. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
   f. Compressor shall be factory mounted on rubber grommets.
   g. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
   h. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

23 81 19.13.L. Filter Section

1. Filters access is specified in the unit cabinet section of this specification.
2. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
3. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
4. Filters shall be standard, commercially available sizes.
5. Only one size filter per unit is allowed.

23 81 19.13.M. Evaporator Fan and Motor

1. Evaporator fan motor:
   a. Shall have permanently lubricated bearings.
   b. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
   c. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
2. Electric Drive (Direct Drive) X13 – 5 Speed/Torque Evaporator Fan:
   a. Multi-speed motor with easy quick adjustment settings.
   b. Blower fan shall be double-inlet type with forward-curved blades.
   c. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

d. Standard on all 04-06 models with 208/230/1/60 operation without Humidi-MiZer
e. Standard on all 04-06 3-phase models without Humidi-MiZer, with optional belt drive.

3. Belt-driven Evaporator Fan:
   a. Belt drive shall include an adjustable-pitch motor pulley.
   b. Shall use sealed, permanently lubricated ball-bearing type.
   c. Blower fan shall be double-inlet type with forward-curved blades.
   d. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.
   e. Standard on all 07-14 size and 04-06 with Humidi-MiZer models. Optional on all 04-06 3-phase models.

23 81 19.13.N. Condenser Fans and Motors

1. Condenser fan motors:
   a. Shall be a totally enclosed motor.
   b. Shall use permanently lubricated bearings.
   c. Shall have inherent thermal overload protection with an automatic reset feature.
   d. Shall use a shaft-down design on 04 to 12 models and shaft-up on 14 size with rain shield.
2. Condenser Fans:
   a. Shall be a direct-driven propeller type fan.
   b. Shall have galvalum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

23 81 19.13.O. Special Features Options and Accessories

1. Staged Air Volume System (SAV) for 2-stage cooling models only:
   a. Evaporator fan motor:
      (1.) Shall have permanently lubricated bearings.
      (2.) Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating.
      (3.) Shall be Variable Frequency duty and 2-speed control.
      (4.) Shall contain motor shaft grounding ring to prevent electrical bearing fluting damage by safely diverting harmful shaft voltages and bearing currents to ground.
2. Variable Frequency Drive (VFD). Only available on 2-speed indoor fan motor option (SAV):
   a. Shall be installed inside the unit cabinet, mounted, wired and tested.
   b. Shall contain Electromagnetic Interference (EMI) frequency protection.
   c. Insulated Gate Bi-Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform, allowing for quiet motor operation.
   d. Self diagnostics with fault and power code LED indicator. Field accessory Display Kit available for further diagnostics and special setup applications.
   e. RS485 capability standard.
   f. Electronic thermal overload protection.
   g. 5% swinging chokes for harmonic reduction and improved power factor.
   h. All printed circuit boards shall be conformal coated.
3. Standard Integrated Economizers (Factory installed on 3 Phase Models Only. Field installed on all 3 and 1 Phase Models):
   a. Integrated, gear-driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
   b. Independent modules for vertical or horizontal return configurations shall be available. Vertical return modules shall be available as a factory installed option.
   c. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
   d. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
   e. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
   f. Standard models shall be equipped with low-leakage dampers, not to exceed 2% leakage at 1 in. wg pressure differential. Economizer controller on electromechanical units shall be Honeywell W7212 that provides:
      (1.) Combined minimum and DCV maximum damper position potentiometers with compressor staging relay.
      (2.) Functions with solid state analog enthalpy or dry bulb changeover control sensing.

(3.) Contain LED indicates for:
when free cooling is available
when module is in DCV mode
when exhaust fan contact is closed

g. Ultra low leak EconoMi$er X system shall be available on models with SAV 2-speed Variable Frequency Drive (VFD) systems. Only available on 2-speed indoor fan motor systems with electromechanical, ComfortLink or RTU Open controls.

(1.) Maximum damper leakage rate to be equal to or less than 4.0 cfm/sq. ft. at 1.0 in. w.g., meeting or exceeding ASHRAE 90.1 requirements. Economizer controller on electromechanical units shall be Honeywell W7220 that provides:

(2.) 2-line LCD interface screen for setup, configuration and troubleshooting

(3.) On-board fault detection and diagnostics

(4.) Sensor failure loss of communication identification

(5.) Automatic sensor detection

(6.) Capabilities for use with multiple-speed indoor fan systems

(7.) Utilize digital sensors: Dry bulb and Enthalpy

h. Shall be capable of introducing up to 100% outdoor air.

i. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air.

j. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.

k. Dry bulb outdoor air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F / 4 to 38°C. Additional sensor options shall be available as accessories.

l. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.

m. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy. A remote potentiometer may be used to override the damper setpoint.

n. Dampers shall be completely closed when the unit is in the unoccupied mode.

o. Economizer controller shall accept a 2-10 Vdc CO_2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.

p. Compressor lockout sensor shall open at 35°F (2°C) and close closes at 50°F (10°C).

q. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.

r. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

4. Two-Position Damper (Factory installed on 3 Phase Models Only. Field installed on all 3 and 1 Phase Models)

a. Damper shall be a Two-Position Damper. Damper travel shall be from the full closed position to the field adjustable %-open setpoint.

b. Damper shall include adjustable damper travel from 25% to 100% (full open).

c. Damper shall include single or dual blade, gear driven dampers and actuator motor.

d. Actuator shall be direct coupled to damper gear. No linkage arms or control rods shall be acceptable.

e. Damper will admit up to 100% outdoor air for applicable rooftop units.

f. Damper shall close upon indoor (evaporator) fan shutoff and/or loss of power.

g. The damper actuator shall plug into the rooftop unit's wiring harness plug. No hard wiring shall be required.

h. Outside air hood shall include aluminum water entrainment filter.

5. Manual damper

a. Manual damper package shall consist of damper, air inlet screen, and rain hood which can be preset to admit up to 25 or 50% outdoor air for year round ventilation.

6. Humidi-MiZer Adaptive Dehumidification System (3-phase models only):

a. The Humidi-MiZer Adaptive Dehumidification System shall be factory installed and shall provide greater dehumidification of the occupied space by two modes of dehumidification operations in addition to its normal design cooling mode:

(1.) Subcooling mode further sub cools the hot liquid refrigerant leaving the condenser coil when both temperature and humidity in the space are not satisfied.

(2.) Hot gas reheat mode shall mix a portion of the hot gas from the discharge of the compressor with the hot liquid refrigerant leaving the condenser coil to create a two-phase heat transfer in the system, resulting in a neutral leaving air temperature when only humidity in the space is not satisfied.

(3.) Includes head pressure controller.

7. Head Pressure Control Package (MotorMaster)
   a. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
   b. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature at outdoor ambient temperatures down to -20°F (-29°C).
8. Low Ambient Controller (Factory installed only)
   a. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
   b. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature at outdoor ambient temperatures down to 0°F (-18°C). (Not available on 11 size models as standard unit cooling operation down to 0°F /-18°C).
9. Propane Conversion Kit
   a. Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit for use with liquefied propane, up to 2000 ft (610m) elevation.
   b. Additional accessory kits may be required for applications above 2000 ft (610m) elevation.
10. Flue Shield (04-12 models only)
   a. Flue shield shall provide protection from the hot sides of the gas flue hood.
11. Condenser Coil Hail Guard Assembly (Factory installed option on 3-phase models. Field installed on all 3 and 1 phase models):
   a. Shall protect against damage from hail.
   b. Shall be of louvered style.
12. Unit-Mounted, Non-Fused Disconnect Switch:
   a. Switch shall be factory-installed, internally mounted.
   b. National Electric Code (NEC) and UL approved non-fused switch shall provide unit power shutoff.
   c. Shall be accessible from outside the unit.
   d. Shall provide local shutdown and lockout capability.
13. HACR Breaker
   a. These manual reset devices provide overload and short circuit protection for the unit. Factory wired and mounted with the units, with access cover to help provide environmental protection. On 575V applications, HACR breaker can only be used with WYE power distribution systems. Use on Delta power distribution systems is prohibited.
14. Convenience Outlet:
   a. Powered convenience outlet (3-phase models only, not available on 11 size models with ComfortLink or RTU Open controls).
      (1.) Outlet shall be powered from main line power to the rooftop unit.
      (2.) Outlet shall be powered from line side or load side of disconnect by installing contractor, as required by code. If outlet is powered from load side of disconnect, unit electrical ratings shall be UL certified and rated for additional outlet amperage.
      (3.) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
      (4.) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
      (5.) Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer.
      (6.) Outlet shall be accessible from outside the unit.
      (7.) Outlet shall include a field-installed “Wet in Use” cover.
   b. Non-Powered convenience outlet.
      (1.) Outlet shall be powered from a separate 115/120v power source.
      (2.) A transformer shall not be included.
      (3.) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
      (4.) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
      (5.) Outlet shall be accessible from outside the unit.

(6.) Outlet shall include a field-installed “Wet in Use” cover.

15. Flue Discharge Deflector (04-12 models only):
    a. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.
    b. Deflector shall be defined as a “natural draft” device by the National Fuel and Gas (NFG) code.
16. Thru-the-Base Connectors:
    a. Kits shall provide connectors to permit gas and electrical connections to be brought to the unit through the unit basepan.
    b. Minimum of four connection locations per unit.
17. Propeller Power Exhaust:
    a. Power exhaust shall be used in conjunction with an integrated economizer.
    b. Independent modules for vertical or horizontal return configurations shall be available.
    c. Horizontal power exhaust is shall be mounted in return ductwork.
    d. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0-100% adjustable setpoint on the economizer control.
18. Roof Curbs (Vertical):
    a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
    b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
    c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
19. High Altitude Gas Conversion Kit:
    a. Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 2000-7000 ft (610 to 2134m) elevation with natural gas or from 0-7000 ft (90-2134m) elevation with liquefied propane.
20. Outdoor Air Enthalpy Sensor:
    a. The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.
21. Return Air Enthalpy Sensor:
    a. The return air enthalpy sensor shall be used in conjunction with an outdoor air enthalpy sensor to provide differential enthalpy control.
22. Indoor Air Quality (CO_2) Sensor:
    a. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
    b. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.
23. Smoke detectors (factory-installed only):
    a. Shall be a Four-Wire Controller and Detector.
    b. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
    c. Shall use magnet-activated test/reset sensor switches.
    d. Shall have tool-less connection terminal access.
    e. Shall have a recessed momentary switch for testing and resetting the detector.
    f. Controller shall include:
        (1.) One set of normally open alarm initiation contacts for connection to an initiating device circuit on a fire alarm control panel.
        (2.) Two Form-C auxiliary alarm relays for interface with rooftop unit or other equipment.
        (3.) One Form-C supervision (trouble) relay to control the operation of the Trouble LED on a remote test/reset station.
        (4.) Capable of direct connection to two individual detector modules.
        (5.) Can be wired to up to 14 other duct smoke detectors for multiple fan shutdown applications
24. Winter start kit
    a. Shall contain a bypass device around the low pressure switch.
    b. Shall be required when mechanical cooling is required down to 25°F (-4°C).
    c. Shall not be required to operate on an economizer when below an outdoor ambient of 40°F (4°C).
25. Time Guard
    a. Shall prevent compressor short cycling by providing a 5-minute delay (±2 minutes) before restarting a compressor after shutdown for any reason.

b. One device shall be required per compressor.

26. Hinged Access Panels
    a. Shall provide easy access through integrated quarter turn latches.
    b. Shall be on major panels of – filter, control box, fan motor and compressor
27. Display Kit for Variable Frequency Drive
    a. Kit allows the ability to access the VFD controller programs to provide special setup capabilities and diagnostics.
    b. Kit contains display module, mounting bracket and communication cable.
    c. Display Kit can be permanently installed in the unit or used on any SAV system VFD controller as needed.
28. Foil faced insulation
    a. Throughout unit cabinet air stream, non-fibrous and cleanable foil faced insulation is used.

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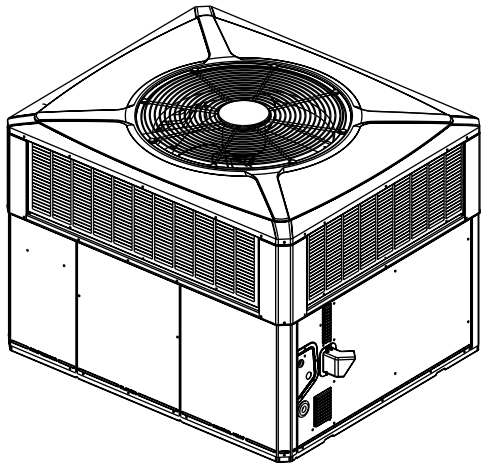
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Replaces: 48HC–14PD

Installer's Guide

Single Packaged
15 SEER Convertible, 2–5 Ton

4YCY5024A1060A
4YCY5030A1070A
4YCY5036A1070A
4YCY5036A1090A
4YCY5042A1090A
4YCY5048A1090A
4YCY5048A1115A
4YCY5060A1115A



Note: *"Graphics in this document are for representation only. Actual model may differ in appearance."*

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

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Ingersoll Rand

SAFETY SECTION

Important — This document contains a wiring diagram, a parts list, and service information. This is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

⚠ WARNING

HAZARDOUS GASES!

Exposure to fuel substances or by-products of incomplete fuel combustion is believed by the state of California to cause cancer, birth defects, or other reproductive harm.

This warning complies with state of California law, Proposition 65.

⚠ WARNING

HAZARDOUS VOLTAGE!

Failure to follow this Warning could result in property damage, severe personal injury, or death.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized.

⚠ WARNING

SAFETY AND ELECTRICAL HAZARD!

Failure to follow this Warning could result in property damage, severe personal injury, or death.

These servicing instructions are for use by qualified personnel only. To reduce the risk of electrical shock, do not perform any servicing other than that contained in these operating instructions unless you are qualified to do so.

⚠ CAUTION

GROUNDING REQUIRED!

Failure to inspect or use proper service tools may result in equipment damage or personal injury.

Reconnect all grounding devices. All parts of this product that are capable of conducting electrical current are grounded. If grounding wires, screws, straps, clips, nuts, or washers used to complete a path to ground are removed for service, they must be returned to their original position and properly fastened.

⚠ WARNING

UNIT CONTAINS R-410A REFRIGERANT!

Failure to use proper service tools may result in equipment damage or personal injury.

R-410A operating pressure exceeds the limit of R-22. Proper service equipment is required. Service using only R-410A Refrigerant and approved POE compressor oil.

⚠ WARNING

SAFETY HAZARD!

Operating the unit without the access panels properly installed may result in severe personal injury or death.

Do not operate the unit without the evaporator fan access panel or evaporator coil access panel in place.

⚠ WARNING

WARNING!

This product can expose you to chemicals including lead, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Important: *Wear appropriate gloves, arm sleeve protectors and eye protection when servicing or maintaining this equipment.*

Important: *Air filters and media wheels or plates shall meet the test requirements in UL 900.*

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Introduction

Read this manual carefully before attempting to install, operate, or perform maintenance on this unit. Installation and maintenance should be performed by qualified service technicians only. Do NOT use this furnace for temporary heating of buildings under construction.

As shipped from the factory, this unit is for use with natural gas only. It is listed by Underwriters Laboratory. An LP Gas conversion kit is available. Extreme mounting kits for slab and curbs are also available.

Packaged units are designed for outdoor mounting with a vertical condenser discharge. They can be located either at ground level or on a roof in accordance with local codes or National Fuel Gas Code (ANSI-Z223.1A) Latest Revision. Since these units are designed exclusively for outdoor operation, additional flue venting systems are not required. Each unit contains an operating charge of refrigerant as shipped. Extreme mounting kits are available for slab (BAYEXMK003A), utility curb (BAYEXMK002B), or curb (BAYEXMK001A) mountings.

The indoor fan motor speed adjustment is provided in the Service Maintenance, see .

This guide is organized as follows:

- Step 1 — Inspect Shipment
- Step 2 — Determine Unit Clearances
- Step 3 — Review Location and Recommendation Information
- Step 4 — Unit Installation
- Step 5 — Unit Startup
- Sequence of Operation
- Maintenance

Step 1 — Inspect Shipment

1. Check for damage after the unit is unloaded. Report promptly to the carrier any damage found to the unit. Do not drop the unit.

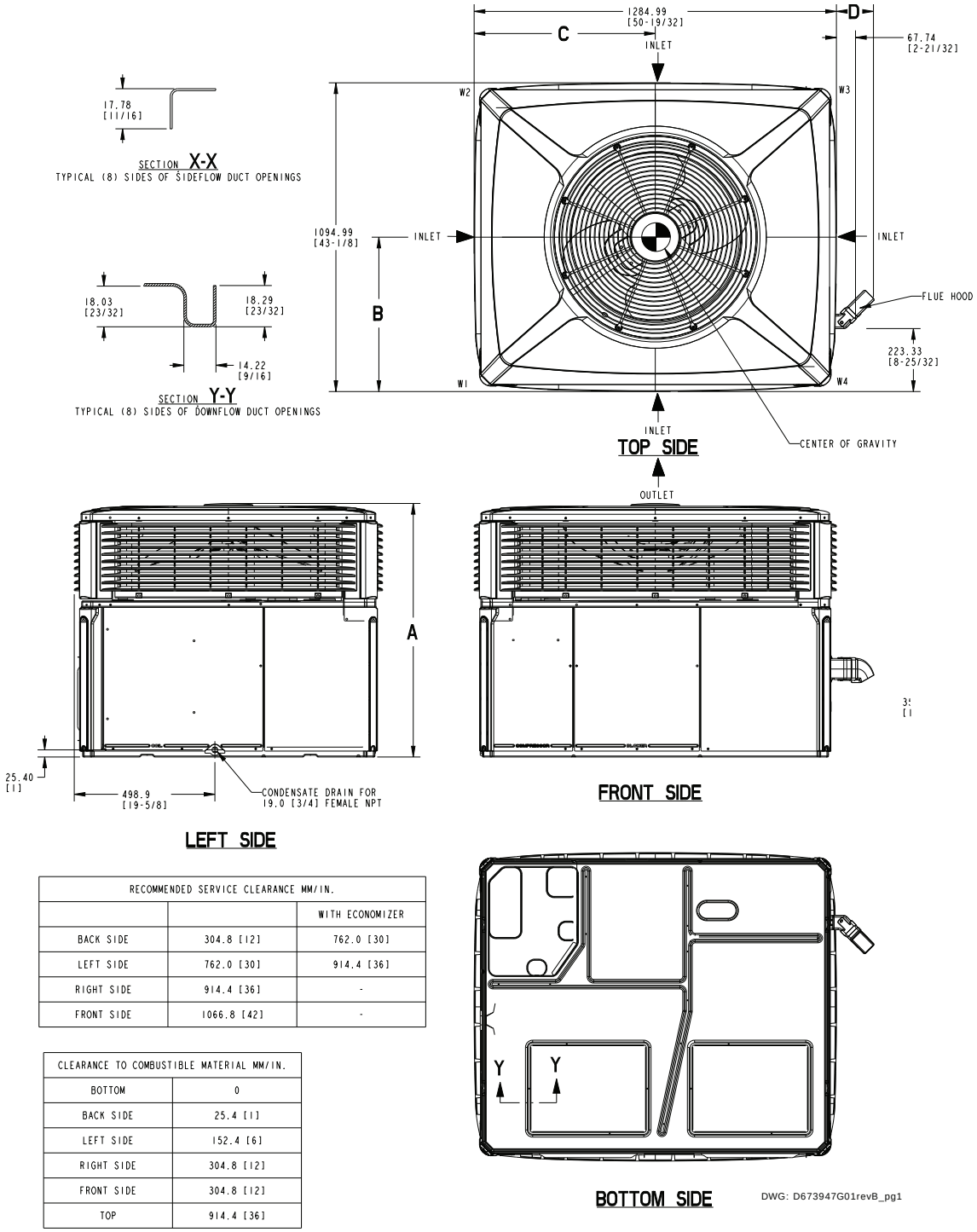
   Important: *To prevent damage to the sides and top of the unit when hoisting, use "spreader bars".*
2. Check the unit's nameplate to determine if the unit is correct for the intended application. The power supply must be adequate for the unit and all accessories.
3. Check to be sure the refrigerant charge has been retained during shipment. Remove the Compressor access panel to access the 1/4" flare pressure taps.
4. The Flue Hood is included with the unit's literature pack.
5. If this unit is being installed on a curb, verify that the correct curb is provided for the unit.
   - 4YCY5024-036 use model BAYCURB050A
   - 4YCY5042-060 use model BAYCURB051A
6. If the unit is being hoisted, accessory kit BAYLIFT002B is recommended. It includes a kit of four (4) lifting lugs and instructions.

Note: *If practical, install any internal accessories to the unit at the shop.*

Note: *The packaged units have been evaluated in accordance with the Code of Federal Regulations, Chapter XX, Part 3280 or the equivalent. "SUITABLE FOR MOBILE HOME USE".*

Step 2 — Determine Unit Clearances

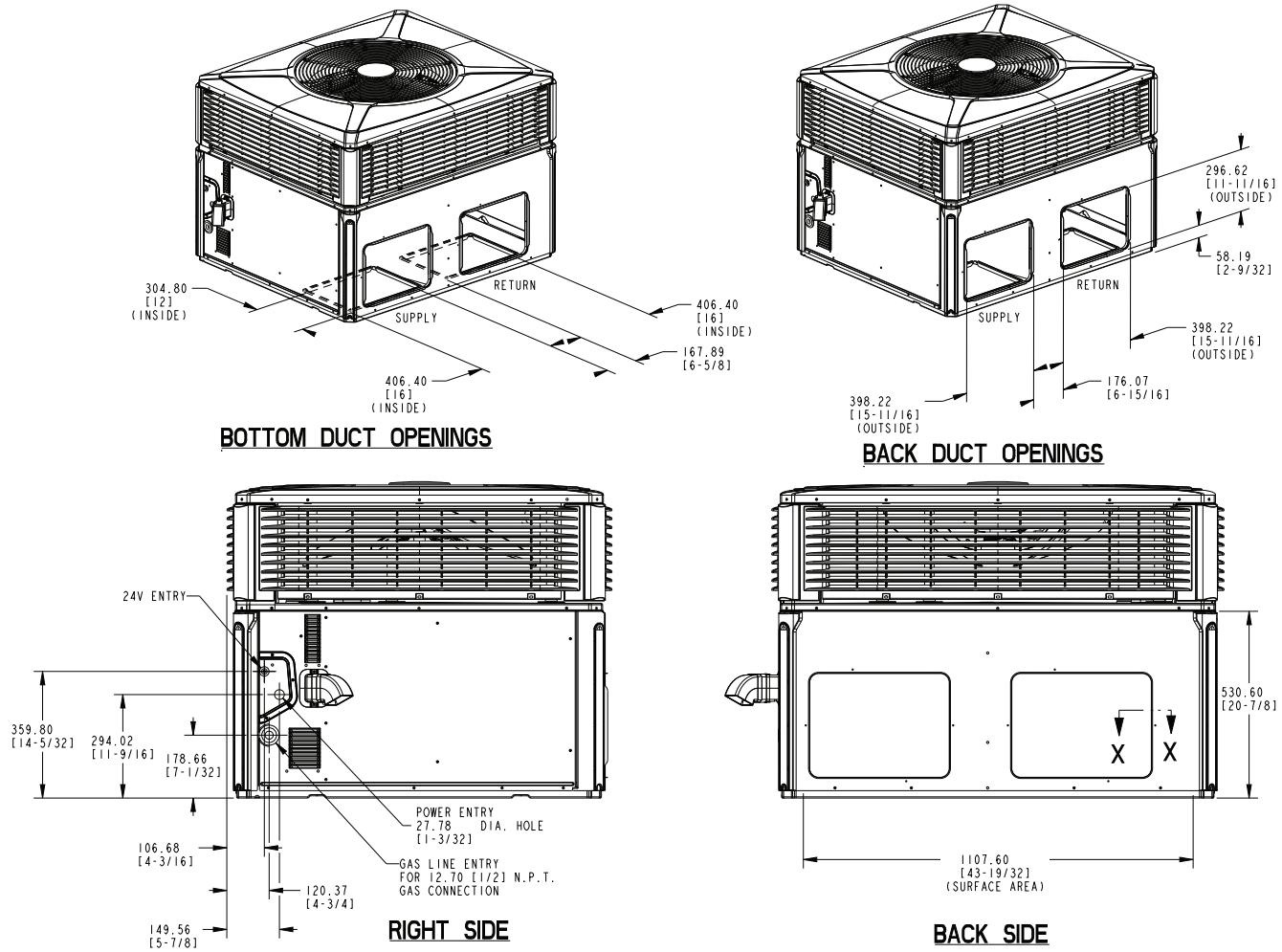
Figure 1. 2.0 — 3.0 Ton Models



RECOMMENDED SERVICE CLEARANCE MM/IN.		
		WITH ECONOMIZER
BACK SIDE	304.8 [12]	762.0 [30]
LEFT SIDE	762.0 [30]	914.4 [36]
RIGHT SIDE	914.4 [36]	-
FRONT SIDE	1066.8 [42]	-

CLEARANCE TO COMBUSTIBLE MATERIAL MM/IN.	
BOTTOM	0
BACK SIDE	25.4 [1]
LEFT SIDE	152.4 [6]
RIGHT SIDE	304.8 [12]
FRONT SIDE	304.8 [12]
TOP	914.4 [36]

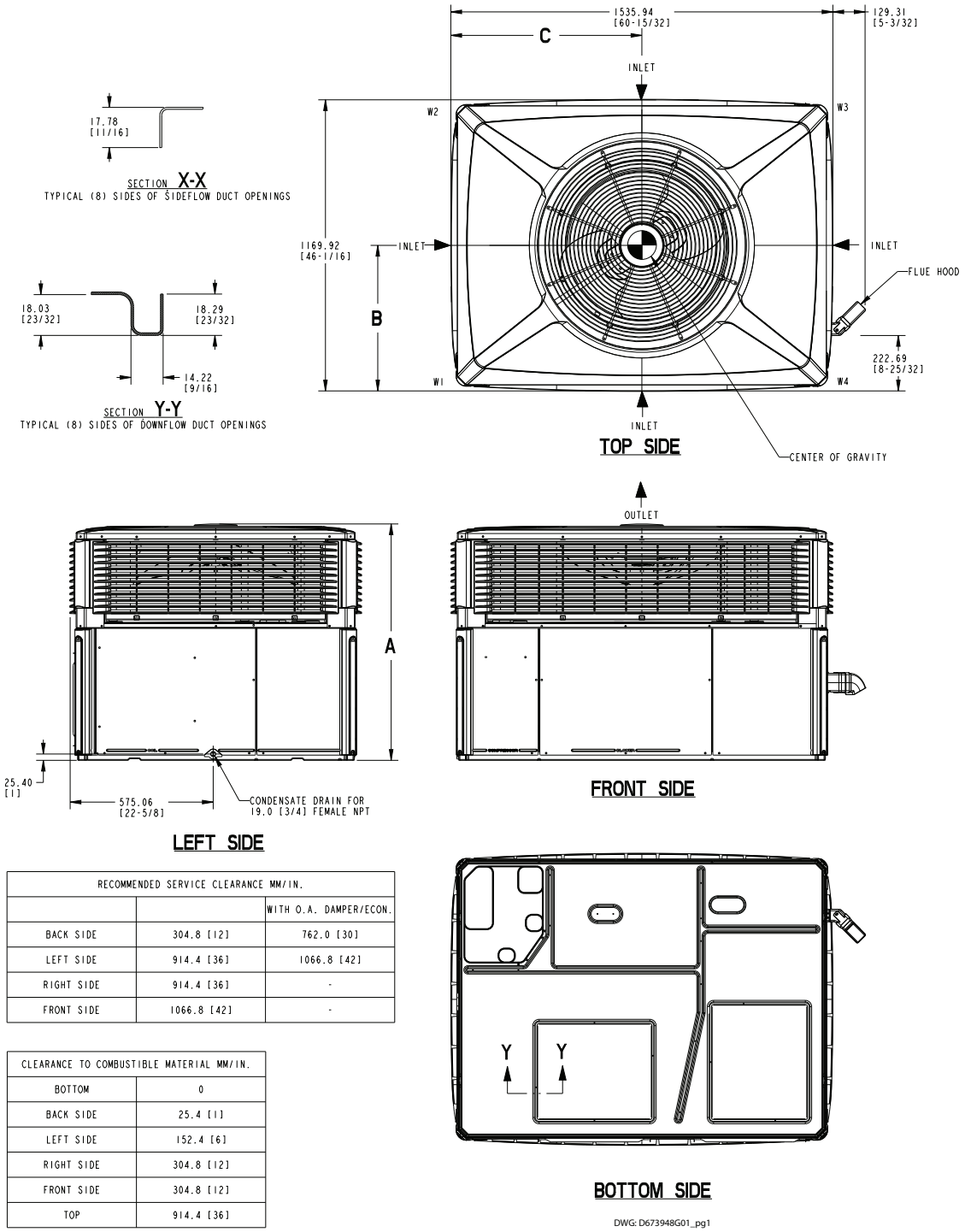
Figure 2. 2.0 — 3.0 Ton Models



MODEL	HEIGHT MM/IN.	FLUE HOOD W/BRKT MM/IN.	APPROX. CORNER WEIGHT - KG/LBS				SHIPPING WEIGHT KG/LBS	TOTAL UNIT WEIGHT KG/LBS	CENTER OF GRAVITY MM/IN.	
	A	D	W1	W2	W3	W4			B	C
4YCY4024 (064)	903.29 [35-9/16]	-	59.0 [130]	37.2 [82]	31.3 [69]	48.5 [107]	218.4 [481]	174.8 [385]	401.3 [15.8]	546.1 [21.5]
4YCY4030 (075)		134.94 [5-5/16]								
4YCY4036/4YCZ6036 (075)	949.99 [37-3/8]		60.3 [133]	36.3 [80]	30.4 [67]	50.3 [111]	221.6 [488]	178.0 [392]	388.6 [15.3]	558.8 [22.0]
4YCY4036/4YCZ6036 (096)			61.2 [135]	36.7 [81]	30.8 [68]	51.3 [113]	223.8 [493]	180.1 [397]	388.6 [15.3]	558.8 [22.0]
4DCY4024 (064)	903.29 [35-9/16]	-	60.8 [134]	38.1 [84]	31.3 [69]	48.5 [107]	218.4 [481]	174.8 [385]	398.8 [15.7]	546.1 [21.5]
4DCY4030 (075)		134.94 [5-5/16]								
4DCY4036/4DCZ6036 (075)	949.99 [37-3/8]		62.1 [137]	37.2 [82]	30.4 [67]	50.3 [111]	221.6 [488]	178.0 [392]	386.1 [15.2]	558.8 [22.0]
4YCY5024(060)	903.29 [35-9/16]	134.94 [5-5/16]	57.8 [128]	36.6 [81]	25.9 [57]	40.7 [90]	192.8 [425]	161.0 [355]	401.3 [15.8]	546.1 [21.5]
4YCY5030(070)	949.99 [37-3/8]	134.94 [5-5/16]	62.7 [138]	39.6 [87]	28.1 [62]	44.2 [97]	206.4 [455]	174.6 [385]	388.6 [15.3]	558.8 [22.0]
4YCY5036(070)	949.99 [37-3/8]	134.94 [5-5/16]	63.5 [140]	40.2 [89]	28.5 [63]	44.7 [99]	208.7 [460]	176.9 [390]	388.6 [15.3]	558.8 [22.0]
4YCY5036(090)	949.99 [37-3/8]	134.94 [5-5/16]	64.4 [142]	40.7 [90]	28.8 [64]	45.3 [100]	210.9 [465]	179.2 [395]	388.6 [15.3]	558.8 [22.0]

DWG: D673947G01_PG2

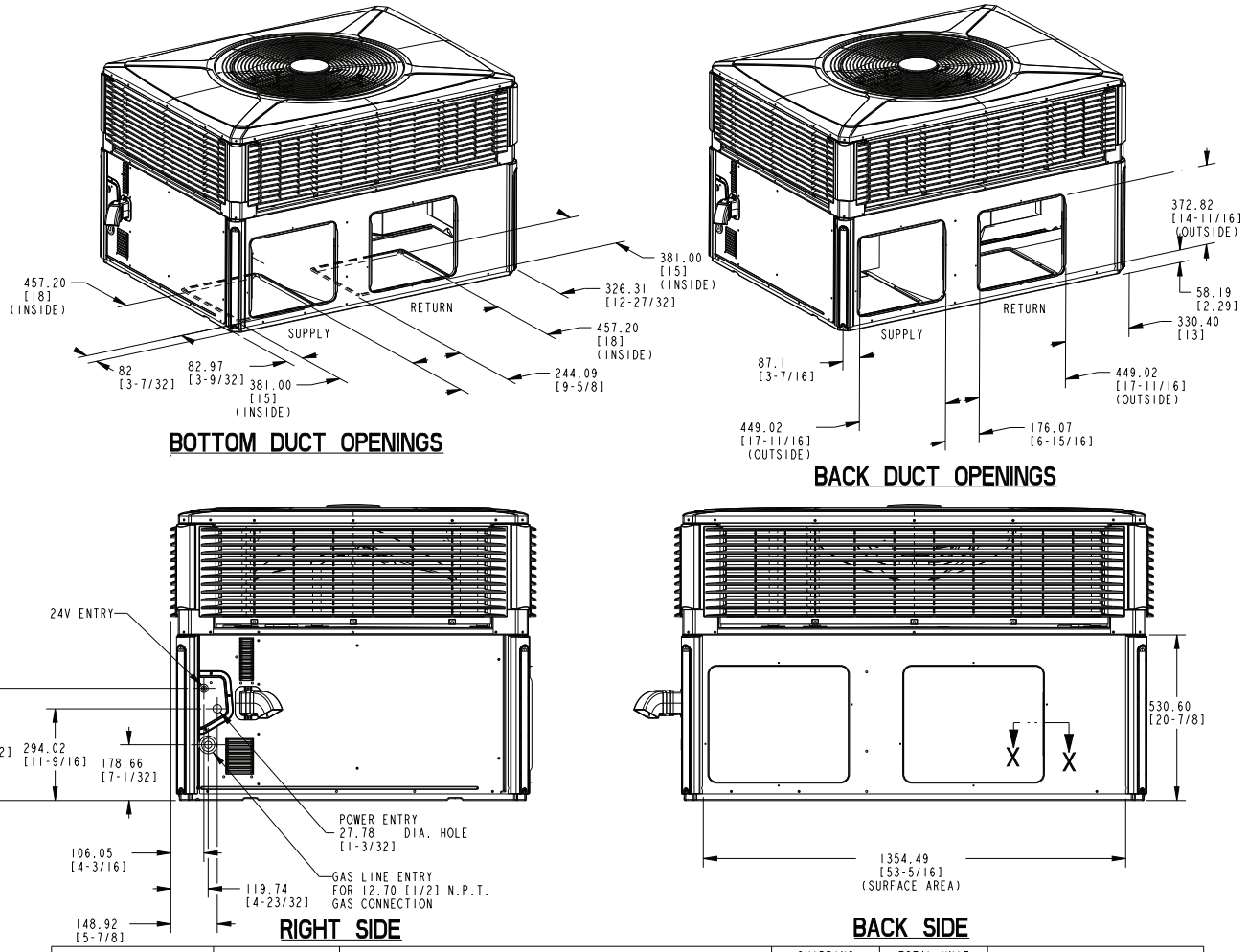
Figure 3. 3.5 — 5.0 Ton Models



RECOMMENDED SERVICE CLEARANCE MM/IN.		
		WITH O.A. DAMPER/ECON.
BACK SIDE	304.8 [12]	762.0 [30]
LEFT SIDE	914.4 [36]	1066.8 [42]
RIGHT SIDE	914.4 [36]	-
FRONT SIDE	1066.8 [42]	-

CLEARANCE TO COMBUSTIBLE MATERIAL MM/IN.	
BOTTOM	0
BACK SIDE	25.4 [1]
LEFT SIDE	152.4 [6]
RIGHT SIDE	304.8 [12]
FRONT SIDE	304.8 [12]
TOP	914.4 [36]

Figure 4. 3.5 — 5.0 Ton Models



MODEL	HEIGHT MM/IN.	APPROX. CORNER WEIGHT - KG/LBS				SHIPPING WEIGHT KG/LBS	TOTAL UNIT WEIGHT KG/LBS	CENTER OF GRAVITY MM/IN.	
	A	W1	W2	W3	W4			B	C
4YCY4042/048A (096)	949.33 [37-3/8]	75.3 [166]	50.3 [111]	45.4 [100]	67.6 [149]	296.5 [653]	238.1 [525]	444.5 [17.5]	698.5 [27.5]
4YCY4048A (120)		75.7 [167]	50.8 [112]	45.8 [101]	68.5 [151]	299.2 [659]	240.9 [531]	444.5 [17.5]	698.5 [27.5]
4YCY4048B (096)	949.33 [37-3/8]	77.1 [170]	52.2 [115]	47.2 [104]	69.4 [153]	303.4 [669]	245.9 [541]	444.5 [17.5]	698.5 [27.5]
4YCY4048B (120)	949.33 [37-3/8]	77.5 [171]	52.7 [116]	47.6 [105]	70.3 [155]	306.2 [675]	248.1 [547]	444.5 [17.5]	698.5 [27.5]
4YCY4060A1/A3 (120)	1050.93 [41-3/8]	82.1 [181]	46.3 [102]	43.1 [95]	76.7 [169]	306.9 [676]	248.6 [548]	401.3 [15.8]	711.2 [28.0]
4DCY4042/048A3 (096)	949.33 [37-3/8]	77.1 [170]	51.3 [113]	45.4 [100]	67.6 [149]	296.5 [653]	238.4 [525]	442.0 [17.4]	698.5 [27.5]
4DCY4048B (096)	949.33 [37-3/8]	78.9 [174]	53.0 [117]	47.2 [104]	69.4 [153]	306.6 [676]	248.5 [548]	442.0 [17.4]	698.5 [27.5]
4DCY4060B1 (120)	1050.93 [41-3/8]	67.9 [150]	47.0 [104]	56.7 [125]	82.0 [181]	311.7 [688]	253.6 [560]	457.2 [18.0]	673.1 [26.5]
4DCY4060A3 (120)	1050.93 [41-3/8]	83.9 [185]	47.2 [104]	43.1 [95]	76.7 [169]	306.9 [676]	248.8 [548]	398.8 [15.7]	711.2 [28.0]
4YCZ6048A1/A3/A4 (096)	1050.93 [41-3/8]	75.7 [167]	50.8 [112]	45.8 [101]	68.5 [151]	299.2 [659]	240.9 [531]	444.5 [17.5]	698.5 [27.5]
4YCZ6048A1/A3/A4 (120)		81.6 [180]	46.3 [102]	42.2 [93]	73.5 [162]	301.6 [665]	243.6 [537]	419.1 [16.5]	706.1 [27.8]
4YCZ6060A1/A3/A4 (120)	1050.93 [41-3/8]	82.1 [181]	46.3 [102]	43.1 [95]	76.7 [169]	306.9 [676]	248.6 [548]	401.3 [15.8]	711.2 [28.0]
4DCZ6048 (096)	1050.93 [41-3/8]	81.6 [180]	46.3 [102]	42.2 [93]	73.5 [162]	301.6 [665]	243.6 [537]	419.1 [16.5]	706.1 [27.8]
4DCZ6060 (120)	1050.93 [41-3/8]	83.9 [185]	47.2 [104]	43.1 [95]	75.7 [169]	306.9 [676]	248.8 [548]	398.8 [15.7]	711.2 [28.0]
4YCY5042A1(090)	1050.93 [41-3/8]	82.8 [182]	52.3 [115]	37.1 [82]	58.3 [128]	269.0 [593]	230.4 [508]	444.5 [17.5]	698.5 [27.5]
4YCY5048A1(090)	1050.93 [41-3/8]	75.7 [167]	50.8 [112]	45.8 [101]	68.5 [151]	279.4 [616]	240.9 [531]	444.5 [17.5]	698.5 [27.5]
4YCY5048A1(115)	1050.93 [41-3/8]	81.6 [180]	46.3 [102]	42.2 [93]	73.5 [162]	282.1 [622]	243.6 [537]	419.1 [16.5]	706.1 [27.8]
4YCY5060A1(115)	1050.93 [41-3/8]	82.1 [181]	46.3 [102]	43.1 [95]	76.7 [169]	287.1 [633]	248.6 [548]	401.3 [15.8]	711.2 [28.0]

DWG: D673948G01revB_pg2

Step 3 – Location and Recommendation Information

Note: *The unit is shipped for horizontal installation.*

Note: *During heating operation, avoid supply air below 80 degrees F or return air below 50 degrees F to prevent flue gas condensation.*

Horizontal Airflow Units

1. Location of the unit must allow service clearance around it to ensure adequate serviceability, maximum capacity, and peak operating efficiency.
2. These units are designed for outdoor installation. They may be installed directly on a slab, wood flooring, or on Class A, B, or C roof covering material. The discharge air from the condenser fans must be unrestricted for a minimum of 3 feet above the unit.
3. The louvers above and below the flue hood in the side panel must have adequate clearance around the air opening into the combustion area. See dimensional drawings preceding this section.
4. Examine all flue product-carrying areas of the furnace, its vent system, and the main burner for safe operation.

   Important: *A minimum 0" clearance to combustible material shall be maintained on air outlet duct.*
5. Exhaust vents or other sources of contaminated air must not be near the unit's air inlet if outside air is to be introduced as make-up air or a ventilation feature is to be used. Contamination from exhaust vents or chimneys may also foul the condenser causing degraded performance.
6. Check the handling facilities to ensure the safety of personnel and the unit(s).
7. The unit must be mounted level for proper drainage of water through the drain holes in the base pan.
8. The unit should not be exposed to direct roof water runoff.
9. Flexible duct connectors must be of a flame retardant material. All duct work outside of the structure must be insulated and weatherproofed in accordance with local codes.
10. Holes through exterior walls or roof must be sealed in accordance with local codes.
11. All fabricated outdoor ducts should be as short as possible.

Clearances

1. See previous outline illustrations for single unit installation clearances.
2. Any reduction of the unit clearances indicated in these figures may result in condenser coil starvation or the recirculation of warm condenser air. Actual clearances, which appear to be inadequate should be reviewed with a local engineer.
3. See the unit's nameplate for the absolute minimum clearance between the unit and any combustible surfaces.

Down Airflow Units

1. Location of the unit must allow service clearance around it to ensure adequate serviceability, maximum capacity, and peak operating efficiency.
2. Refer to the Installation section for instruction on converting the supply and return airflow covers to down airflow.
3. The field assembled Roof Mounting Curb (BAYCURB050A or BAYCURB051A) or a field fabricated curb should be in place before the unit is hoisted to the roof top.

   The Roof Mounting Curb (frame) must be installed on a flat, level section of the roof (maximum of 1/4" per foot pitch) and provide a level mounting surface for the unit. Also, be sure to provide sufficient height above the roof to prevent water from entering the unit.
4. Be sure the mounting curb spans structural members (trusses) of the roof, thereby providing sufficient support for the weight of the unit, the curb, the duct(s), and any factory or field installed accessories.
5. The unit must be mounted level for proper drainage of water through the drain holes in the base pan.
6. Be sure the hole in the structure for the ducts is large enough to accommodate the fabricated ducts and the insulation surrounding them. Flexible duct connectors must be of a flame retardant material. All duct work outside of the structure must be insulated and weatherproofed in accordance with local codes.
7. Holes through exterior walls or roof must be sealed in accordance with local codes.
8. These units are designed for outdoor installation. They may be installed directly on a slab, wood flooring, or on Class A, B, or C roof covering material. The discharge air from the condenser fans must be unrestricted for a minimum of 3 feet above the unit.
9. The louvers above and below the flue hood in the side panel must have adequate clearance around the air opening into the combustion area.
10. Examine all flue product-carrying areas of the furnace, its vent system, and the main burner for safe operation.

Important: *A minimum 0" clearance to combustible material shall be maintained on air outlet duct.*

11. Exhaust vents or other sources of contaminated air should not be near the unit's air inlet if outside air is to be introduced as make-up air or a ventilation feature is to be used. Contamination from exhaust vents or chimneys may also foul the condenser causing degraded performance.
12. Check the handling facilities to ensure the safety of personnel and the unit(s).

Unit Installation

Figure 5. Typical Ground Level Application

Note: *Use the extreme mounting kit, BAYEXMK003AA, to secure the unit to the slab.*

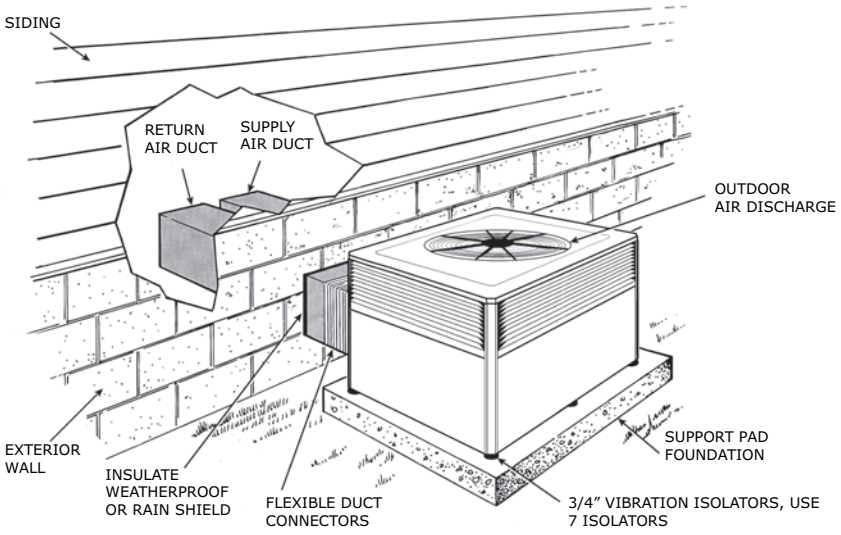
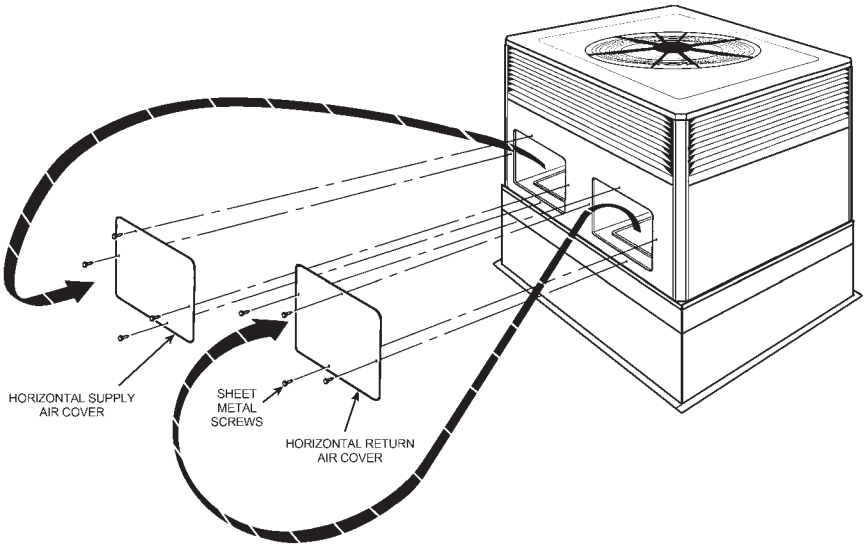


Figure 6. Converting Horizontal to Down Airflow

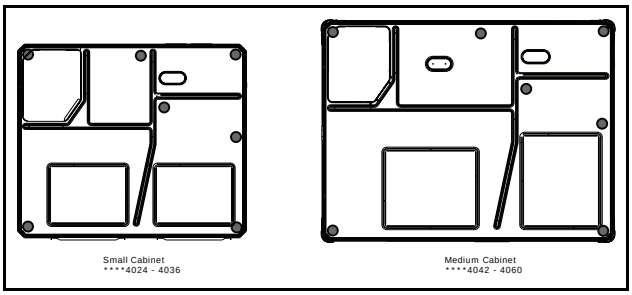


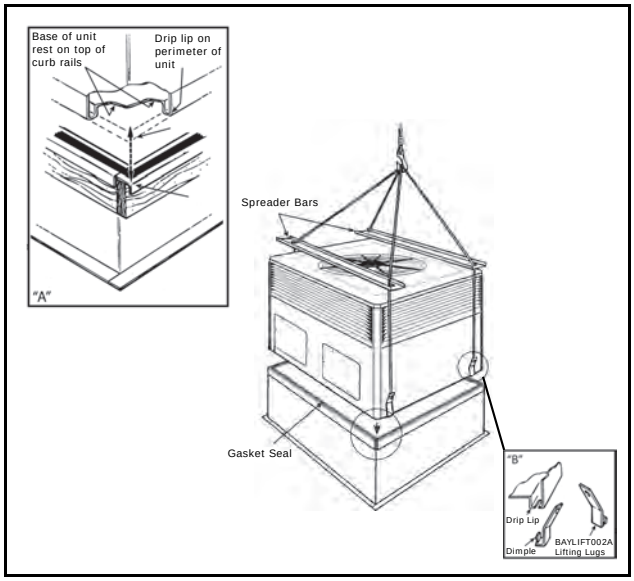
⚠ WARNING

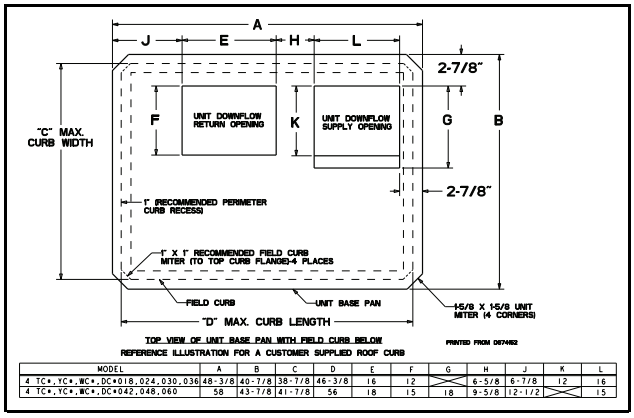
IMPROPER UNIT LIFT!

Failure to properly lift unit could result in death or serious injury or possible equipment or property-only damage

Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level. .







MODEL	A	B	C	D	E	F	G	H	J	K	L
4 TC*,YC*,WC*,DC*018,024,030,036	48-3/8	40-7/8	38-7/8	46-3/8	16	12		6-5/8	6-7/8	12	16
4 TC*,YC*,WC*,DC*042,048,060	58	43-7/8	41-7/8	56	18	15	18	9-5/8	12-1/2		15

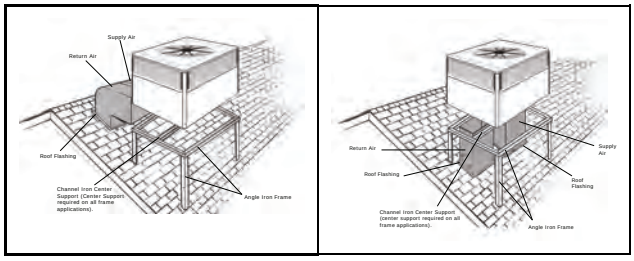


Figure 7. Attaching Down Airflow Ductwork

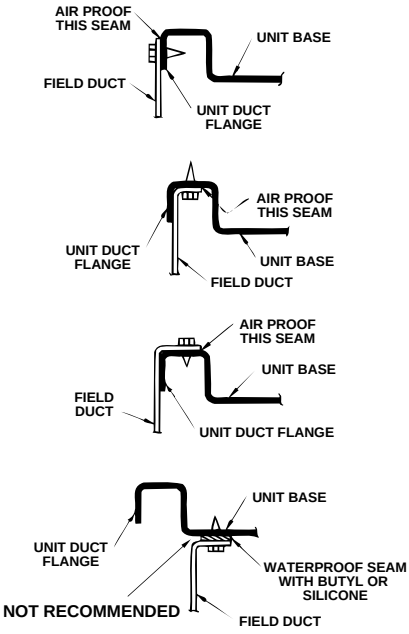
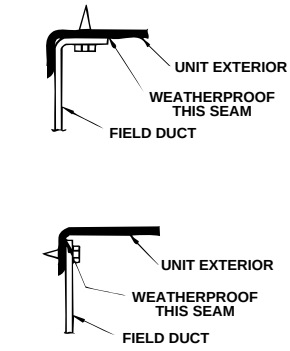


Figure 8. Attaching Horizontal Airflow Ductwork



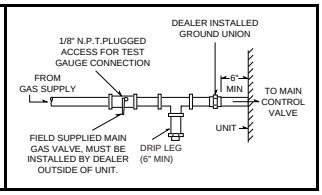
⚠ WARNING

FIRE OR EXPLOSION HAZARD!

Failure to follow the safety warning exactly could result in serious injury, death, or property damage.

Use a commercially available soap solution made specifically for the detection of leaks to check all connections.

$$CFH = \frac{\text{Furnace Input in BTUH}}{\text{Gas Heat Contne in BTU/Cu. Ft. X Multiplier}}$$



Electrical Wiring

⚠ WARNING

INSTALLATION WARNING — HIGH VOLTAGE MOVING PARTS!

Failure to follow this Warning could result in property damage, severe personal injury, or death.

Bodily injury can result from high voltage electrical components, fast moving fans, and combustible gas. For protection from these inherent hazards during installation and servicing, the main gas valve must be turned off and the electrical supply must be disconnected. If operating checks must be performed with the unit operating, it is the technician's responsibility to recognize these hazards and proceed safely.

Note: *This unit is factory wired for 230V. See wiring diagram for 208V conversion.*

Electrical Connections

Electrical wiring and grounding must be installed in accordance with local codes or, in the absence of local codes, with the National Electrical Code ANSI/NFPA 70, Latest Revision.

Disconnect Switch

Provide an approved weatherproof disconnect within close proximity and **within sight of the unit.**If disconnect must be mounted to the cabinet, the location shown in Figure 11, p. 14should be the only one considered.

Over Current Protection

The branch circuit feeding the unit must be protected as shown on the unit's rating plate.

Power Wiring

The power supply lines must be run in weather-tight conduit to the disconnect and into the side of the unit control box. Provide strain relief for all conduit with suitable connectors.

Provide flexible conduit supports whenever vibration transmission may cause a noise problem within the building structure.

1. Remove the Control/Heat access panel. Pass the power wires through the Power Entry hole in the end of the unit. Figure 9, p. 13
2. Connect the high voltage wires to the appropriate contactor terminals. Single phase units use a two (2) pole contactor and three phase units use three (3) pole contactor. Connect the ground to the ground lug on the chassis. See Figure 10, p. 13.

Be sure all connections are tight.

GROUNDING: THE UNIT MUST BE ELECTRICALLY GROUNDED IN ACCORDANCE WITH LOCAL CODES OR THE NATIONAL ELECTRIC CODE.

Note: *Unit must be grounded for ignitor to operate properly. Gas pipe to unit is not an adequate ground. Ground the unit internally as provided. See wiring diagram for location in .*

Figure 9. Power Wiring

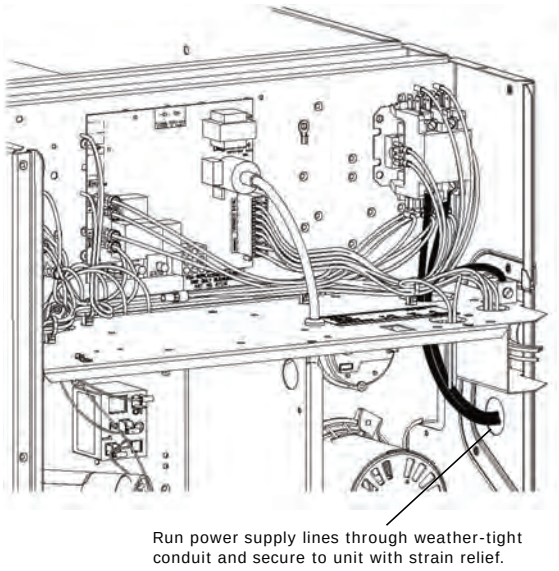


Figure 10. Power Connections

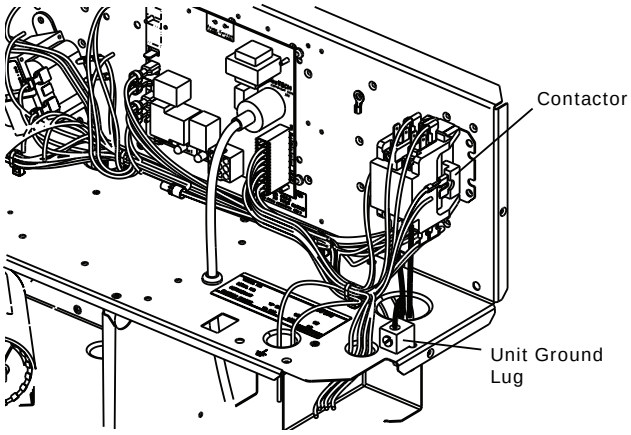
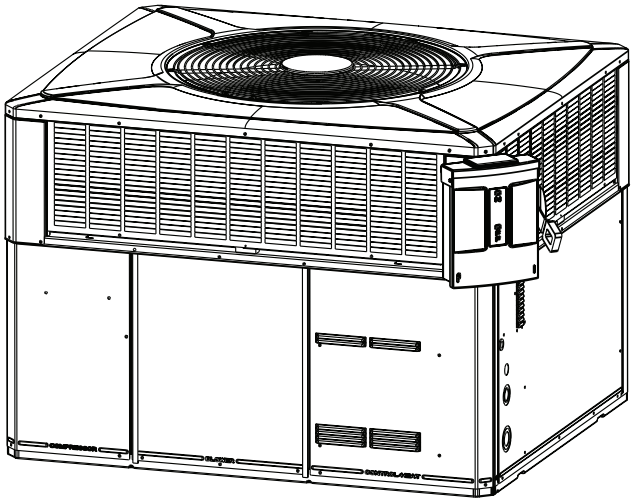


Figure 11. Mounted Disconnect Location



Control Wiring (Class II)

Low voltage control wiring should not be run in conduit with power wiring unless Class 1 wire of proper voltage rating is used. Route the thermostat cable or equivalent single leads of No. 18 AWG colored wire from the thermostat subbase terminals through the rubber grommet on the unit. See Unit Clearance Graphics for the control entry (24V Entry) location. Make connections as shown on the unit wiring diagram.

Do not short thermostat wires since this will damage the control transformer.

Refer to Table 1, p. 14 for recommended wire sizes and lengths for installing the unit thermostat. The total resistance of these low voltage wires must not exceed one (1) ohm. Any resistance in excess of 1 ohm may cause the control to malfunction because of the excessive voltage drop.

Table 1. Thermostat Wire Size and Max. Length

Wire Size	Maximum Length
18	75
16	125
14	200

Thermostat Heat Anticipator

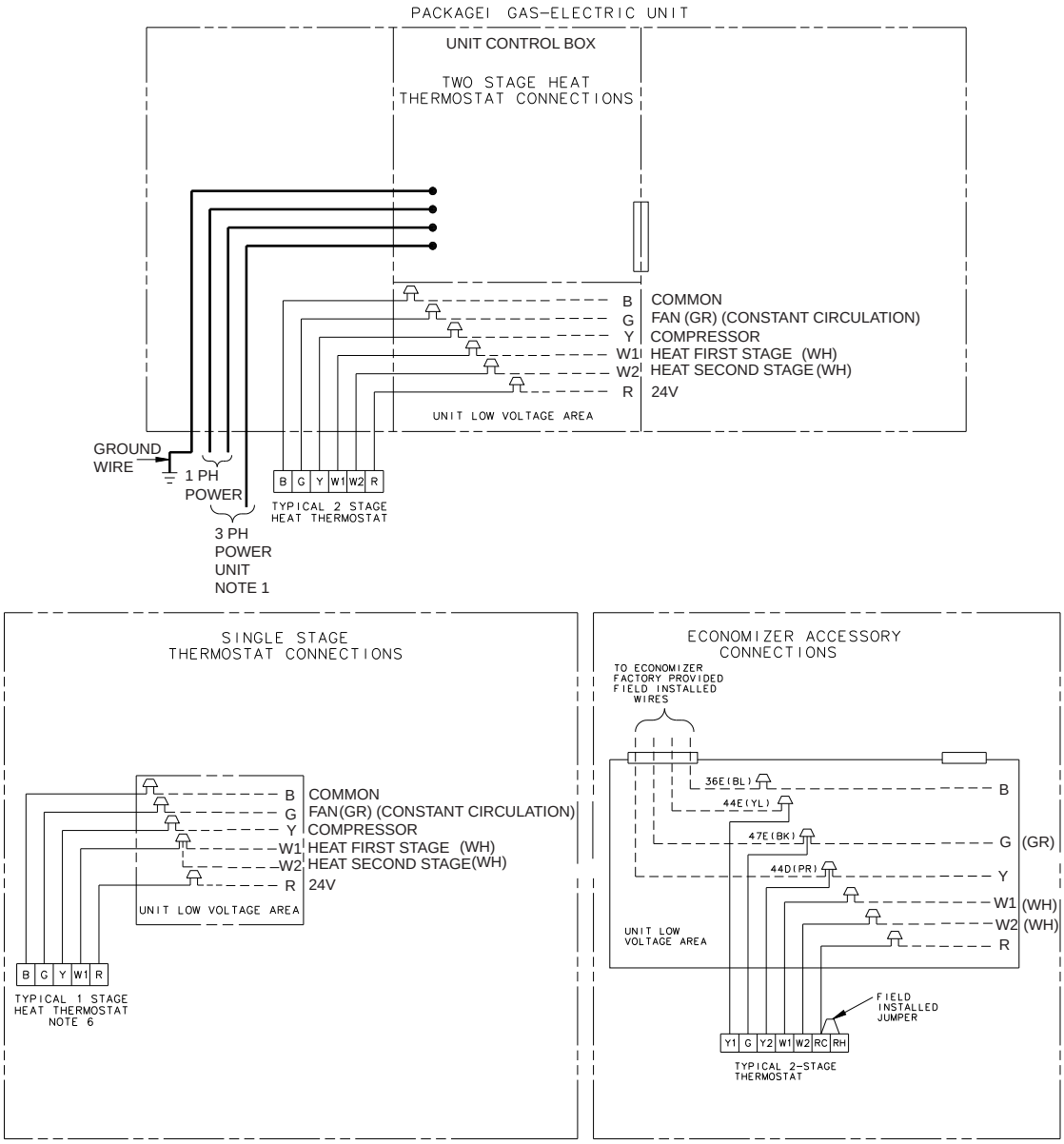
Set the heat anticipator of the thermostat to equal the amperage draw of the gas valve

Important: Upon completion of wiring, check all electrical connections, including factory wiring within the unit.

Make sure all connections are tight. Replace and secure all electrical box covers and access panels before leaving the unit or turning on the power to the unit.

Field Wiring

Figure 12. 4YCY5024–042 Field Wiring Diagram



NOTES:

1. FUSED DISCONNECT SIZE, POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT AND HEATER NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE 18 AWG MINIMUM CONDUCTOR.
4. SEE UNIT DIAGRAM FOR ELECTRICAL CONNECTION DETAILS.
5. THE THERMOSTAT ON THE GAS/ELECTRIC UNIT MUST PROVIDE A 'G' SIGNAL IN THE COOLING MODE ONLY. DURING THE HEATING MODE THE FAN WILL BE ENERGIZED BY THE SYSTEM.
6. FOR SINGLE STAGE THERMOSTATS JUMPER W1 AND W2 TOGETHER. SECOND STAGE HEAT WILL BEGIN 10 MINUTES AFTER FIRST STAGE.

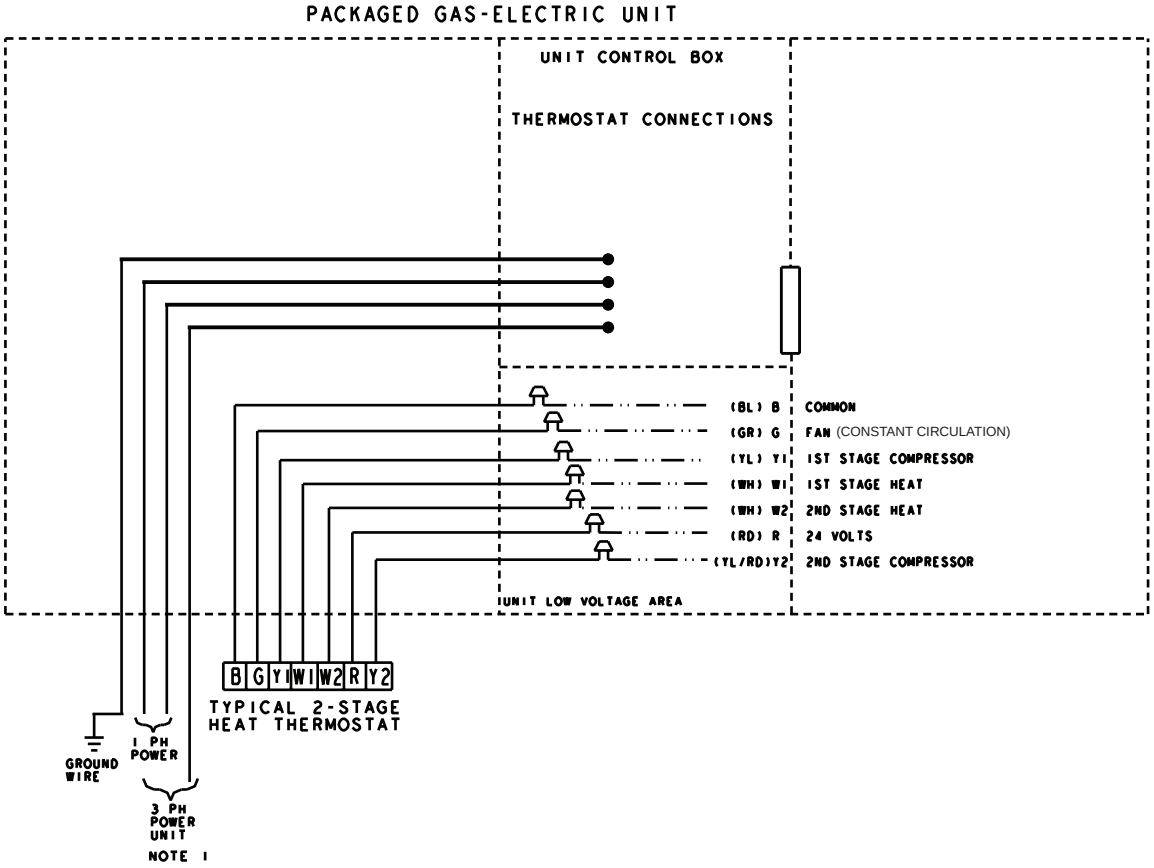
INTER–COMPONENT WIRING

- 24V. / LINE V. } FACTORY WIRING
- 24V. / LINE V. } FIELD WIRING

WIRE COLOR DESIGNATION			
ABBR	COLOR	ABBR	COLOR
BK	BLACK	PR	PURPLE
BL	BLUE	RD	RED
BR	BROWN	WH	WHITE
GR	GREEN	YL	YELLOW
OR	ORANGE		

C 757192i2

Figure 13. 4YCY5048–060 Field Wiring Diagram



NOTES:

1. FUSED DISCONNECT SIZE, POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH CODES.
2. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT AND HEATER NAMEPLATE.
3. LOW VOLTAGE WIRING TO BE 18 AWG MINIMUM CONDUCTOR.
4. SEE UNIT DIAGRAM FOR ELECTRICAL CONNECTION DETAILS.
5. THE THERMOSTAT ON THE GAS/ELECTRICAL UNIT MUST PROVIDE A 'G' SIGNAL IN THE COOLING MODE ONLY. DURING THE HEATING MODE THE FAN WILL BE ENERGIZED BY THE SYSTEM.
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INTER-COMPONENT WIRING

24V } FACTORY WIRING
LINE V }

24V. } FIELD WIRING
LINE V. }

WIRE COLOR DESIGNATION			
ABBR	COLOR	ABBR	COLOR
BK	BLACK	PR	PURPLE
BL	BLUE	RD	RED
BR	BROWN	WH	WHITE
GR	GREEN	YL	YELLOW
OR	ORANGE		

Step 5 — Unit Startup

Pre-Start Quick Checklist

- ☐ Is the unit properly located and level with the proper clearances? See Figures 1–6.
- ☐ Is the duct work correctly sized, run, taped, insulated, and weatherproofed with proper unit arrangement as shown in the ductwork installation section?
- ☐ Is the condensate line properly sized, run, trapped, and pitched and shown in the Condensate Drain Piping section?
- ☐ Is the gas piping correctly sized, run, trapped, and purged of air? See Gas Piping Installation section.
- ☐ Is the filter of the correct size and quantity? Is it clean and in place? See Air Filter Installation section.
- ☐ Is the wiring properly sized and run according to the unit wiring diagram?
- ☐ Are all the wiring connections, including those in the unit tight?
- ☐ Has the unit been properly grounded and fused with the recommended fuse size?
- ☐ Is the thermostat well located, level, and correctly wired? See Electrical Wiring section
- ☐ Have the air conditioning systems been checked at the service ports for charge and leak tested if necessary?
- ☐ Do the condenser fan and indoor blower turn free without rubbing and are they tight on the shafts?
- ☐ Has the indoor blower speed been determined and the proper speed been set? To adjust the fan, see the Indoor Fan Motor Speed Tap Setting section.
- ☐ Has all work been done in accordance with applicable local and national codes?
- ☐ Are all covers and access panels in place to prevent air loss and safety hazards?

Starting the Unit in Cooling Mode

Note: *See the section on Sequence of Operation for a description of the cooling operating sequence.*

To start the unit in the cooling mode, set the thermostat system switch to COOL and move the thermostat COOL indicator to a setting below room temperature. The condenser fan motor, compressor and evaporator fan motor will operate automatically.

Operating Pressure Checks

After the unit has operated in the cooling mode for a short period of time, install pressure gauges on the gauge ports of the discharge and suction line valves (behind the Compressor access panel). Check the suction and discharge pressures and compare them to the normal operating pressures provided in the unit's SERVICE FACTS.

Note: *Do not use the PRESSURE CURVES from the unit's SERVICE FACTS to determine the unit refrigerant charge. The correct charge is shown on the unit nameplate. To charge the system accurately, weigh in the charge according to the unit nameplate and check subcooling against the Subcooling Charging Table in the SERVICE FACTS.*

Voltage Check

With the compressor operating, check the line voltage at the unit (contactor is located behind the Control/Heat access panel). The voltage should be within the range shown on the unit nameplate. If low voltage is encountered, check the size and length of the supply line from the main disconnect to the unit. The line may be undersized for the length of the run.

Cooling Shut Down

At the thermostat, place the system selector to the OFF position or reset the thermostat to a setting above room temperature.

Important: *De-energize the main power disconnect ONLY when servicing the unit. Power may be required to keep the heat pump compressor warm and to boil off refrigerant in the compressor.*

Starting the Unit in Heating Mode

Note: *See the section on Sequence of Operation for a description of the heat pump heating operating sequence.*

These units are equipped with a solid-state ignition control that lights the burners each time the thermostat calls for heat. The burners are extinquished during the OFF cycle. To start the gas heating section of the unit:

1. Check that all grills and registers are open and all unit access panels are closed before start-up.
2. Purge the gas supply line of air by opening the union ahead (upstream) of the unit. When the odor of gas is detected, retighten the union and wait five (5) minutes before proceeding.
3. Be sure the thermostat is at its lowest setting and the power to the unit is off.
    a. Turn the main shut-ff valve on the gas supply line to ON.
    b. Turn the thermostat to the highest setting in the heating cycle.
4. Be sure the burner compartment access panel is in place.

a. Turn on the electrical power to the unit.

b. Turn the thermostat to the highest setting in the heating cycle.

5. As the thermostat calls for heat, the system cycles as follows:

   a. The combustion blower is energized.

   b. The pressure switch is closed.

   c. The gas valve opens and the ignitor lights the burner.

   d. Cycle the thermostat on and off a few times to check out the control system and burner operation characteristics.

      Note: *For manifold pressures and orifice sizes for gas with other BTU ratings, contact the local gas utility. Manifold pressure should be 3.5 inches w.c. (+0.1). Input must* ***not*** *exceed the value shown on the rating plate.*

   e. With the burner operating, check the manifold pressure with a manometer.

6. Do not exceed recommended pressures. If the manifold pressure needs adjustment, refer to Manifold Pressure Check and Adjust in the Maintenance section. With the burners operating, check the manifold pressure with a manometer.

7. If necessary, adjust the unit to obtain an air temperature rise with that specified on the unit nameplate. To adjust, refer to the Indoor Fan Motor Speed Adjustment in the Maintenance section.

   Note: *Blue smoke produced by the heat exchanger during the initial burner firing is caused by a thin film of oil on the surface of the heat exchanger. This oil will burn off quickly.*

8. Set the thermostat at the desired temperature setting and the unit will function automatically.

Final Installation Checklist

☐ Does the unit run and operate as described in the section on "Sequence of Operation" in response to the room thermostat?

☐ Are the condenser fan and indoor blower operating correctly with proper rotation and without undue noise?

☐ Is the compressor operating correctly and has the system been checked with a charging chart?

☐ Has the voltage and running current been checked to deter mine if it is within limits?

☐ Has the thermostat been checked for calibration and the air discharge grilles adjusted to balance the system?

☐ Has the ductwork been checked for air leaks and condensation?

☐ Has the furnace manifold pressure been checked and adjusted if necessary?

☐ Has the heating air temperature rise been checked?

☐ Has the unit been checked for tubing and sheet metal rattles? Are there any other unusual noises to be checked?

☐ Are all covers and panels in place and properly fastened?

☐ Has the owner been instructed on the proper operation and maintenance of the unit? Be sure to leave this manual with the owner.

Sequence of Operation

Operation of the unit heating or cooling cycles is controlled by the setting of the comfort control. Once the comfort control is set to either HEAT or COOL, unit operation is automatic. A fan setting on the comfort control also provides for continuous operation of the indoor fan when desired. The fan, when set to ON provides continuous operation at constant circulation of 40 - 50% nominal airflow at selected dipswitch setting, while AUTO provides operation during the heating or cooling cycles. CONTINUOUS fan mode during COOLING operation may not be appropriate in humid climates. If the indoor air exceeds 60% relative humidity or simply feels uncomfortably humid, it is recommended that the fan only be used in the AUTO mode.

Heating Cycle
Comfort Control call for heat (2–stage thermostat)
Call for 1st stage only:

(R) and (W1) thermostat contacts close signaling the control module (IGN) to run its self-check routine. After the control has verified that the pressure switch (PS) contacts are open, the limit switch (TCO) contacts are closed, and the flame rollout (FL) switch is closed, the induced draft blower (CBM) will be energized on high speed for approximately 5 seconds.

After the induced draft blower (CBM) has come up to speed, the control will verify that the pressure switch (PS) contacts are closed and switch the induced draft blower to low speed for 20 second prepurge. The gas valve (GV) is energized in the first stage to permit gas flow and the spark igniter (IP) is energized. The flame detector (FD) confirms that ignition has been achieved within the 7 second trial period.

As the flame detector confirms that ignition has been achieved the delay to indoor fan on period begins timing and after approximately 45 seconds, the indoor blower motor (IDM) will be energized at low speed and will continue to run during the heating cycle.

Call for 2nd stage after 1st stage:

(R) and (W2) thermostat contacts close signaling a call for second stage heat. The induced draft motor (CBM) is energized on high speed and the gas valve on second stage. After approximately 30 seconds the control energizes the indoor blower on high speed.

2nd stage satisfied, 1st stage still called:

(R) and (W2) opens, the induced draft blower is reduced to low speed the gas valve is reduced to first stage. After about 30 seconds the indoor blower motor is reduced to low speed.

1st stage satisfied:

(R) and (W1) opens, the gas valve (GV) will close. The induced draft blower (CBM) will be de-energized after approximately 5 seconds postpurge. The indoor blower motor (IDM) will continue to run for the fan off period (field selectable 60 or 90 seconds [by jumpers]), then will be de-energized by the control module.

Comfort Control call for heat (1-stage Comfort Control)

(R) and (W1/W2) (jumped) thermostat contacts close signaling a call for heat. 1st stage sequence of operation remains the same as above. 2nd stage heat has a 10 minute delay from the time of 1st stage ignition.

Comfort Control satisfied:

(R) and (W1/W2) (jumped) contacts open signaling the control module to close the gas valve and de-energize the induced draft blower after approximately 5 second postpurge. The I.D. blower motor will continue to operate at the current speed for 60 or 90 seconds after the flames are extinguished .

Safety Sequences

This product is equipped with safety devices to protect against abnormal conditions.

The temperature limit switch (TCO) is located on the blower barrier, and can be accessed through the blower compartment. This automatic reset device protects against excessive supply air temperature. If this device opens, the gas valve is immediately closed and will not permit operation until the limit switch closes.

The rollout switch (RO) is located in the gas compartment near the inlet of the burners. This is a manual reset device designed to protect against any form of flame rollout. If this device is opened the gas valve is immediately de-energized and the control (IGN) will lockout the system. The rollout switch (RO) must be reset before operation is allowed to continue.

The pressure switch (PS) is located in the upper right side of the gas compartment. This automatic device assures adequate combustion air pressure. If pressure against the induced draft blower outlet becomes excessive, the pressure switch will react and shut off the gas valve, until acceptable combustion pressure is again available.

If the control (IGN) does not sense flame within the first trial for ignition period, the gas valve will be de-energized. The control (IGN) will initiate a 60-second interpurge. Following the interpurge, the control will perform a second ignition attempt. If the second try is not successful, the control will start another 60-second interpurge. After the interpurge, a third attempt will be tried. If the third try is not successful, the control will lock out.

If loss of flame occurs during a heating cycle, the control (IGN) will close the gas valve and cycle through the ignition trial as stated above.

If control lock out occurs, the control (IGN) will retry a complete ignition sequence in 1 hour.

The control (IGN) can be reset by removing power to the unit or by turning the thermostat from ON to OFF for approximately three seconds, then back ON.

Cooling Cycle

With the comfort control set to COOL and the fan set to AUTO, the compressor contactor (CC) and the indoor fan motor (IDM) are energized.

The energized compressor contactor (CC) completes the circuit to the compressor (CPR) and a secondary circuit to the outdoor fan motor (ODM). If the compressor safety controls are closed, the compressor (CPR) will operate with the outdoor fan motor (ODM). The indoor fan motor (IDM) will operate. The thermostat will continue to cycle the compressor and fans to maintain the desired temperature.

With the comfort control fan set to ON, the indoor fan motor (IDM) will continue to run at constant circulation regardless of compressor and condenser fan operation.

Maintenance

⚠ WARNING

EXPLOSION HAZARD!

Failure to follow this Warning could result in property damage, serious personal injury, or death.

Do not store combustible materials, gasoline, or other flammable vapors or liquids near the unit.

Some of the periodic maintenance functions of the packaged unit can be performed by the owner; this includes replacing the disposable or cleaning the permanent air filters, cleaning the unit cabinet, and conducting a general unit inspection on a regular basis.

Filters

When the system is in constant operation, inspect the filters at least once each month.

If you have disposable-type filters, replace them with new filters of the same type and size. Do not attempt to clean disposable filters.

Permanent-type filters can be cleaned by washing them with a mild detergent and water. Make sure that the filters are thoroughly dry before reinstalling them.

Note: *It may be necessary to replace permanent filters annually if washing fails to clean the filter or if the filter shows signs of deterioration. Be sure to use the same type and size as was originally installed.*

Condenser Coil

Be sure to keep all vegetation and debris away from the condenser coil area.

Service Maintenance

Service maintenance should be performed by qualified service personnel.

Cooling Season

To keep the unit operating safely and efficiently, the manufacturer recommends that a qualified service technician check the entire system at least once each year or more often if needed. The service technician should examine these areas of the packaged unit:

- filters (for cleaning or replacement)
- motors and drive system components
- economizer gaskets (for possible replacement)
- safety controls (for mechanical cleaning)
- electrical components and wiring (for possible replacement and connection tightness)
- condensate drain (for proper sealing and cleaning)
- unit duct connections (to see that they are physically sound and sealed to the unit casing)
- unit mounting support (for structural integrity)
- the unit (for obvious unit deterioration)

Heating Season

Complete the following unit inspections and service routines described at the beginning of each heating season.

- Visually inspect the unit to ensure that the airflow required for combustion and condenser coil is not obstructed from the unit.
- Inspect the control panel wiring to verify that all electrical connections are tight and that the wire insulation is intact.
- Check the operation of the gas ignition system as follows: Turn off the gas supply with the unit operating to verify that the gas valve closes and that a re-ignition cycle is initiated by the unit.
- Visually inspect the inside of the burners and the burner ports for deposit buildup and corrosion. Wipe and brush the inside of the burner and the burner ports and then clean with a dry cloth. If the deposit buildup or corrosion is excessive, replace the burners.

Manifold Pressure Check and Adjust

1. Connect a manometer to the pressure tap at the outlet side of the unit's gas valve (remove the Control/Heat access panel). Read the manifold pressure with the burners firing. See for gas valve connections.
2. If the manifold pressure reading does not match the value indicated on the unit's nameplate, the unit's pressure regulator must be adjusted as follows:
   a. Remove the cover screw on the gas regulator located on the front side of the unit's gas valve.
   b. Turn the adjusting screw clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure.

3. Check the temperature rise during furnace operation to insure that it falls within the range specified on the unit's nameplate.
4. If the temperature rise noted is outside of the specified limits, adjust the indoor air flow to cause the temperature rise of the heat exchanger to fall within the required range.

Flue Hood and Combustion Blower Cleaning

⚠ CAUTION

Fire or Explosion!

Failure to follow proper procedures can result in personal injury or severe equipment damage
Never use combustible cleaning fluids on any part of the furnace.

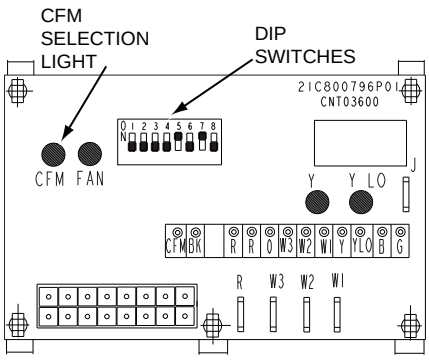
Before each heating season, the flue should be inspected for signs of flaking rust and soot deposits. **Dirty flues should be cleaned by qualified service personnel ONLY** using the following procedure:

1. Turn the comfort control to **OFF**. Turn the main power disconnect **OFF**. Turn the manual gas valve **OFF**.
2. Remove the flue hood and the CONTROL/HEAT access panel.
3. Remove the combustion blower assembly from the flue box. Remove the flue box and the flue restrictors.
4. Remove all wires from the gas valve while carefully noting their locations.
5. Disconnect the gas supply line from the valve.
6. Remove the manifold retaining screws and pull the burner-manifold assembly from the heat exchanger.
7. Remove the inlet turbulators being careful not to break or damage them.
8. Wipe the flue box and flue baffles clean with a clean, dry cloth.
9. Replace all gaskets with new ones.
10. Replace all damaged or broken turbulators with new ones.
11. Reassemble the unit by reversing Steps 2 through 7 above. Take care that all gaskets seat properly.
12. Check all wires for correct installation by referring to the unit's electrical wiring diagram in the SERVICE FACTS.
13. Leak test all gas line connections with a soap and water solution or the equivalent.
14. Re-install the CONTROL/HEAT access panels and the flue hood.
15. Visually inspect the unit to ensure that the airflow opening for combustion is not obstructed.
16. Follow the start-up procedure on page 22 to place the unit back in service.

ECM Fan Motor Adjustments

If the airflow needs to be increased or decreased, see the Airflow Table in the SERVICE FACTS. Information on changing the speed of the blower motor is in the Blower Performance Table. Blower speed changes are made on the ECM Fan Control mounted in the control box. The ECM Fan Control controls the variable speed motor. There is a bank of 8 dip switches, (See Figure 23 below), located on the board. The dip switches work in pairs to match the cooling/heat airflow (CFM/TON), Fan off-delay options and electric heat airflow adjustment. The switches appear as shown in the ECM Fan Control Figure.

Figure 14. ECM Fan Control



IGN Diagnostic Flash Codes

IGN Diagnostic Flash Codes			
Status LED		Liteport LED	
Steady OFF	Check Power or Bad Board	2 Flashes	System Lockout: Failed to detect or sustain flame.
Slow Flash Rate	Normal, No Call for Heat	3 Flashes	Pressure switch problem detected.
Fast Flash Rate	Not used	4 Flashes	High limit switch protection device open
Steady ON	Normal, Call for Heat	5 Flashes	Flame sensed and gas valve not energized or flame sensed and no "W" signal.
-	-	6 Flashes	Flame Rollout Switch open
-	-	7 Flashes	Thermostat miswired: W1 & W2

1. Fast Flash Rate: The LED will flash on for 1/4 second and off for 1/4 second.
2. Slow Flash Rate: The LED will flash on for 3/4 second then off for 1/4 second.
3. The pause between groups of fast flashes is 3 seconds.

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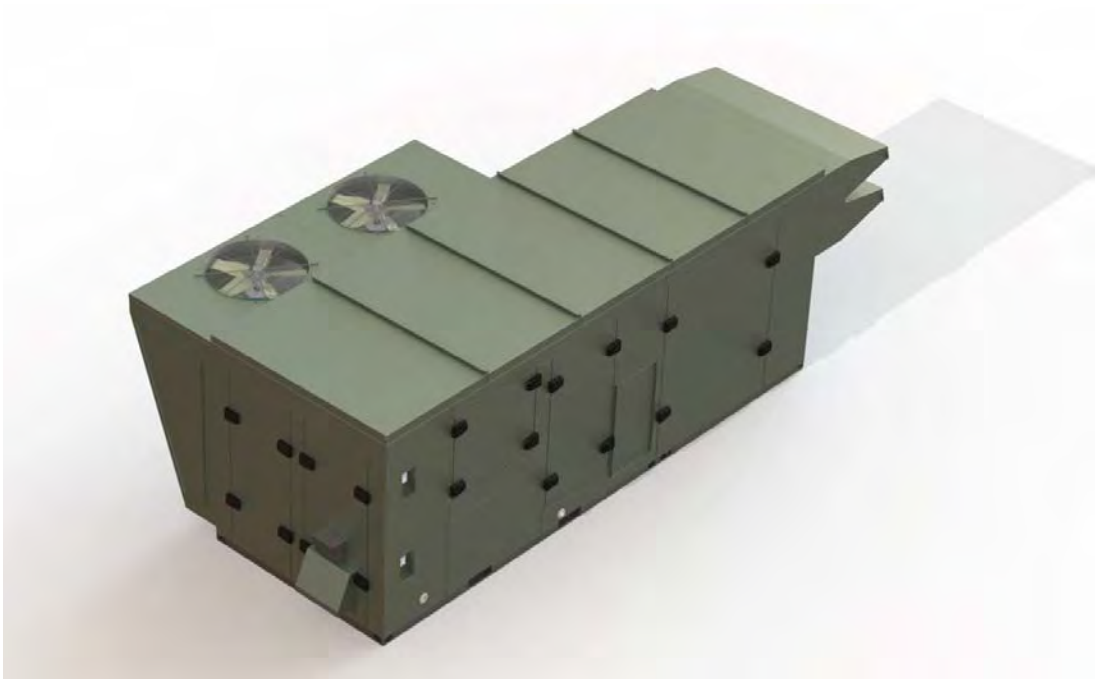
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Product Catalog

Horizon™ Outdoor Air Unit
For 100% Outdoor Air Applications
Model: OADG and OANG



October 2018

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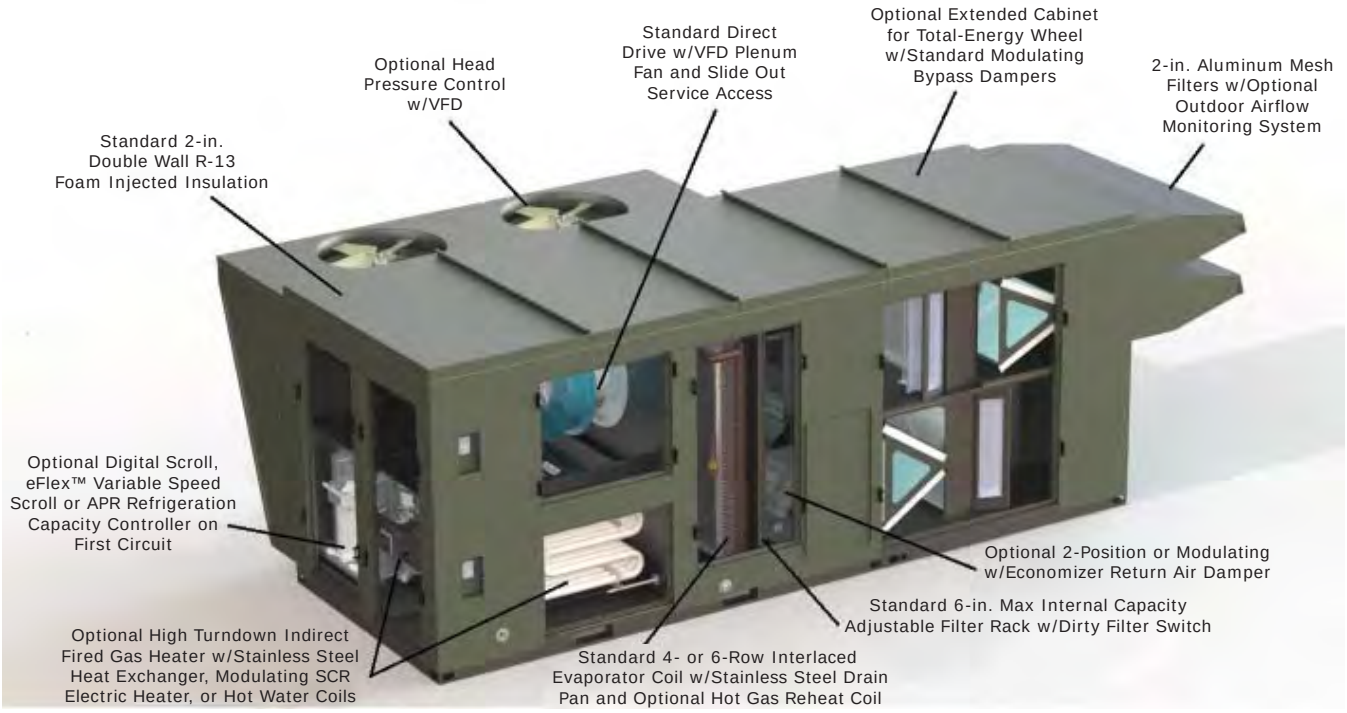
Introduction

The Horizon Outdoor Air Unit...

The Trane DX Horizon™ Outdoor Air Unit for 100 percent outdoor air or dew point design applications leads the industry in:

- Indoor Air Quality (IAQ) Features
- Moisture Management
- High Quality and Durability
- Advanced Controls

Figure 1. OADG unit components



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Model Number Descriptions

Horizon Outdoor Air Unit

Model: OADG and OANG

Digit 1, 2 — Unit Type

OA = Outdoor Air

Digit 3 — Cabinet Size

D = 1250–8000 cfm
N = 5000–25000 cfm

Digit 4 — Major Design Sequence

G = Revision 6

Digit 5, 6, 7 — Normal Gross Cooling Capacity (MBh)

000 = No DX Cooling
010 = 10 Tons High Efficiency
012 = 12 Tons High Efficiency
015 = 15 Tons High Efficiency
017 = 17 Tons High Efficiency
020 = 20 Tons High Efficiency
040 = 40 Tons High Efficiency
045 = 45 Tons High Efficiency
050 = 50 Tons High Efficiency
055 = 55 Tons High Efficiency
060 = 60 Tons High Efficiency
065 = 65 Tons High Efficiency
070 = 70 Tons High Efficiency
075 = 75 Tons High Efficiency
080 = 80 Tons High Efficiency

Digit 8 — Airflow Configuration

A = Vertical Discharge/No Return
B = Horizontal Discharge/No Return
C = Vertical Discharge/Vertical Return
D = Vertical Discharge/Horizontal Return/Exhaust
E = Horizontal Discharge/Vertical Return/Exhaust
F = Horizontal Discharge/Horizontal Return/Exhaust
G = Vertical Discharge/Vertical Return/Vertical Exhaust
H = Vertical Discharge/Vertical Return/Horizontal Exhaust
J = Vertical Discharge/Horizontal Return/Vertical Exhaust
K = Vertical Discharge/Horizontal Return/Horizontal Exhaust
L = Horizontal Discharge/Vertical Return/Vertical Exhaust
M = Horizontal Discharge/Vertical Return/Horizontal Exhaust
N = Horizontal Discharge/Horizontal Return/Vertical Exhaust
P = Horizontal Discharge/Horizontal Return/Horizontal Exhaust

Digit 9 — Voltage Selection

1 = 208/60/3
2 = 230–240/60/3
3 = 460/60/3
4 = 575/60/3

Digit 10 — Not Used

Digit 11 — Indoor Coil Type

0 = No Indoor Coil
C = DX 4-Row
D = DX 6-Row
F = Glycol/Chilled Water Coil—4-Row
G = Glycol/Chilled Water Coil—6-Row
H = Glycol/Chilled Water Coil with Cooney Freeze Block Technology—4-Row
J = Glycol/Chilled Water Coil with Cooney Freeze Block Technology—6-Row

Digit 12 — Reheat

0 = No Reheat
A = Fin and Tube Modulating HGRH

Digit 13 — Compressor

0 = No Compressor
A = Scroll Compressors
B = Digital Scroll—1st Circuit Only
C = Digital Scroll—1st Circuit and 2nd Circuit

Digit 14 — Outdoor Coil

0 = No Condenser
1 = Air-cooled Fin and Tube
3 = Water-cooled Copper/Nickel
4 = Water-cooled Copper/Steel
5 = ASHP Fin and Tube
7 = WSHP Copper/Nickel
8 = WSHP Copper/Steel

Digit 15 — Refrigerant Capacity Control

0 = No RCC Valve
1 = RCC Valve on 1st Circuit

Digit 16 — Heat Type—Primary

0 = No Heat
A = Indirect Fired NG (IF)—Standard Efficiency (80%)
B = Indirect Fired NG (IF)—High Efficiency (82%)
D = Indirect Fired LP (IF)—Standard Efficiency (80%)
E = Indirect Fired LP (IF)—High Efficiency (82%)
G = Hot Water
H = Electric—Staged
J = Electric—SCR Modulating

Digit 17 — Heat Capacity—Primary

		IF	ELEC	HOT WATER
0	=	No Heat		
A	=	50 MBh	5 kW	1 Row/10 FPI
B	=	75 MBh	10 kW	1 Row/12 FPI
C	=	100 MBh	15 kW	1 Row/14 FPI
D	=	125 MBh	20 kW	2 Row/10 FPI
E	=	150 MBh	24 kW	2 Row/12 FPI
F	=	200 MBh	28 kW	2 Row/14 FPI
G	=	250 MBh	32 kW	3 Row/10 FPI
H	=	300 MBh	40 kW	3 Row/12 FPI
J	=	350 MBh	48 kW	3 Row/14 FPI
K	=	400 MBh	60 kW	
L	=	500 MBh	68 kW	
M	=	500 MBh (Dual 250)	79 kW	
N	=	600 MBh	99 kW	
P	=	600 MBh (Dual 300)	111 kW	
R	=	800 MBh	119 kW	
S	=	800 MBh (Dual 400)	139 kW	
T	=	1000 MBh	159 kW	
U	=	1000 MBh (Dual 500)	179 kW	
V	=	1200 MBh	199 kW	
W	=		215 kW	
Y	=		230 kW	
Z	=		250 kW	

Digit 18 — Heat Type—Secondary

0 = No Secondary Heat
4 = Electric—Staged

Digit 19 — Heat Capacity—Secondary

0 = No Secondary Heat
A = 5 kW
B = 10 kW
C = 15 kW
D = 20 kW
E = 24 kW
F = 28 kW
G = 32 kW
H = 40 kW
J = 48 kW
K = 60 kW
L = 68 kW
M = 79 kW
N = 99 kW
P = 111 kW

Model Number Descriptions

R = 119 kW

Digit 20 — Not Used

Digit 21 — Supply Fan Motor

A = 1 hp—1800 rpm
B = 1 hp—3600 rpm
C = 1.5 hp—1800 rpm
D = 1.5 hp—3600 rpm
E = 2 hp—1800 rpm
F = 2 hp—3600 rpm
G = 3 hp—1800 rpm
H = 3 hp—3600 rpm
J = 5 hp—1800 rpm
K = 5 hp—3600 rpm
L = 7.5 hp—1800 rpm
M = 7.5 hp—3600 rpm
N = 10 hp—1800 rpm
P = 10 hp—3600 rpm
R = 15 hp—1800 rpm
S = 15 hp—3600 rpm
T = 20 hp—1800 rpm
U = 20 hp—3600 rpm

Digit 22 — Supply Fan Motor Type

1 = Direct Drive w/VFD
2 = Direct Drive (VFD by Others)
3 = Direct Drive w/Shaft Grounding Ring w/VFD

Digit 23, 24 — Supply Fan Wheel Diameter

AA = 12-in. Wheel
AB = 12-in.—60% Width Wheel
AC = 14-in. Wheel
AD = 14-in.—60% Width Wheel
AE = 16-in. Wheel
AF = 16-in.—60% Width Wheel
AG = 18-in. Wheel
AH = 18-in.—60% Width Wheel
AJ = 20-in. Wheel
AK = 20-in.—60% Width Wheel
AL = 22-in. Wheel
AM = 22-in.—60% Width Wheel
AN = 25-in. Wheel
AP = 25-in.—60% Width Wheel
BG = Dual 18-in. Wheel
BH = Dual 18-in.—60% Width Wheel
BJ = Dual 20-in. Wheel
BK = Dual 20-in.—60% Width Wheel
BL = Dual 22-in. Wheel
BM = Dual 22-in.—60% Width Wheel
BN = Dual 25-in. Wheel
BP = Dual 25-in.—60% Width Wheel

Digit 25 — Exhaust Fan Motor

0 = No Powered Exhaust
A = 1 hp—1800 rpm
B = 1 hp—3600 rpm
C = 1.5 hp—1800 rpm
D = 1.5 hp—3600 rpm
E = 2 hp—1800 rpm
F = 2 hp—3600 rpm
G = 3 hp—1800 rpm
H = 3 hp—3600 rpm
J = 5 hp—1800 rpm
K = 5 hp—3600 rpm
L = 7.5 hp—1800 rpm
M = 7.5 hp—3600 rpm
N = 10 hp—1800 rpm
P = 10 hp—3600 rpm
R = 15 hp—1800 rpm
S = 15 hp—3600 rpm
T = 20 hp—1800 rpm
U = 20 hp—3600 rpm

Digit 26 — Exhaust Fan Motor Type

0 = No Powered Exhaust
1 = Direct Drive w/VFD
2 = Direct Drive (VFD by Others)
3 = Direct Drive w/Shaft Grounding Ring w/VFD

Digit 27, 28 — Exhaust Fan Wheel Diameter

00 = No Powered Exhaust
AA = 12-in. Wheel
AB = 12-in.—60% Width Wheel
AC = 14-in. Wheel
AD = 14-in.—60% Width Wheel
AE = 16-in. Wheel
AF = 16-in.—60% Width Wheel
AG = 18-in. Wheel
AH = 18-in.—60% Width Wheel
AJ = 20-in. Wheel
AK = 20-in.—60% Width Wheel
AL = 22-in. Wheel
AM = 22-in.—60% Width Wheel
AN = 25-in. Wheel
AP = 25-in.—60% Width Wheel
BG = Dual 18-in. Wheel
BH = Dual 18-in.—60% Width Wheel
BJ = Dual 20-in. Wheel
BK = Dual 20-in.—60% Width Wheel
BL = Dual 22-in. Wheel
BM = Dual 22-in.—60% Width Wheel
BN = Dual 25-in. Wheel
BP = Dual 25-in.—60% Width Wheel

Digit 29 — Powered Exhaust Fan Motor (PFM) and Exhaust Dampers

0 = No Piezo Ring
1 = Supply Fan Piezo Ring
2 = Exhaust Fan Piezo Ring
3 = Supply Fan Piezo Ring and Exhaust Fan Piezo Ring

Digit 30 — Not Used

Digit 31 — Unit Controls

0 = No Controls
1 = Space Control
2 = Discharge Air Control
3 = Multi-Zone VAV
4 = Single-Zone VAV

Digit 32 — Building Interface

0 = No Controls
1 = BACnet®
3 = LON

Digit 33 — Filter Options

0 = No Filters
A = MERV-8, 30%
B = MERV-13, 80%
C = MERV-14, 95%
D = MERV-8 30%, MERV-13 80%
E = MERV-8 30%, MERV-14 95%

Digit 34 — Energy Recovery

0 = No Energy Recovery
1 = ERV—Composite Construction with Bypass for Frost Protection
2 = ERV—Composite Construction with Frost Protection w/VFD
3 = ERV—Aluminum Construction with Bypass for Frost Protection
4 = ERV—Aluminum Construction with Frost Protection w/VFD

Digit 35 — Energy Recover Option, Purge

0 = No Purge
1 = Purge

Digit 36 — Energy Recover Wheel Size

0 = No ERV
A = 3014
B = 3622
C = 4136
D = 4634
E = 5262
F = 5856
G = 6488
H = 6876
J = 74122
K = 81146
L = 86170
M = 92180

Digit 37 — Energy Recovery Option, Rotation Sensor

0 = No Rotation Sensor
1 = Rotation Sensor

Digit 38 — Damper Options

1 = 100% OA 2-Position Damper
2 = 100% OA 2-Position Damper w/RA 2-Position Damper
3 = Modulating OA and RA Dampers w/Economizer
4 = Modulating OA Damper

Digit 39 — Exhaust Dampers

0 = No Exhaust Dampers
A = Gravity Dampers
B = Isolation Dampers
C = Barometric Relief Dampers

Digit 40 — Not Used

Digit 41 — Electrical Options

0 = Terminal Block—No Factory Installed Disconnect
A = Non-Fused Disconnect
B = Fused Disconnect Switch
C = 65 SCCR Electrical Rating w/Non-Fused Disconnect
D = 65 SCCR Electrical Rating w/Fused Disconnect
E = 65 KAIC Electrical Rating w/Non-Fused Disconnect
F = 65 KAIC Electrical Rating w/Fused Disconnect
G = Dual Point Power
H = Dual Point Power 65 KAIC
J = Dual Point Power 65 SCCR

Model Number Descriptions

Digit 42 — Corrosive Environment Package

0 = No Corrosive Package
A = Eco Coated Coils
B = S/S Interior
C = S/S Coil Casing
D = S/S Coil Casing with Eco Coated Coils
E = S/S Interior, Eco Coated Coils
F = Corrosion Resistant Package

Digit 43 — Outdoor Air Monitoring

0 = No Outdoor Air Monitoring
1 = Airflow Probes

Digit 44 — Condenser Fan Options

0 = No Condenser Fans
A = Standard Condenser Fan
B = Passive Head Pressure Control
C = Active Head Pressure Control
D = ECM Condenser Fans with Active Head Pressure Control
E = ECM Condenser Fans with Active Head Pressure Control for Sound Attenuation

Digit 45 — Compressor Sound Blankets and Sound Attenuation

0 = No Sound Attenuation Package
A = Compressor Sound Blankets
B = Compressor Sound Blankets with Sound Attenuation Condenser Fans

Digit 46 — Smoke Detector

0 = No Smoke Detector
1 = Supply Smoke Detector
2 = Return Smoke Detector
3 = Supply and Return Smoke Detector

Digit 47 — Hailguards

0 = No Hailguards
A = Hailguards

Digit 48 — Service Lights

0 = No Service Lights
A = Supply Fan Section Service Light
B = Exhaust Fan Section Service Light
C = Supply and Exhaust Fan Section Service Light

Digit 49 — UV Lights

0 = No UV Lights
1 = UV Lights

Digit 50 — Not Used

Digit 51 — Unit Installation Location

A = Outdoor
B = Indoor

Digit 52 — Convenience Outlet

0 = No Convenience Outlet
A = Convenience Outlet

Digit 53 — Controls Display

0 = No Display
1 = TD7 Factory Installed
2 = TD7 Remote Mounted

Digit 54 — Cooling Controls

0 = No ReliaTel™
A = ReliaTel™
B = ReliaTel™ with BCIR Card

Digit 55 — Face and Bypass on Indoor Coil

0 = No Face and Bypass

Digit 56 — Thermostat

0 = No Thermostat
1 = Thumbwheel Thermostat

Digit 57 — Altitude

0 = Sea Level to 1000 Feet
1 = 1001 to 2000 Feet
2 = 2001 to 3000 Feet
3 = 3001 to 4000 Feet
4 = 4001 to 5000 Feet
5 = 5001 to 6000 Feet
6 = 6001 to 7000 Feet
7 = Above 7000 Feet

Digit 58 — Condensate Overflow Switch

0 = No Condensate Overflow Switch
A = Condensate Overflow Switch

Digit 59 — Frostat

0 = No Frostat™
A = Frostat™ Installed

Digit 60 — Not Used

Digit 61 — Outdoor Coil Fluid Type

0 = None
1 = Water
2 = Ethylene Glycol
3 = Propylene Glycol
4 = Methanol
5 = Other

Digit 62 — Minimum Damper Leakage

0 = Standard
1 = Class 1A

Digit 63, 64, 65, 66, 67, 68, 69 — Reserved for Future Use

Features and Benefits

We designed the Horizon™ Outdoor Air Unit based on customer requirements from across the country. Thorough analysis of the performance requirements resulted in a robust design with the ability to effectively operate over an expansive performance envelope required for the year-round treatment of outdoor air.

Also, we took into account today's HVAC market issues, such as indoor air quality (IAQ). We equipped the Horizon Outdoor Air Unit to meet your ventilation needs—in direct response to the ventilation and humidity control requirements of ASHRAE standard 62.1.

Trane's Horizon Outdoor Air Unit leads the industry in the key areas of:

- indoor air quality (IAQ)
- energy efficiency
- high quality and durability
- advanced, integrated controls
- flexibility (including indoor installation)
- enhanced serviceability

Indoor Air Quality (IAQ) Features

- Stainless steel drain pan sloped in two directions to ensure proper drainage and reduce the potential for microbial growth
- Double-wall foamed panel construction throughout the indoor section of unit to provide, non-porous, cleanable interior surfaces
- Inlet hood with moisture eliminators
- High efficiency throwaway filter option with standard 2-, 4-, or 6-in. adjustable filter rack
- Piezometer airflow measurement option
- Easy filter access encourages frequent changing
- Refrigerant hot gas reheat for low dewpoint supply air for superior humidity control
- Capable of providing low dew point supply air for superior humidity control

Energy Efficiency

- Total energy wheel option for recovered energy from centralized building exhaust
- Optional modulating recovered refrigerant reheat for unit supply air

High Quality and Durability

- Robust unit construction with 2-in. double wall panels with foam insulation for an R-value of 13
- Reversible, hinged access doors
- High quality, long-lasting latches and hinges for all access doors
- Protective standard prepainted finish on cabinet exterior with optional corrosion inhibiting coatings available for the unit exterior, interior and coils

Advanced Controls

- All controls are factory-engineered, mounted, configured and tested to minimize field startup time
- UC600 BACnet® microprocessor control
- Human interface with touch-pad screen for monitoring, setting, editing and controlling
- Capable of supply-air control or zone control of both temperature and relative humidity
- Occupied and unoccupied control sequences
- Optional remote human interface for ease of control access without going outdoors
- Optional LonTalk® communications interface communication link with a Tracer® Summit™ building management system or other control systems that support LonTalk

Flexibility

- Numerous heater options and temperature rise capabilities available
- Multiple roof curb options (1- or 2-in. vibration isolation, horizontal discharge, multiple heights) and seismic certification
- Dual fuel (indirect fired gas primary heat/electric preheat) option

Enhanced Serviceability

- Hinged access doors for ease of maintenance and service
- Easy-open door latches
- Slide out access direct-drive plenum fan
- Optional slide out, self-cleaning total-energy wheel
- Sight glass for each refrigeration circuit
- Optional control display
- High voltage cover

Standard Unit Features

- Multiple cabinet sizes with airflow range from 1,250 to 25,000 cfm
- Two-in. double-wall, R-13 construction (including unit floor and roof) with heavy gauge galvanized metal skin
- Outdoor air inlet hood
- Prepainted exterior finish
- Air-cooled DX refrigeration system
- Completely factory-piped and leak-tested refrigeration system
- Stainless steel drain pans sloped in two planes
- Scroll compressors
- Single-point power connections for units with optional total-energy wheel, powered exhaust, and electric heat
- Filter rack adjustable for 2-, 4-, or 6-in. filters
- Factory-assembled inlet hood with 2-in. mist eliminators
- Non-fused disconnect switch
- Type 439 stainless steel heat exchanger
- Class 2 low leak parallel blade outdoor air damper with edge seals
- High-efficiency fan motors
- Variable frequency drive (VFD)
- Neoprene vibration isolation under supply and exhaust fan base and compressors
- Low ambient operation down to 40°F

Standard Control Features

- Fully integrated, factory-installed and commissioned microelectronic controls
- Supply airflow proving
- Emergency stop for safety interlock
- Mechanical refrigeration capacity control (RCC)
- Occupied/unoccupied control modes
- High turn-down (up to 20:1) modulating indirect gas-fired heat
- Clogged filter switch

Optional Features

- SCR electric heat
- Hot water coils
- Indirect-fired gas heat

Features and Benefits

- Class 1A, ultra low leak parallel blade return air damper with edge seals
- Modulating damper control systems
- Low ambient/head pressure control down to 0°F
- Pleated media filters (2-in. MERV-8, 2-in. MERV-13, 4-in. MERV-14, or a combination 2-in./4-in. filter)
- 120 V UVC downstream of evaporator coil
- Adjustable powered exhaust
- Exhaust dampers (gravity, barometric relief, and 2-position isolation)
- Fused disconnect switch
- Factory-installed smoke detectors (supply and/or return)
- Stainless steel inner liner
- Integral total-energy wheel
- Protective coatings for the coils
- Factory or field-wired convenience outlet
- Air source heat pump
- Hailguards
- LED service lights
- Direct drive BI airfoil plenum fan
- Digital scroll compressors on 1st and 2nd circuits
- Unit mounted human interface panel
- Horizontal supply/return through the unit casing for units with indirect fired gas heat, hot water heat, or no heat option
- Sound attenuation package to reduce radiated sound
- Chilled water coils with optional Cooney Freeze Block
- Compressor sound blankets
- Sound attenuating condenser fans
- Condensate overflow switch
- 65 kA SCCR rating

Application Considerations

Overview

Outdoor Air Unit Functions

The Horizon™ Outdoor Air Unit (OAU) provides conditioned outdoor air suitable for mechanical ventilation or make-up air. The OAU conditions outdoor air as necessary to meet system performance requirements by ventilation with filtration, cooling, dehumidification, and/or heating. The OAU may deliver ventilation air in a number of ways. Refer to "System Configurations," p. 11 and Figure 5, p. 13, Figure 6, p. 13, and Figure 8, p. 14 for more information.

- Ventilation with Filtration
- Cooling
- Dehumidification
- Heating

System Configurations

Dedicated outdoor air systems can deliver conditioned outdoor air in one of the following ways:

1. Conditioned outdoor air supplied directly to each occupied space, with the local terminal unit controlling the space dry-bulb temperature. Refer to Figure 2, p. 11.
2. Conditioned outdoor air supplied directly to local terminal units, or return ducts of local RTUs, which deliver a mixture of the conditioned outdoor air and (conditioned) recirculated air to the space. Refer to Figure 3, p. 12.
3. Conditioned outdoor air supplied directly to a single space to control the space temperature and humidity. For example, this application will provide temperature and humidity control of ventilated spaces, such as commercial kitchens or laboratories.

Figure 2. Direct discharge to conditioned space

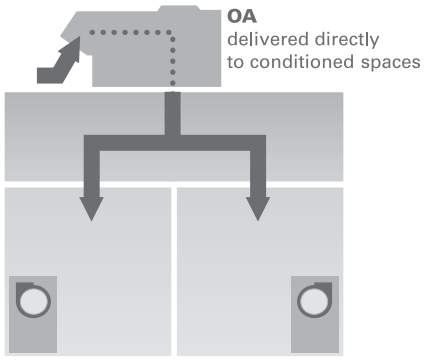
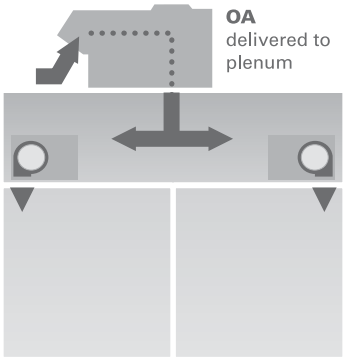


Figure 3. Indirect discharge to fan-coil units



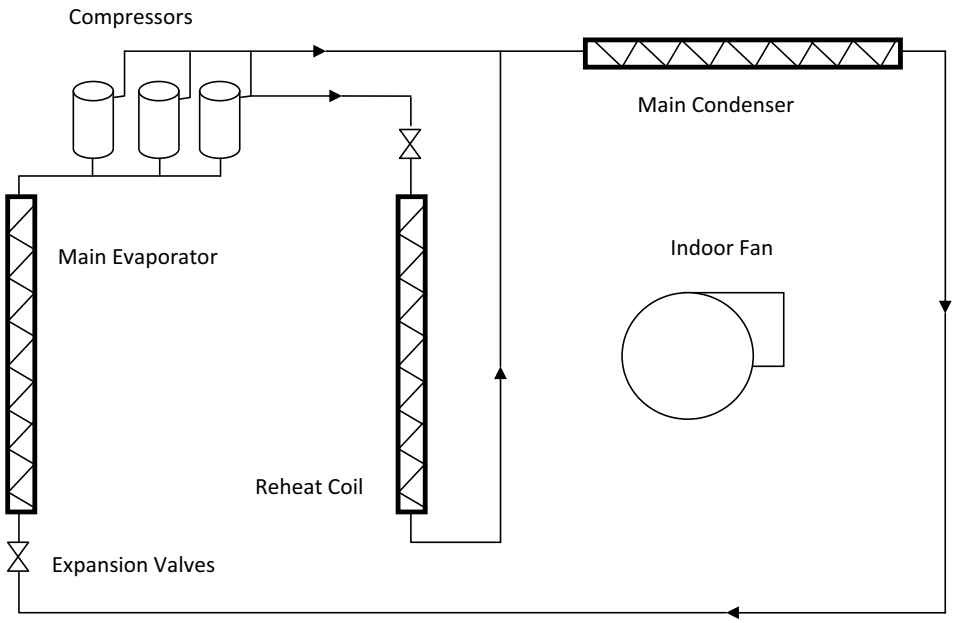
Horizon OAU Operation

The Horizon™ OAU can use either DX cooling, condenser reheat, electric or gas heat to condition outdoor air. The unit controls modulate cooling and heating capacity, reducing the supply air temperature swings associated with staged heating and cooling.

OAU with Reheat

The following figure shows the OAU system with a DX refrigerant circuit design using reheat.

Figure 4. Refrigeration system diagram with reheat



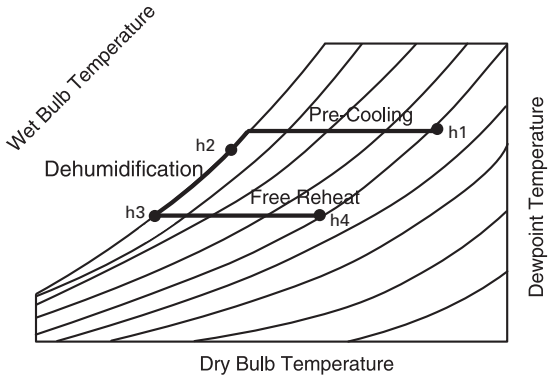
Dehumidification

Consider Figure 5, p. 13. If the outdoor air dew point is above the dehumidification setpoint (or in the case of zone control, the zone RH is above the RH setpoint), the OAU will:

- cool the outdoor air to remove required moisture and
- reheat to meet the discharge temperature setpoint.

At h1, 100 percent outdoor air enters the OAU. The OAU filters, cools, and dehumidifies the air as it moves through the evaporator coil. Air leaves the evaporator coil saturated at the preset dew point condition (h3) and is reheated by the reheat coil to the pre-set reheat temperature setpoint (h4). The reheat coil transfers energy to the airstream. A liquid solenoid valve effectively modulates the reheat capacity. The outdoor condenser rejects surplus heat. The reheat circuit is first on and last off, so reheat energy is available at full and part load conditions. Since both the dew point setpoint and discharge temperature setpoint are fully adjustable, the desired supply air conditions are maintained at all load conditions.

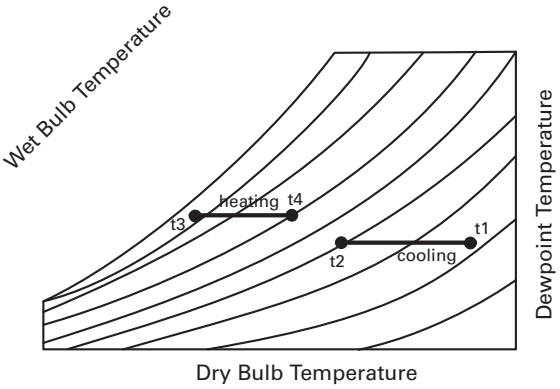
Figure 5. Psychrometric chart with dehumidification and reheat



Cooling or Heating

Consider the following figure. If the outdoor air dew point or zone RH is equal to or below the dehumidification setpoint, the OAU will heat or cool the outdoor air to separate cooling or heating setpoints. At t1 or t3, 100 percent outdoor air enters the OAU. The OAU filters, and cools or heats the air as it is drawn through the evaporator and heating section. The air leaves the OAU at the cooling or heating discharge setpoint (t2 or t4).

Figure 6. Psychrometric chart with cooling or heating only

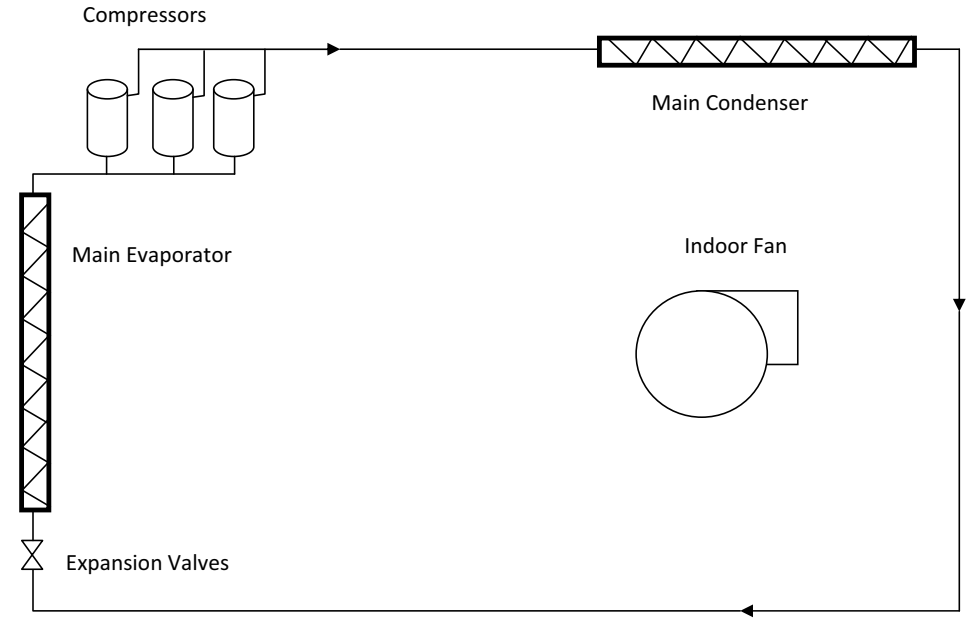


OAU Outdoor Air Control without Reheat

The following figure shows the Horizon™ OAU DX system, using a refrigerant circuit design without reheat.

Note: Space control not available without reheat.

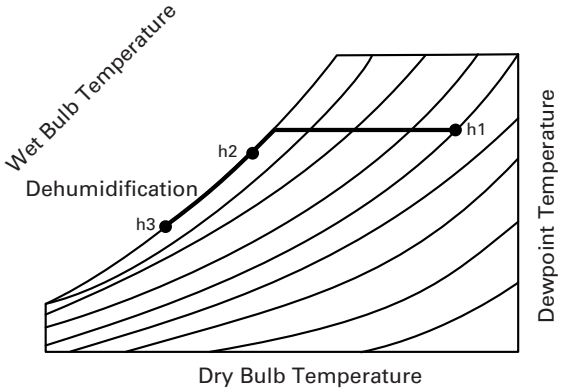
Figure 7. Refrigeration system diagram without reheat



Dehumidification

Consider the following figure. If the outdoor air dew point is above the dehumidification setpoint, the OAU will dehumidify the outdoor air. 100 percent outdoor air enters the OAU (h1). The unit filters, cools and dehumidifies the air as it is drawn through the evaporator coils. Air leaves the evaporator coils saturated at a preset dew point setpoint (h3). Since the dew point setpoint is fully adjustable, the desired dew point condition is maintained at all load conditions.

Figure 8. Psychrometric chart with dehumidification, no reheat



Establishing Capacity Requirements

Determining the OAU capacity requirements requires careful thought. Light Commercial equipment is typically selected based on design sensible conditions. Since latent loads drive the need for the OAU, base the selection on design latent conditions.

Cooling & Dehumidification Selection Criteria

Evaporator Design Entering Conditions

For many climates the peak outdoor air enthalpy occurs at a time when the outdoor dry-bulb temperature is not the highest. Refer to the chapter on climatic design information in the ASHRAE Handbook of Fundamentals. The cooling and dehumidification design condition data is provided three ways:

1. Design dry-bulb temperature with mean coincident wet bulb temperature
2. Design wet-bulb temperature with mean coincident dry-bulb temperature
3. Design dew point temperature with mean coincident dry-bulb temperature

The design wet-bulb condition typically represents a significantly higher outdoor air enthalpy than the design dry-bulb condition. Use the condition that represents the highest enthalpy as the entering evaporator selection condition.

Evaporator Design Leaving Conditions

Due to the uncertainty of the local terminal unit's latent capacity at part load, it is usually most straightforward to size the OAU to handle the entire latent load on the system, both indoor and outdoor. With this design approach, the terminal units may do some latent cooling (dehumidification) during periods of higher sensible load. At these times, the space will run slightly drier than the design RH limit. This is why it makes sense to select the OAU to limit the space RH to a maximum allowable level for those conditions when the terminal units are providing no space latent cooling, such as 60 percent RH. Using lower humidity limits may result in an unnecessary increase in system operating energy use.

Use the tables in "Reheat," p. 15 to identify the appropriate supply air dew point for specific design conditions. For a more detailed discussion on determining the selection criteria of a OAU, refer to SYS-APG001*-EN (Application Guide: Designing Dedicated Outdoor-Air Systems) or SYS-APM004*-EN (Applications Engineering Manual: Dehumidification in HVAC Systems).

Reheat

Table 1. Supply air dew point temperature, 75°F at 60 percent RH space limit

Latent Load	cfm per person										
Btu/h per Person	10	15	20	25	30	35	40	45	50	55	60
100	54.6	56.6	57.5	58.1	58.4	58.7	58.9	59.0	59.2	59.2	59.3
120	53.3	55.8	57.0	57.6	58.1	58.4	58.6	58.8	58.9	59.1	59.2
140	52.0	55.0	56.4	57.2	57.7	58.1	58.3	58.6	58.7	58.9	59.0
160	50.6	54.2	55.8	56.7	57.3	57.8	58.1	58.3	58.5	58.7	58.8
180	49.2	53.3	55.2	56.3	57.0	57.4	57.8	58.1	58.3	58.5	58.6
200	47.7	52.5	54.6	55.8	56.6	57.1	57.5	57.8	58.1	58.3	58.4
220	46.1	51.6	54.0	55.3	56.2	56.8	57.2	57.6	57.9	58.1	58.3
240	—	50.6	53.3	54.8	55.8	56.5	57.0	57.3	57.6	57.9	58.1
260	—	49.7	52.7	54.3	55.4	56.1	56.7	57.1	57.4	57.7	57.9
280	—	48.7	52.0	53.8	55.0	55.8	56.4	56.8	57.2	57.5	57.7
300	—	47.7	51.3	53.3	54.6	55.5	56.1	56.6	57.0	57.3	57.5
320	—	46.6	50.6	52.8	54.2	55.1	55.8	56.3	56.7	57.1	57.3
340	—	45.5	49.9	52.3	53.8	54.8	55.5	56.1	56.5	56.8	57.1
360	—	—	49.2	51.7	53.3	54.4	55.2	55.8	56.3	56.6	57.0
380	—	—	48.5	51.2	52.9	54.1	54.9	55.5	56.0	56.4	56.8
400	—	—	47.7	50.6	52.5	53.7	54.6	55.3	55.8	56.2	56.6
420	—	—	46.9	50.1	52.0	53.3	54.3	55.0	55.6	56.0	56.4
440	—	—	46.1	49.5	51.6	53.0	54.0	54.7	55.3	55.8	56.2
460	—	—	45.3	48.9	51.1	52.6	53.6	54.4	55.1	55.6	56.0
480	—	—	—	48.3	50.6	52.2	53.3	54.2	54.8	55.4	55.8
500	—	—	—	47.7	50.2	51.8	53.0	53.9	54.6	55.1	55.6

Note: Minimum dew point selectable is 45°F.

Table 2. Supply air dew point temperature, 75°F at 55 percent RH space limit

Latent Load	cfm per person										
Btu/h per Person	10	15	20	25	30	35	40	45	50	55	60
100	51.6	53.8	54.9	55.5	55.9	56.1	56.3	56.5	56.6	56.7	56.8
120	50.2	53.0	54.2	55.0	55.5	55.8	56.1	56.2	56.4	56.5	56.6
140	48.8	52.1	53.6	54.5	55.1	55.5	55.8	56.0	56.2	56.3	56.4
160	47.2	51.2	53.0	54.0	54.6	55.1	55.5	55.7	55.9	56.1	56.2
180	45.6	50.2	52.3	53.5	54.2	54.8	55.2	55.5	55.7	55.9	56.1
200	—	49.3	51.6	53.0	53.8	54.4	54.9	55.2	55.5	55.7	55.9
220	—	48.3	50.9	52.4	53.4	54.1	54.5	54.9	55.2	55.5	55.7
240	—	47.2	50.2	51.9	53.0	53.7	54.2	54.6	55.0	55.2	55.5
260	—	46.2	49.5	51.4	52.5	53.3	53.9	54.4	54.7	55.0	55.3
280	—	45.1	48.8	50.8	52.1	53.0	53.6	54.1	54.5	54.8	55.1
300	—	—	48.0	50.2	51.6	52.6	53.3	53.8	54.2	54.6	54.9
320	—	—	47.2	49.7	51.2	52.2	53.0	53.5	54.0	54.3	54.6
340	—	—	46.4	49.1	50.7	51.8	52.6	53.3	53.7	54.1	54.4
360	—	—	45.6	48.5	50.2	51.4	52.3	53.0	53.5	53.9	54.2
380	—	—	—	47.9	49.8	51.0	52.0	52.7	53.2	53.7	54.0
400	—	—	—	47.2	49.3	50.6	51.6	52.4	53.0	53.4	53.8
420	—	—	—	46.6	48.8	50.2	51.3	52.1	52.7	53.2	53.6
440	—	—	—	46.0	48.3	49.8	50.9	51.8	52.4	53.0	53.4
460	—	—	—	45.3	47.8	49.4	50.6	51.5	52.2	52.7	53.2
480	—	—	—	—	47.2	49.0	50.2	51.2	51.9	52.5	53.0
500	—	—	—	—	46.7	48.6	49.9	50.9	51.6	52.2	52.7

Note: Minimum dew point selectable is 45°F.

Table 3. Supply air dew point temperature, 75°F at 50 percent RH space limit

Latent Load	cfm per person										
Btu/h per Person	10	15	20	25	30	35	40	45	50	55	60
100	48.4	50.8	51.9	52.6	53	53.3	53.6	53.8	53.9	54	54.1
120	46.8	49.8	51.3	52.1	52.6	53	53.3	53.5	53.6	53.8	53.9
140	45.2	48.9	50.6	51.5	52.2	52.6	52.9	53.2	53.4	53.5	53.7
160	—	47.9	49.8	51	51.7	52.2	52.6	52.9	53.1	53.3	53.5
180	—	46.8	49.1	50.4	51.3	51.8	52.3	52.6	52.9	53.1	53.3
200	—	45.7	48.4	49.8	50.8	51.5	51.9	52.3	52.6	52.8	53.0
220	—	—	47.6	49.3	50.3	51.1	51.6	52	52.3	52.6	52.8
240	—	—	46.8	48.7	49.8	50.7	51.3	51.7	52.1	52.4	52.6
260	—	—	46	48.1	49.4	50.3	50.9	51.4	51.8	52.1	52.4
280	—	—	45.2	47.4	48.9	49.8	50.6	51.1	51.5	51.9	52.2
300	—	—	—	46.8	48.4	49.4	50.2	50.8	51.3	51.6	51.9
320	—	—	—	46.2	47.9	49	49.8	50.5	51	51.4	51.7
340	—	—	—	45.5	47.3	48.6	49.5	50.2	50.7	51.1	51.5
360	—	—	—	—	46.8	48.2	49.1	49.8	50.4	50.9	51.3
380	—	—	—	—	46.3	47.7	48.7	49.5	50.1	50.6	51
400	—	—	—	—	45.7	47.3	48.4	49.2	49.8	50.4	50.8
420	—	—	—	—	45.2	46.8	48	48.9	49.6	50.1	50.6
440	—	—	—	—	—	46.3	47.6	48.5	49.3	49.8	50.3
460	—	—	—	—	—	45.9	47.2	48.2	49	49.6	50.1
480	—	—	—	—	—	45.4	46.8	47.9	48.7	49.3	49.8
500	—	—	—	—	—	—	46.4	47.5	48.4	49.1	49.6

Note: Minimum dew point selectable is 45°F.

The Trane OAU utilizes recovered energy from the cooling process to reheat the air leaving the evaporator coil as required to meet the discharge air setpoint. The reheat refrigeration circuit is adequate to deliver enough reheat to supply neutral-temperature air (e.g., 75°F dry-bulb) under most operating conditions. On very low load days, the reheat circuit may not contain enough energy to meet the desired reheat setpoint.

Heating

The OAU has electric, heat pump, hot water, or gas heat options. The electric heat option is available in 0°F–80°F temperature rise offerings with staged or SCR modulation. This means that the lowest temperature rise provided depends only on heater size and unit airflow. Calculate the

temperature rise to confirm that it provides acceptable control. The electric heat will modulate to maintain heating setpoint.

When using hot water heat, the unit controller will modulate a field-provided coil control valve. Provide an ethylene glycol and water mixture or other means of freeze protection for the hot water coil if the OAU will be subject to sub-freezing temperatures.

Capacity Control

The capacity control system on the Horizon™ Outdoor Air Unit is flexible enough to accommodate a variety of system applications. These applications include:

- treating outdoor air to supply a single space or multiple spaces or
- simultaneously meet building make-up air needs while controlling the temperature and relative humidity of a single space.

Each of these applications requires careful consideration to achieve the desired results.

Discharge Air Control

For many multiple space, dedicated outdoor air systems, the OAU will continuously supply outdoor air at a dry-bulb setpoint and a dew point that does not exceed its dew point setpoint. This control approach is simple because it allows the OAU to function independent of local terminal unit operation or actual space conditions. If the unit selection criteria is determined using the method suggested in "Establishing Capacity Requirements," p. 14, the Outdoor Air Unit will limit the space relative humidity to the target level.

Many dedicated outdoor air systems supply reheated air directly to terminal units or to spaces that have terminal units performing local sensible cooling. This results in the local terminal units re-cooling the previously re-heated outdoor air. Resetting the supply air dry-bulb temperature of the Outdoor Air Unit offers the opportunity to minimize the amount of time re-cooling occurs. Refer to "Cooling Setpoint," p. 17 for more information.

Cooling Setpoint

Because the Trane OAU dehumidifies the outdoor air by cooling it, this cool outdoor air can reduce the sensible cooling load on the local terminal unit. At low space sensible loads, the cool outdoor air may sub-cool the space, causing the local terminal unit to add heat (new energy heat). Therefore, reset occupied Space Cooling Setpoint (SPCS—Space Control Sequence) or Evaporator Cooling Setpoint (ECS—Outdoor Air Control Sequence) of the OAU to minimize space sensible re-cooling so the terminal unit with the lowest sensible load is almost at zero cooling capacity (within the limit of the dew point setpoint). To take full advantage of space demand based dry-bulb reset, you may need to size some of the local terminal units based on neutral outdoor air temperature. This strategy will more effectively manage occupant comfort during seasonal changeover for two-pipe terminal unit systems. Because the OAU is not connected to the chiller or boiler plant, accomplish this by resetting the Outdoor Air Unit SPCS or ECS to keep the critical zone at zero heating capacity when the boiler is off and zero cooling capacity when the chiller is off. A Trane Integrated Comfort™ system can provide this control capability.

Unoccupied Space Humidity Control

The Horizon™ OAU provides conditioned outdoor air for the ventilation and/or make-up air needs of a building during occupied hours. It can also limit building relative humidity during unoccupied hours. To do this, provide a return air path to the OAU and place a relative humidity sensor in the space served by the OAU or in a common relief air path (like a return corridor) if the OAU serves multiple spaces. The unit will cycle as required to limit the space humidity to the unoccupied Dewpoint Setpoint (NSDS) setpoint. Reheat and return air damper options are required for this operation. For dedicated outdoor air systems ducted to terminal units, these units must cycle with the operation of the Horizon OAU. A Trane Integrated Comfort™ system can provide this control capability.

Space Control

For single space applications, the Horizon OAU can control space temperature and limit space relative humidity. To do this, size the airflow to meet whichever is the highest: the space loads and ventilation and/or make-up air needs of the application. Install a temperature sensor in the space to provide temperature control and reset the supply air temperature. If reset of the supply air dew point is desired, install a space relative humidity sensor in the space to provide relative humidity limit control.

Outdoor Airflow Balancing

Establish final unit airflow through a field air balancing procedure. Change the fan speed through VFD Setpoint via the UC600 controller (direct drive fan motor).

Air to Air Energy Recovery

Energy recovery can significantly reduce HVAC system first-cost and operating energy costs. You can use recovered energy for two purposes:

1. to temper or reheat supply air for independent control of sensible and latent capacity, or
2. to precondition outdoor air as it enters the building for ventilation.

The Horizon™ OAU offers refrigerant heat recovery for reheating the supply air. To precondition the outdoor air, use the optional total-energy wheel to recover energy from building exhaust.

Controlling the Total-Energy Wheel

One way to control an energy recovery device is to turn it on and off with the OAU system exhaust fan. In this case, the total energy wheel enables when the unit is in occupied mode and the exhaust fan is running. While this control method is certainly simple and effective in some applications, it may not provide the expected energy saving benefit, particularly when cold air (vs. neutral air) is supplied to the building.

Another more effective approach is to use the outdoor air dry-bulb to determine when to energize or de-energize the energy recovery device. See Figure 10, p. 19 for an example of this simplified control. In addition to being more effective from a control standpoint, it's also a very simple control method because the wheel is enabled when all of the following are true:

- unit is in occupied mode,
- exhaust fan is enabled,
- Unit Main Control Module (MCM) calls for unit to operate in dehumidification, cooling, or heating modes, and
- outside air temperature is above the frost protection setpoint (default setpoint 12°F).

If using the OAU to deliver cold, dry conditioned air to the building (outdoor air is cooled to a low dew point but not reheated), use the cooling setpoint control strategy (see "Cooling Setpoint," p. 17).

Figure 9. Dry-bulb control in a cold DB/dry DP application

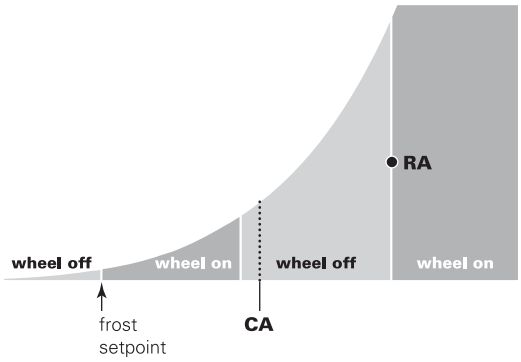
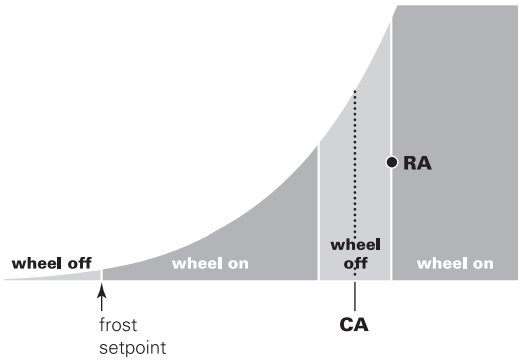


Figure 10. Dry-bulb control in a neutral DB/dry DP application



Cross Leakage

All energy wheels have some cross leakage. Therefore, do not use energy wheels in applications involving toxic or hazardous air streams. The percentage of cross leakage depends on the pressure differentials across the wheel section. With Trane Horizon™ OAU energy wheels, the exhaust air transfer ratios are typically low (less than 4 percent).

Condensate Drain Configuration

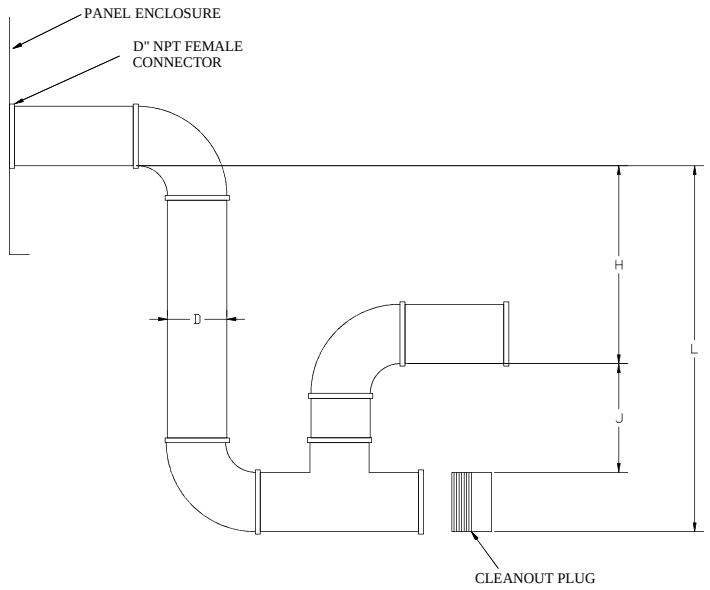
OAU units are selected based on dehumidification capability. As such, condensate can form at a high rate. Therefore, the OAU drain pan and condensate line are sized and designed accordingly. However, an often-overlooked element of proper condensate drainage is proper P-Trap and drain line sizing and installation. An incorrectly-designed and -installed P-Trap can restrict condensate flow or cause water in the condensate drain pan to "spit" or "geyser" which may cause condensate overflow. Carefully install and trap the drain pan to ensure adequate condensate removal under all conditions.

An evaporator condensate drain connection is provided on each unit. For more information, refer to OAU-SVX006*-EN (Installation, Operation, and Maintenance: Horizon Outdoor Air Unit - Model: OADG).

A condensate trap must be installed at the unit due to the drain connection being on the "negative pressure" side of the fan. Install the P-Trap using the guidelines in the following figure.

Pitch drain lines connected to P-Trap at least 1/2 in. for every 10 feet of horizontal run to assure proper condensate flow. Do not allow the horizontal run to sag causing a possible double-trap condition which could result in condensate backup due to "air lock".

Figure 11. Condensate trap installation



D = PIPE DIAMETER
H = INTERNAL STATIC PRESSURE (IN W.G.) + 1"
J = H * 0.5
L = H + J + D

NOTES: 1. PITCH DRAIN AT LEAST 1/2" PER 10' HORIZONTAL RUN
2. CONDENSATE DRAIN PAN WILL NOT DRAIN PROPERLY IF P-TRAP IS NOT PRIMED & OF ADEQUATE HEIGHT TO ALLOW FOR CABINET OPERATING NEGATIVE PRESSURE

Acoustical Considerations

Proper unit placement is critical to reducing transmitted sound levels from the OAU to the building. Therefore, consider acoustic concerns during the design phase and place the unit accordingly. The most economical means of avoiding an acoustical problem is to place the unit(s) away from acoustically critical areas. If possible, do not locate units directly above areas such as: offices, conference rooms, executive office areas, and classrooms. Instead, ideal locations to consider are: over corridors, utility rooms, toilets, or other areas where higher sound levels directly below the unit(s) are acceptable.

Follow these basic guidelines for unit placement to minimize sound transmission through the building structure.

1. Never cantilever the compressor side of the unit. A structural cross member or full perimeter roof curb, supported by roof structural members, must support this side of the unit.
2. Locate the unit's center of gravity close to or over column or main support beam.
3. If the roof structure is very light, replace roof joists by a structural shape in the critical areas described above.
4. If several units are to be placed on one span, stagger them to reduce deflection over that span.

It is impossible to totally quantify the building structure effect on sound transmission because it is dependent on how the roof and building members respond to the OAU's sound and vibration. However, following the guidelines listed above will help reduce sound transmissions.

Clearance Requirements

Follow the recommended unit clearances to assure adequate serviceability, maximum capacity, and peak operating efficiency. Reducing unit clearances may result in condenser coil starvation or

warm condenser air recirculation. If the recommended clearances are not possible on a particular job, consider the following:

- Do the clearances available allow for major service work, such as changing compressors or coils?
- Do the clearances available allow for proper outside air intake, exhaust air removal, and condenser airflow?
- If screening around the unit is used, is there a possibility of air recirculation from the exhaust to the outside air intake or from condenser exhaust to condenser intake.

Review any actual clearances that appear inadequate with your local Trane sales engineer.

When two or more units are placed side by side, increase the distance between the units to twice the recommended single unit clearance. Stagger the units for these two reasons:

1. To reduce span deflection if more than one unit is placed on a single span. Reducing deflection discourages sound transmission.
2. To assure proper exhaust air diffusion before contact with the adjacent unit's outside air intake.

Duct Design

It is important to note that the rated capacities of the OAU can be met only if the unit is properly installed. A well-designed duct system is essential to meet these capacities.

Satisfactory air distribution throughout the system requires an unrestricted and uniform airflow from the OAU discharge duct.

However, when job conditions dictate installation of elbows near the OAU outlet, using guide vanes may reduce capacity loss and static pressure loss.

Controls Sequence

For sequence of operation, please refer to OAU-SVX006*-EN (Installation, Operation, and Maintenance: Horizon Outdoor Air Unit - Model: OADG).

General Data

Table 4. General Data—Cooling 10–20 Tons High Efficiency

	10 Tons Downflow	12 Tons Downflow	15 Tons Downflow	17 Tons Downflow	20 Tons Downflow
	OADG010	OADG012	OADG015	OADG017	OADG020
Cooling Performance (6-row)					
Gross Cooling Capacity, Btu (kW)	134,530 (39.43)	153,380 (44.95)	192,718 (56.48)	215,551 (63.17)	248,068 (72.70)
Nominal cfm (m^3/h)	1,500 (2,549)	1,800 (3,058)	2,250 (3,823)	2,550 (4,332)	3,000 (5,097)
Cooling Performance (4-row)					
Gross Cooling Capacity, Btu (kW)	135,303 (39.65)	151,147 (44.30)	186,972 (54.80)	213,659 (62.62)	242,918 (71.19)
Nominal cfm (m^3/h)	4,000 (6,796)	4,800 (8,155)	6,000 (10,194)	6,800 (11,553)	8,000 (13,592)
Compressor					
Number	2	2	2	2	2
Type	Scroll	Scroll	Scroll	Scroll	Scroll
Outdoor Coil					
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	30 (2.79)	30 (2.79)	30 (2.79)	30 (2.79)	30 (2.79)
Rows	2	2	2	2	2
FPI	14	14	14	14	14
Indoor Coil					
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size (6-row)—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)
Tube Size (4-row)—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	10 (0.93)	10 (0.93)	10 (0.93)	17 (1.58)	17 (1.58)
Rows	6 or 4	6 or 4	6 or 4	6 or 4	6 or 4
FPI	14 or 15	14 or 15	14 or 15	14 or 15	14 or 15
Refrigerant Control	TXV	TXV	TXV	TXV	TXV
Drain Connection Number	1	1	1	1	1
Drain Connection Size, in. (mm)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)
Outdoor Fan					
Type	Propeller	Propeller	Propeller	Propeller	Propeller
Number Used	2	2	2	3	3
Diameter, in. (mm)	27 (685.8)	27 (685.8)	27 (685.8)	27 (685.8)	27 (685.8)
Drive Type	Direct	Direct	Direct	Direct	Direct
No. Speeds	1	1	1	1	1
Fan cfm (m^3/h)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)
Number Motors	2	2	2	2	2
Motor HP (kW), per motor	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)
Motor RPM	1,140	1,140	1,140	1,140	1,140
Indoor Fan					
Type	Airfoil	Airfoil	Airfoil	Airfoil	Airfoil
Number Used	1	1	1	1	1
Diameter, in. (mm)	Varies	Varies	Varies	Varies	Varies
Drive Type	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Number Motors	1	1	1	1	1
Motor HP (kW)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)
Motor RPM	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500
Motor Frame Size	Varies	Varies	Varies	Varies	Varies
Filters					
Type Furnished Number Size Recommended	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53

Table 5. General Data—ASHP 10–20 Tons High Efficiency

	10 Tons Downflow	12 Tons Downflow	15 Tons Downflow	17 Tons Downflow	20 Tons Downflow
	OADG010	OADG012	OADG015	OADG017	OADG020
Performance					
Gross Cooling Capacity, Btu (kW)	131,284 (38.48)	149,705 (43.87)	187,181 (54.86)	217,530 (63.75)	250,834 (73.51)
Gross Heating Capacity, Btu (kW)	85,752 (25.13)	98,970 (29.01)	119,043 (34.89)	145,594 (42.67)	153,122 (44.88)
Nominal cfm (m^3/h)	1,500 (2,549)	1,800 (3,058)	2,250 (3,823)	2,550 (4,332)	3,000 (5,097)
Compressor					
Number	2	2	2	2	2
Type	Scroll	Scroll	Scroll	Scroll	Scroll
Outdoor Coil					
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	30 (2.79)	30 (2.79)	30 (2.79)	29 (2.69)	29 (2.69)
Rows	2	2	2	3	3
FPI	14	14	14	12	12
Indoor Coil					
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	10 (0.93)	10 (0.93)	10 (0.93)	17 (1.58)	17 (1.58)
Rows	6	6	6	6	6
FPI	14	14	14	14	14
Refrigerant Control	TXV	TXV	TXV	TXV	TXV
Drain Connection Number	1	1	1	1	1
Drain Connection Size, in. (mm)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)
Outdoor Fan					
Type	Propeller	Propeller	Propeller	Propeller	Propeller
Number Used	2	2	2	3	3
Diameter, in. (mm)	27 (685.8)	27 (685.8)	27 (685.8)	27 (685.8)	27 (685.8)
Drive Type	Direct	Direct	Direct	Direct	Direct
No. Speeds	1	1	1	1	1
Fan cfm (m^3/h)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)	7,000 (11,893)
Number Motors	2	2	2	3	3
Motor HP (kW), per motor	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)	1.0 (0.75)
Motor RPM	1,140	1,140	1,140	1,140	1,140
Indoor Fan					
Type	Airfoil	Airfoil	Airfoil	Airfoil	Airfoil
Number Used	1	1	1	1	1
Diameter, in. (mm)	Varies	Varies	Varies	Varies	Varies
Drive Type	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Number Motors	1	1	1	1	1
Motor HP (kW)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)	1–7.5 (0.75–5.59)
Motor RPM	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500
Motor Frame Size	Varies	Varies	Varies	Varies	Varies
Filters					
Type Furnished Number Size Recommended	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53

Table 6. General Data—Cooling 40–80 Tons High Efficiency

	40 Tons Downflow	45 Tons Downflow	50 Tons Downflow	55 Tons Downflow	60 Tons Downflow	70 Tons Downflow	80 Tons Downflow
	OANG040	OANG045	OANG050	OANG055	OANG060	OANG070	OANG080
Cooling Performance (6-row)							
Gross Cooling Capacity, Btu (kW)	511,968 (150.04)	569,546 (166.92)	604,728 (177.23)	686,668 (201.24)	752,012 (220.39)	871,572 (255.43)	998,910 (292.75)
Nominal cfm (m^3/h)	7,500 (12,743)	6,750 (11,468)	7,500 (12,743)	8,250 (14,017)	9,000 (15,291)	10,500 (17,840)	12,000 (20,388)
Cooling Performance (4-row)							
Gross Cooling Capacity, Btu (kW)	488,728 (143.23)	553,912 (162.34)	605,568 (177.47)	642,968 (188.44)	701,308 (205.53)	847,228 (248.30)	924,696 (271.00)
Nominal cfm (m^3/h)	12,800 (21,747)	14,400 (24,466)	16,000 (27,184)	17,600 (29,903)	19,200 (32,621)	22,400 (38,058)	25,000 (42,475)
Compressor							
Number	4	4	4	4	4	4	4-6
Type	Scroll	Scroll	Scroll	Scroll	Scroll	Scroll	Scroll
Outdoor Coil							
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	30 (2.79)	30 (2.79)	30 (2.79)	48 (4.46)	48 (4.46)	48 (4.46)	48 (4.46)
Rows	3	3	3	3	3	3	3
FPI	14	14	14	14	14	14	14
Indoor Coil							
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size (6-row)—OD, in. (mm)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)
Tube Size (4-row)—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area (6-row), ft^2 (m^2)	26 (2.42)	26 (2.42)	26 (2.42)	34 (3.16)	34 (3.16)	34 (3.16)	34 (3.16)
Face Area (4-row), ft^2 (m^2)	34 (3.16)	34 (3.16)	34 (3.16)	2x21 (3.90)	2x21 (3.90)	2x21 (3.90)	2x21 (3.90)
Rows	6 or 4	6 or 4	6 or 4	6 or 4	6 or 4	6 or 4	6 or 4
FPI	14	14	14	14	14	14	14
Refrigerant Control	TXV	TXV	TXV	TXV	TXV	TXV	TXV
Drain Connection Number	1	1	1	1	1	1	1
Drain Connection Size, in. (mm)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)
Outdoor Fan							
Type	Propeller	Propeller	Propeller	Propeller	Propeller	Propeller	Propeller
Number Used	4	4	4	6	6	6	6
Diameter, in. (mm)	30 (762)	30 (762)	30 (762)	30 (762)	30 (762)	30 (762)	30 (762)
Drive Type	Direct	Direct	Direct	Direct	Direct	Direct	Direct
No. Speeds	1	1	1	1	1	1	1
Fan cfm (m^3/h)	40,000 (67,960)	40,000 (67,960)	40,000 (67,960)	60,000 (101,941)	60,000 (101,941)	60,000 (101,941)	60,000 (101,941)
Number Motors	4	4	4	6	6	6	6
Motor HP (kW), per motor	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)
Motor RPM	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Indoor Fan							
Type	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined
Number Used	1	1	1	1	1	1	1
Diameter, in. (mm)	Varies	Varies	Varies	Varies	Varies	Varies	Varies
Drive Type	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive

Table 6. General Data—Cooling 40–80 Tons High Efficiency (continued)

	40 Tons Downflow	45 Tons Downflow	50 Tons Downflow	55 Tons Downflow	60 Tons Downflow	70 Tons Downflow	80 Tons Downflow
	OANG040	OANG045	OANG050	OANG055	OANG060	OANG070	OANG080
Number Motors	1	1	1	1	1	1	1
Motor HP (kW) (Standard/ Oversized)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)
Motor RPM (Standard/ Oversized)	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500
Motor Frame Size (Standard/Oversized)	Varies	Varies	Varies	Varies	Varies	Varies	Varies
Filters							
Type Furnished	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53
Number Size Recommended							

Table 7. General Data—ASHP 40–80 Tons High Efficiency

	40 Tons Downflow	45 Tons Downflow	50 Tons Downflow	55 Tons Downflow	60 Tons Downflow	70 Tons Downflow	80 Tons Downflow
	OANG040	OANG045	OANG050	OANG055	OANG060	OANG070	OANG080
Cooling Performance							
Gross Cooling Capacity, Btu (kW)	495,304 (145.16)	558,120 (163.57)	577,584 (169.27)	670,550 (196.52)	719,942 (210.99)	842,536 (246.92)	928,964 (272.25)
Gross Heating Capacity, Btu (kW)	460,464 (134.95)	522,116 (153.02)	568,292 (166.55)	632,996 (185.51)	648,720 (190.12)	774,200 (226.90)	876,054 (256.75)
Nominal cfm (m^3/h)	5,000–10,000 (8,495–16,990)	5,625–11,250 (9,557–19,114)	6,250–12,500 (10,619–21,238)	6,875–13,750 (11,681–23,361)	7,500–15,000 (12,743–25,485)	8,750–17,500 (14,866–29,733)	10,000–20,000 (16,990–33,980)
Compressor							
Number	4	4	4	4	4	4	5
Type	Scroll	Scroll	Scroll	Scroll	Scroll	Scroll	Scroll
Outdoor Coil							
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Face Area, ft^2 (m^2)	45 (2.79)	45 (2.79)	45 (2.79)	45 (2.69)	45 (2.69)	45 (2.69)	45 (2.69)
Rows	2	2	2	2	2	3	3
FPI	14	14	14	14	14	14	14
Indoor Coil							
Type	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance	High-Performance
Tube Size—OD, in. (mm)	1/2 (9.5)	1/2 (9.5)	1/2 (9.5)	1/2 (9.5)	1/2 (9.5)	1/2 (9.5)	1/2 (9.5)
Face Area, ft^2 (m^2)	26 (0.93)	26 (0.93)	26 (0.93)	26 (1.58)	34 (1.58)	34 (1.58)	34 (1.58)
Rows	6	6	6	6	6	6	6
FPI	14	14	14	14	14	14	14
Refrigerant Control	TXV	TXV	TXV	TXV	TXV	TXV	TXV
Drain Connection Number	1	1	1	1	1	1	1
Drain Connection Size, in. (mm)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)	1 (25.4)
Outdoor Fan							
Type	Propeller	Propeller	Propeller	Propeller	Propeller	Propeller	Propeller
Number Used	4	4	4	6	6	6	6
Diameter, in. (mm)	30 (685.8)	30 (685.8)	30 (685.8)	30 (685.8)	30 (685.8)	30 (685.8)	30 (685.8)
Drive Type	Direct	Direct	Direct	Direct	Direct	Direct	Direct
No. Speeds	1	1	1	1	1	1	1
Fan cfm (m^3/h)	40,000 (67,960)	40,000 (67,960)	40,000 (67,960)	60,000 (101,941)	60,000 (101,941)	60,000 (101,941)	60,000 (101,941)

Table 7. General Data—ASHP 40–80 Tons High Efficiency (continued)

	40 Tons Downflow	45 Tons Downflow	50 Tons Downflow	55 Tons Downflow	60 Tons Downflow	70 Tons Downflow	80 Tons Downflow
	OANG040	**OANG045**	**OANG050**	**OANG055**	**OANG060**	**OANG070**	**OANG080**
Number Motors	6	6	6	6	6	6	6
Motor HP (kW), per motor	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)	1.5 (1.12)
Motor RPM	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Indoor Fan							
Type	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined	Backward Inclined
Number Used	1	1	1	1	1	1	1
Diameter, in. (mm)	Varies	Varies	Varies	Varies	Varies	Varies	Varies
Drive Type	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Number Motors	1	1	1	1	1	1	1
Motor HP (kW) (Standard/ Oversized)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)	1.5–20 (1.12–14.91)
Motor RPM (Standard/ Oversized)	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500	1750–3500
Motor Frame Size (Standard/Oversized)	Varies	Varies	Varies	Varies	Varies	Varies	Varies
Filters							
Type Furnished	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53	Refer to "OAU Filter Guide" in "Appendix," p. 53
Number Size Recommended							

Unit Clearances, Curb Dimensions, and Dimensional Data

OAD Units

Unit Clearances

Figure 12. Installation clearances for units with no powered exhaust or ERV, in. (cm)

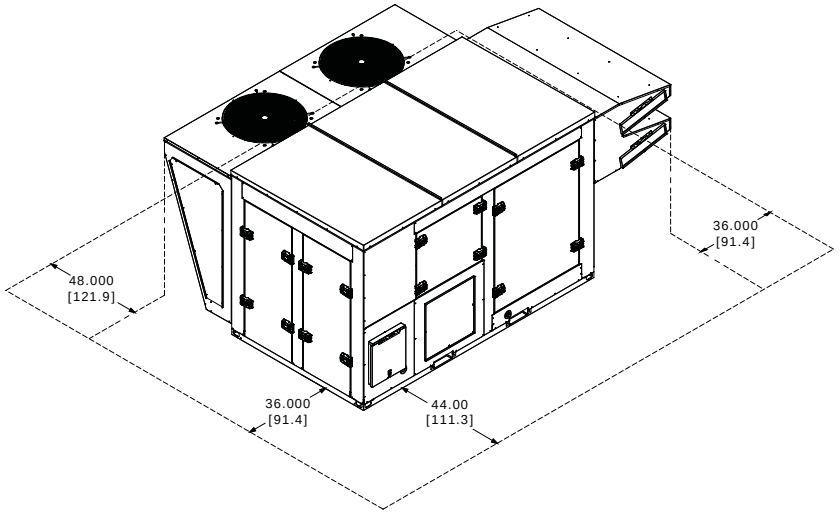
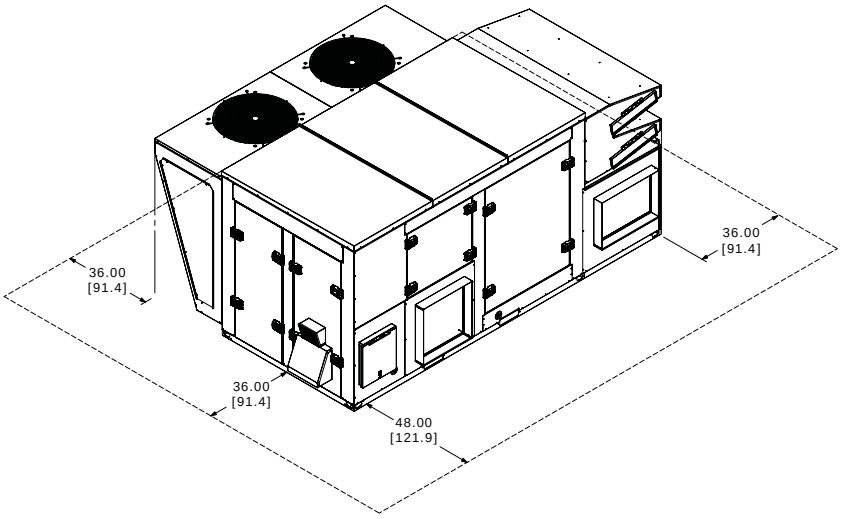
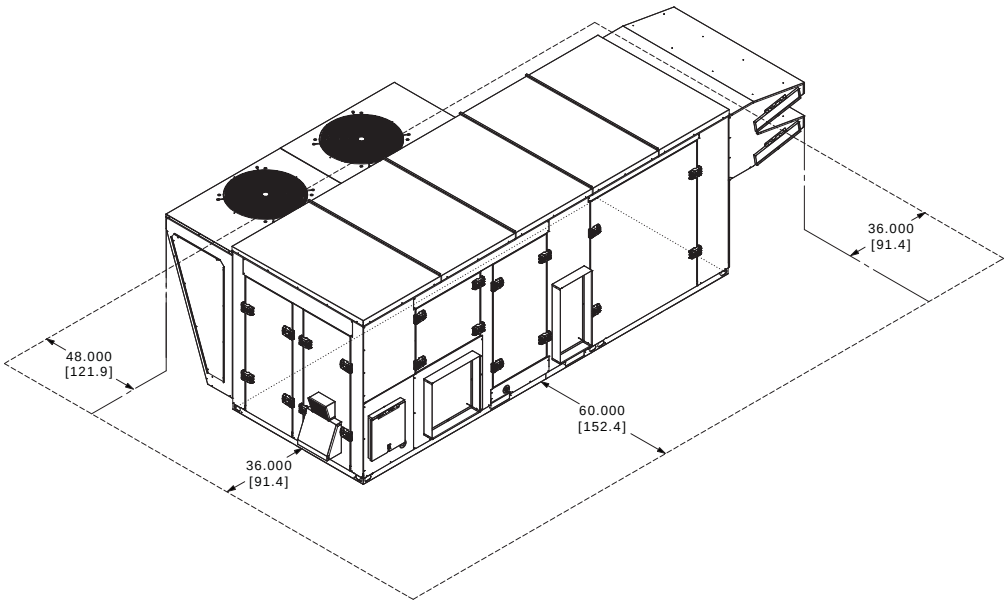


Figure 13. Installation clearances for unit with powered exhaust but no ERV, in. (cm)



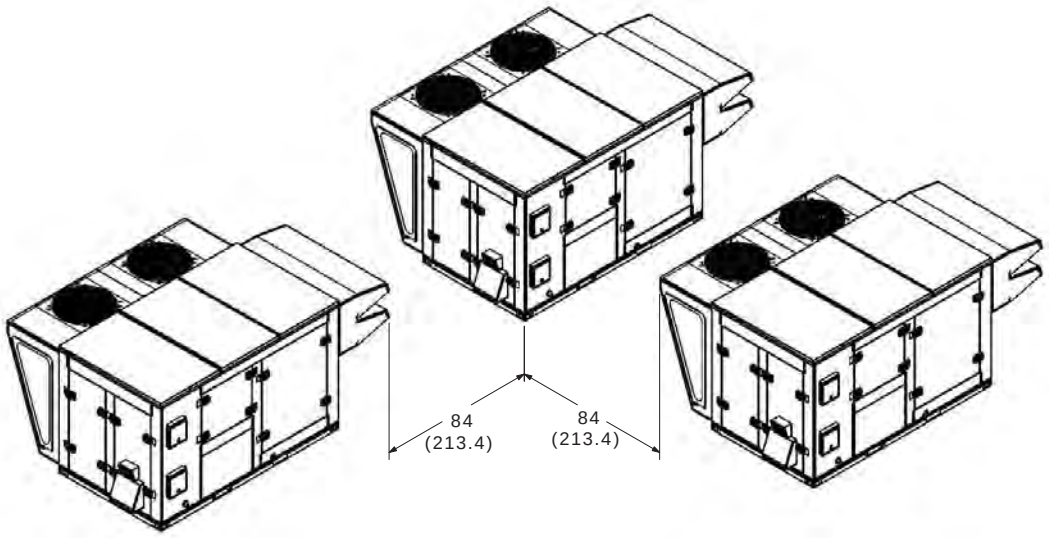
Note: 72 in. (182.9 cm) clearance is required above the condenser fans.

Figure 14. Installation clearances for unit with ERV, in. (cm)



Note: 72 in. (182.9 cm) clearance is required above the condenser fans.

Figure 15. Unit to unit clearance, in. (cm)



Curb Dimensions

Figure 16. Unit curb data for OAD cabinet with no powered exhaust or ERV, in. (cm)

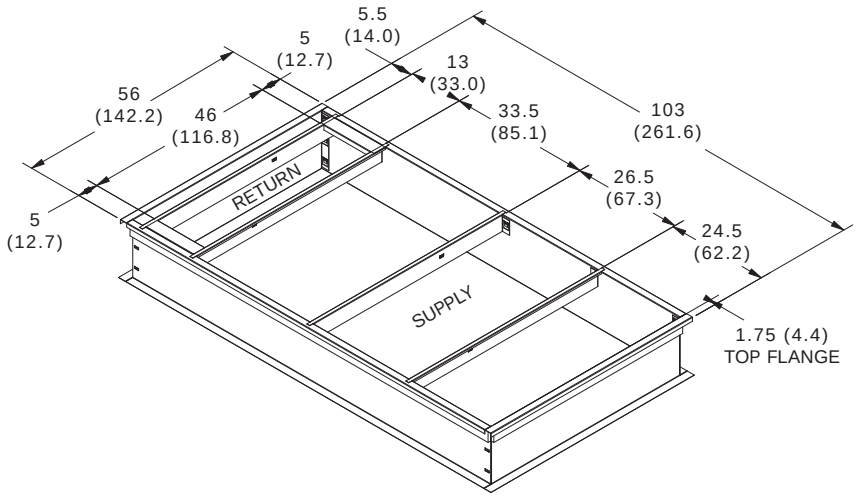


Figure 17. Unit curb data for OAD cabinet with powered exhaust but no ERV, in. (cm)

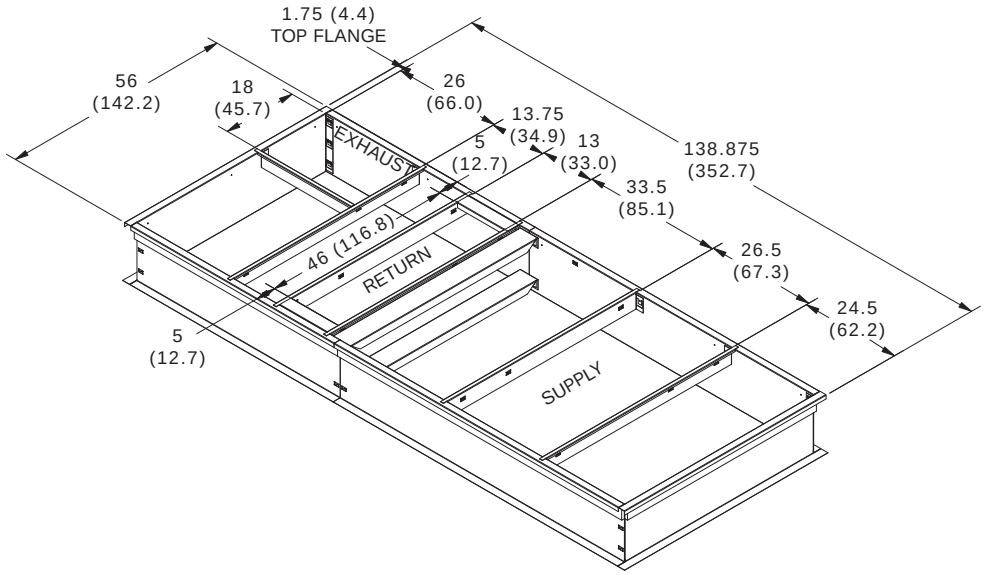
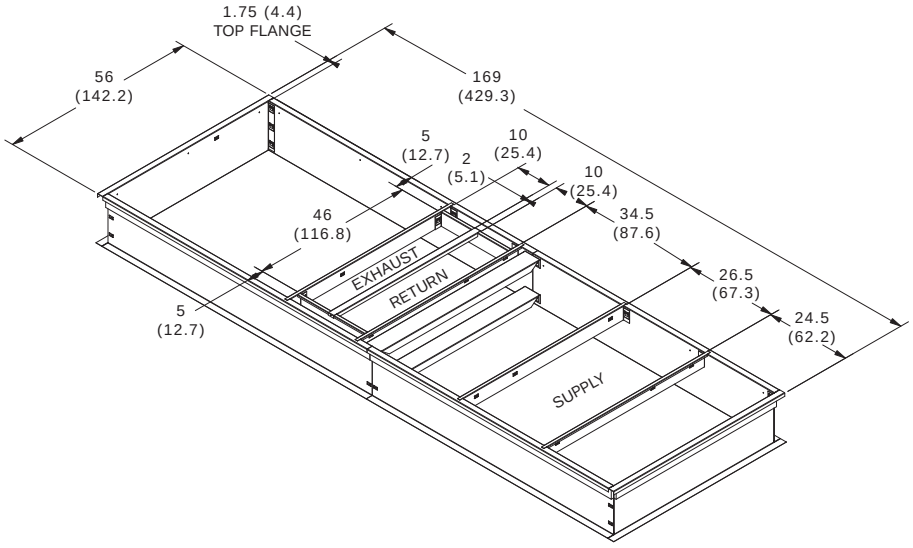
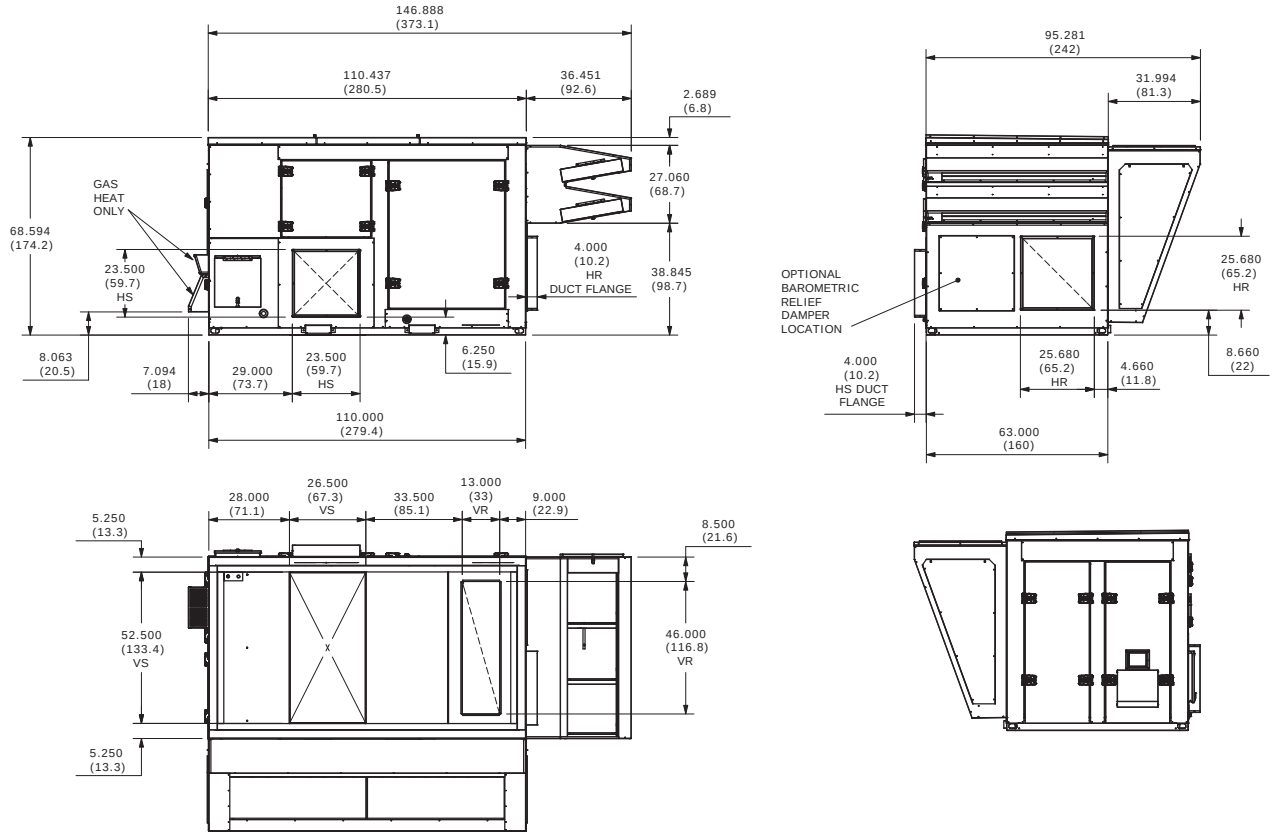


Figure 18. Unit curb data for OAD cabinet with ERV, in. (cm)



Dimensional Data

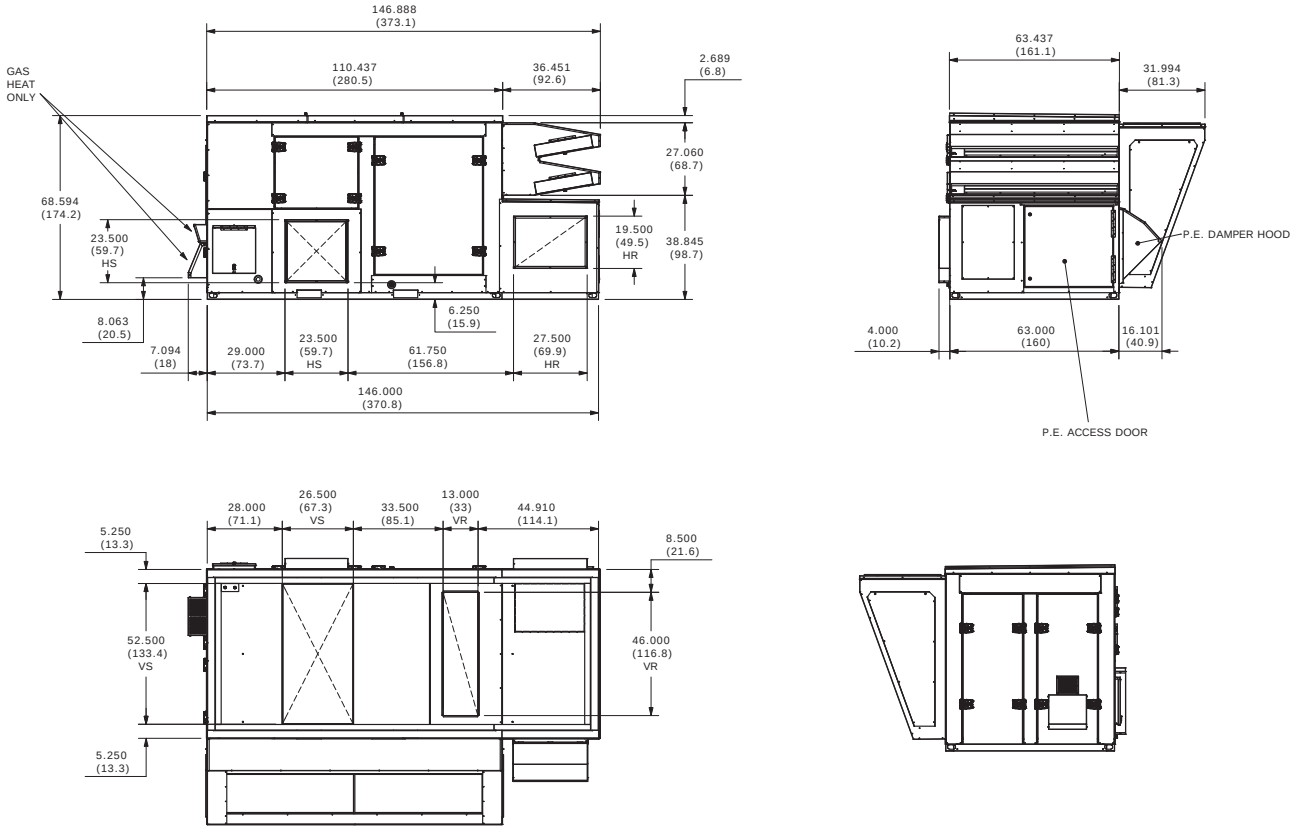
Figure 19. Unit dimensional data for OAD unit with no powered exhaust or ERV, in. (cm)



Notes:

- Sound attenuation package will add 16 in. (40.6 cm) to the height of the condenser fan section.
- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (25.4 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

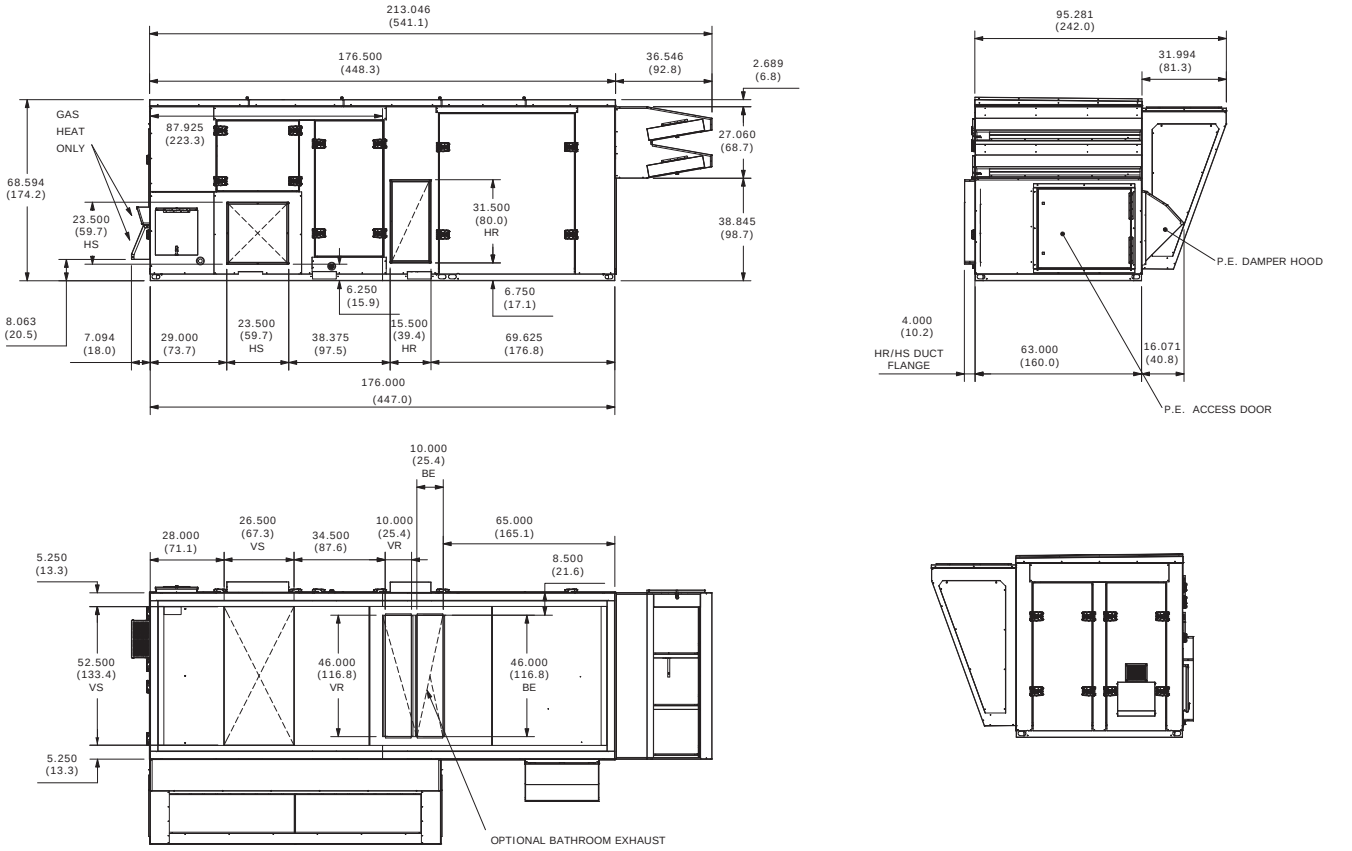
Figure 20. Unit dimensional data for OAD cabinet with powered exhaust but no ERV, in. (cm)



Notes:

- Sound attenuation package will add 16 in. (40.6 cm) to the height of the condenser fan section.
- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (45.7 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

Figure 21. Unit dimensional data for OAD cabinet with ERV, in. (cm)



Notes:

- Sound attenuation package will add 16 in. (40.6 cm) to the height of the condenser fan section.
- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (45.7 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

OAN Units

Unit Clearances

Figure 22. Installation clearances for units with no powered exhaust or ERV, in. (cm)

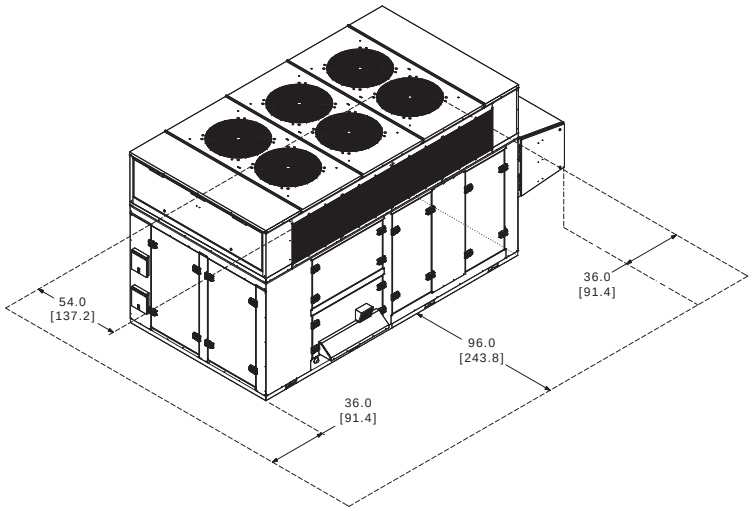
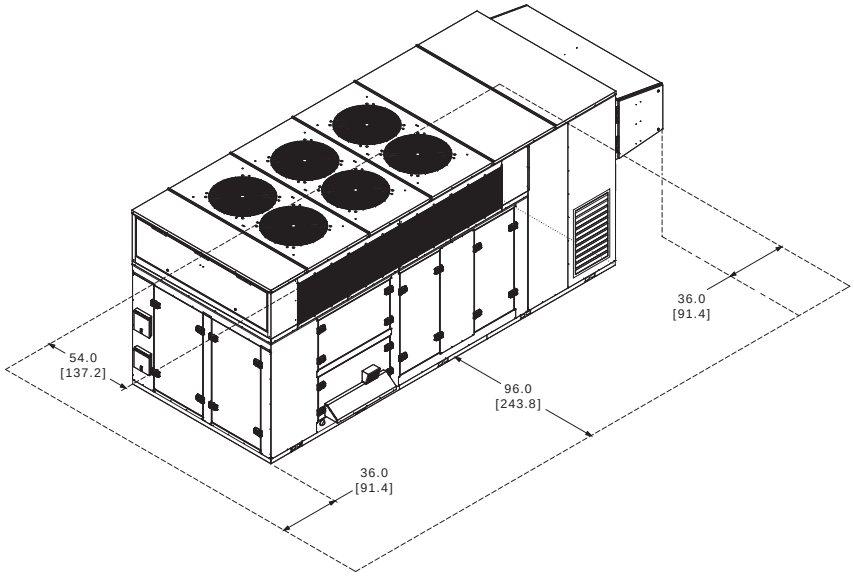
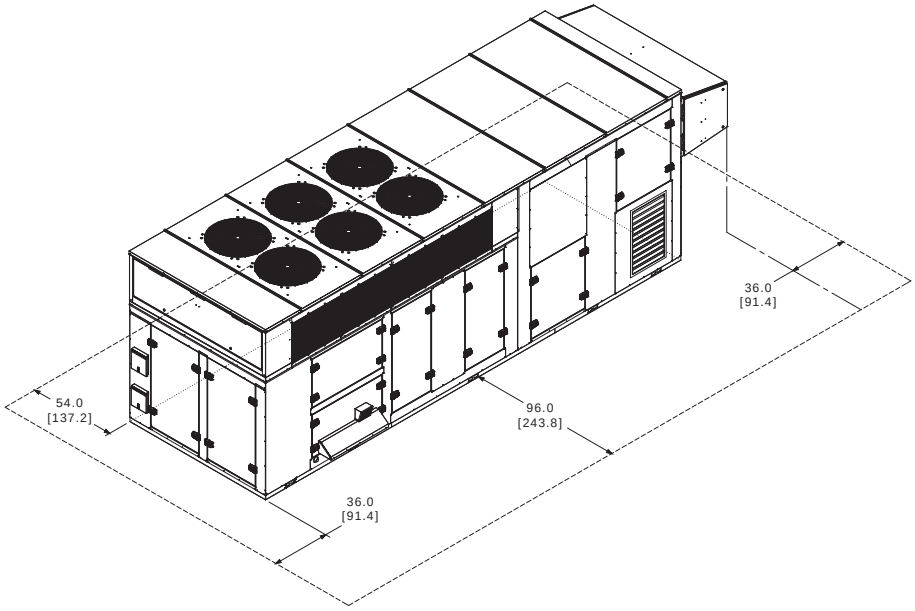


Figure 23. Installation clearances for unit with powered exhaust but no ERV, in. (cm)



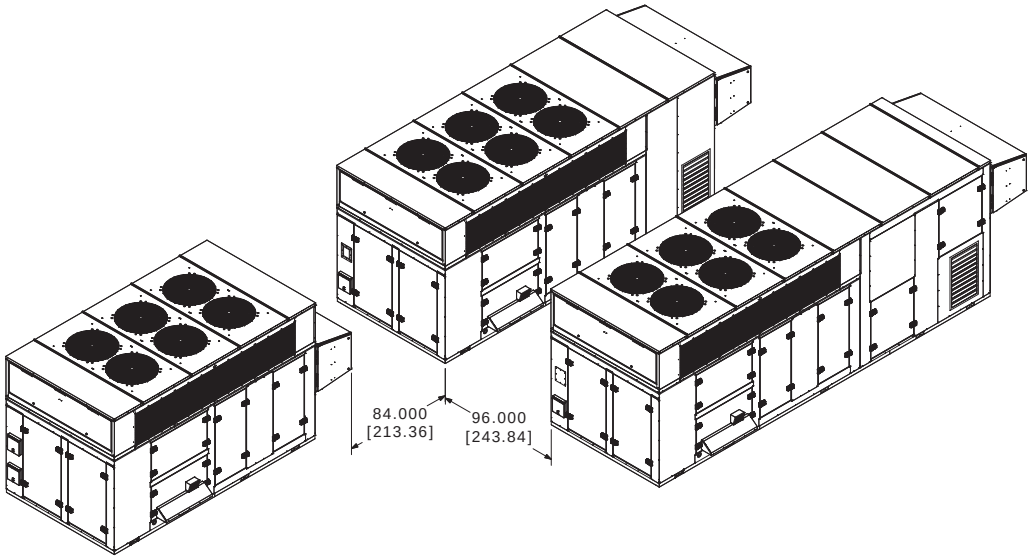
Note: 72 in. (182.9 cm) clearance is required above the condenser fans.

Figure 24. Installation clearances for unit with ERV, in. (cm)



Note: 72 in. (182.9 cm) clearance is required above the condenser fans.

Figure 25. Unit to unit clearance, in. (cm)



Curb Dimensions

Figure 26. Unit curb data for OAN cabinet with no powered exhaust or ERV, in. (cm)

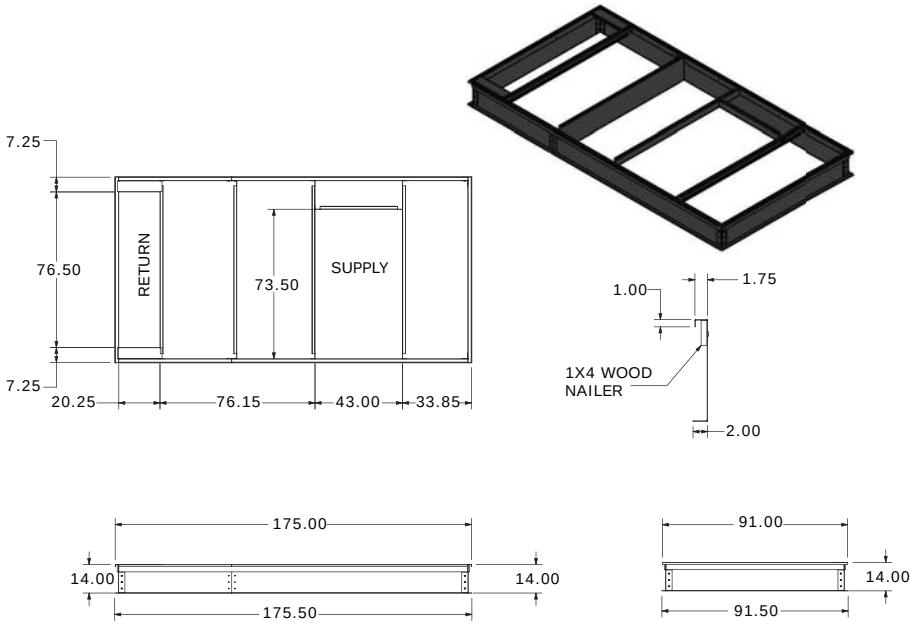


Figure 27. Unit curb data for OAN cabinet with powered exhaust but no ERV, in. (cm)

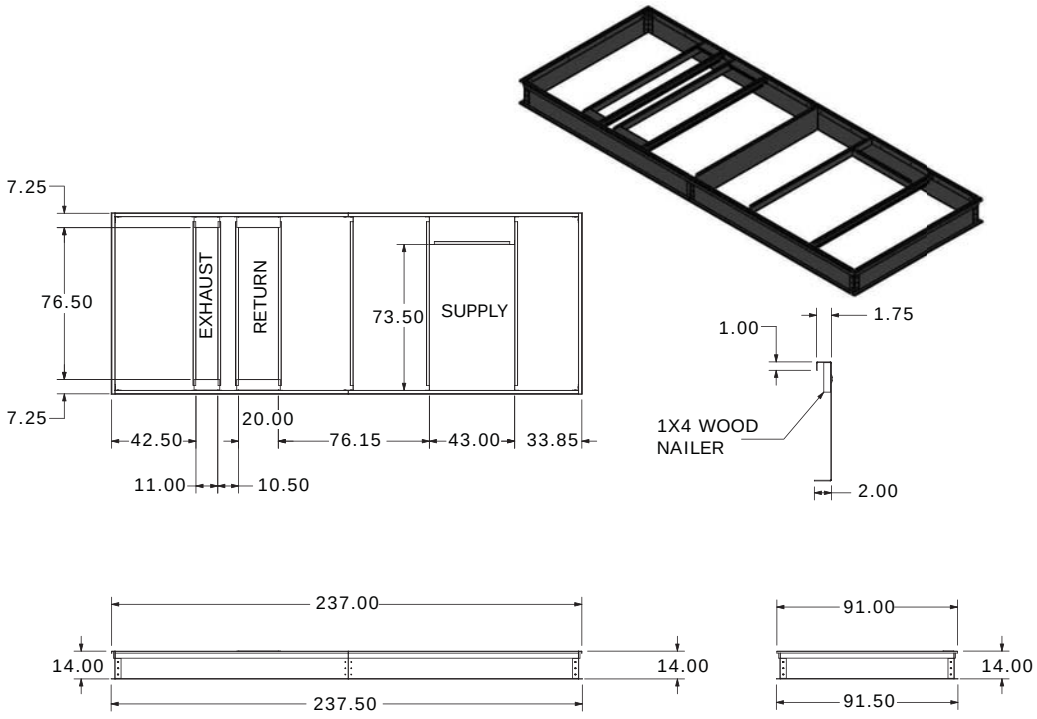
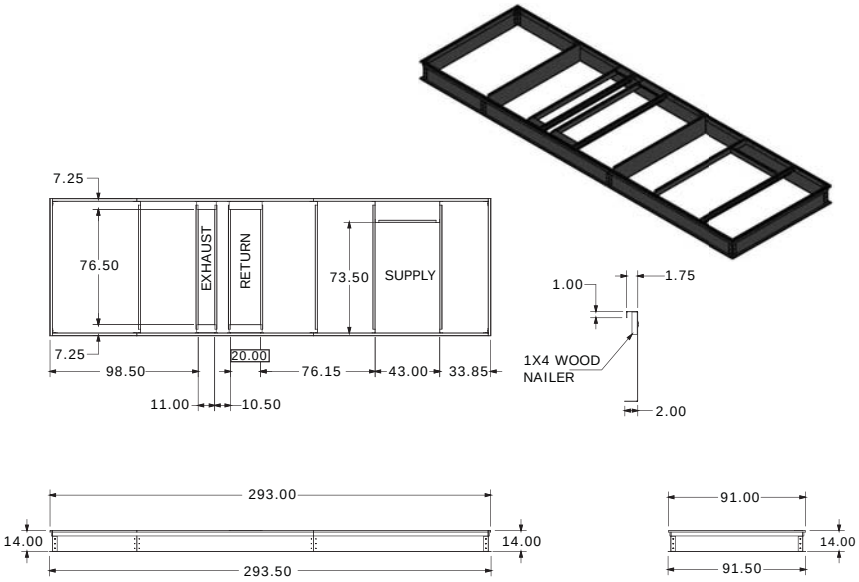
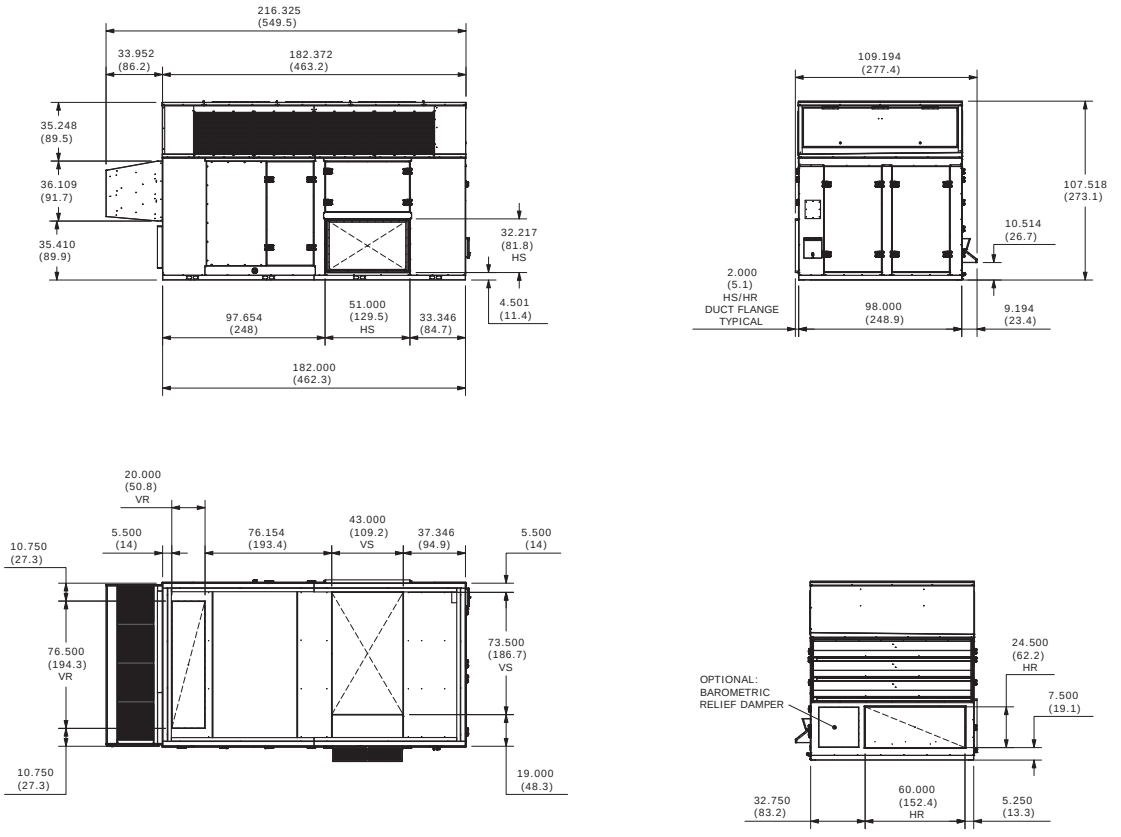


Figure 28. Unit curb data for OAN cabinet with ERV, in. (cm)



Dimensional Data

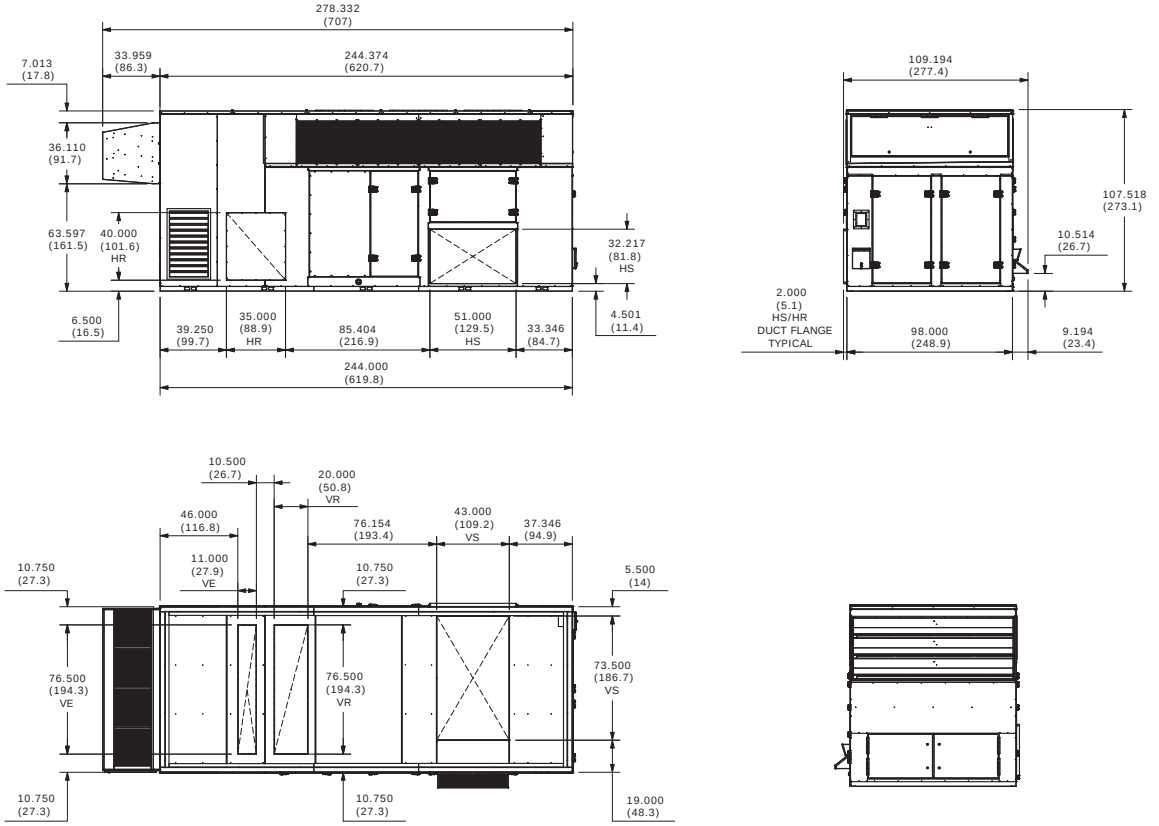
Figure 29. Unit dimensional data for OAN unit with no powered exhaust or ERV, in. (cm)



Notes:

- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (45.7 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

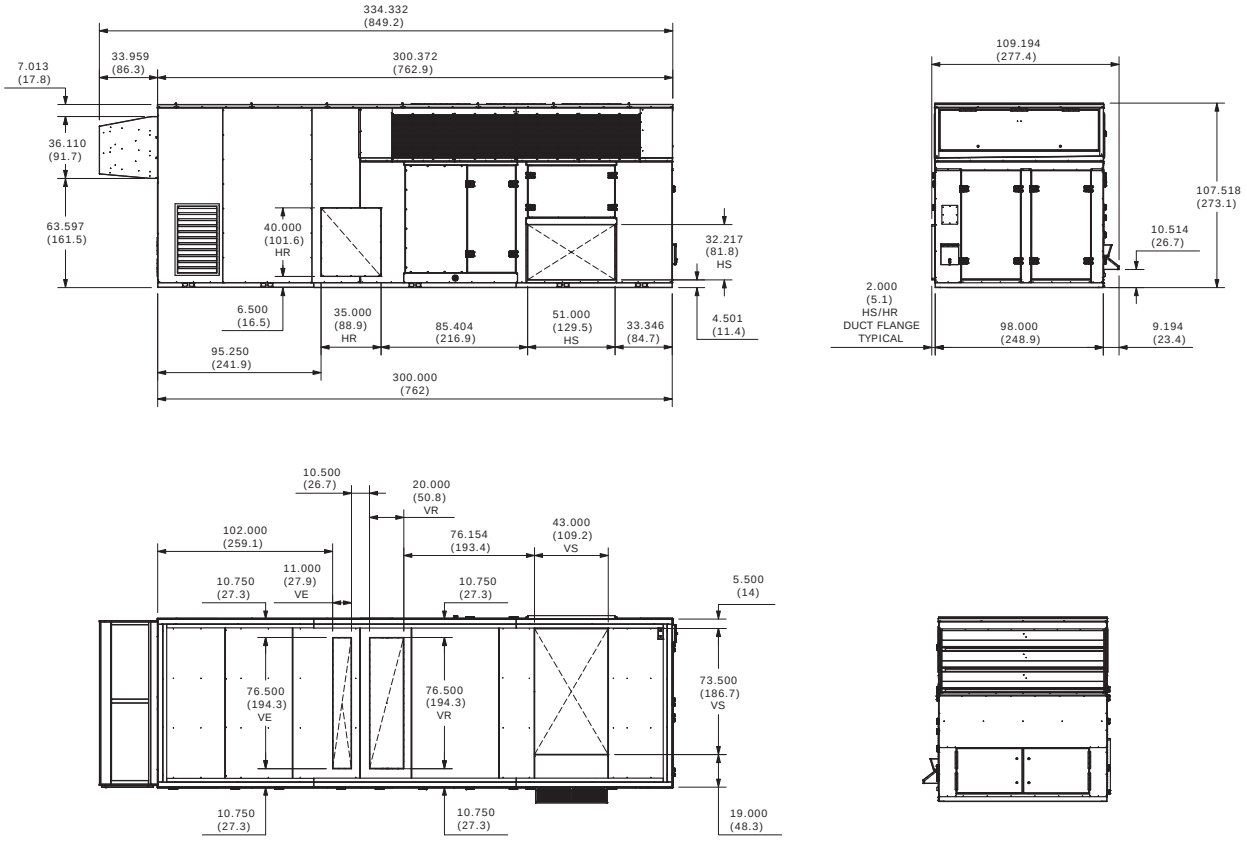
Figure 30. Unit dimensional data for OAN cabinet with powered exhaust but no ERV, in. (cm)



Notes:

- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (45.7 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

Figure 31. Unit dimensional data for OAN cabinet with ERV, in. (cm)



Notes:

- Units with no cooling will have the same dimensions, less the condensing section.
- Units with chilled water cooling will have the same dimensions, less the condensing section, and with an 18 in. (45.7 cm) deep pipe cabinet added.
- Refer to project-specific unit submittals.

Indirect Gas-fired Furnace Heater and Power

Figure 32. OAD indirect gas-fired furnace heater components

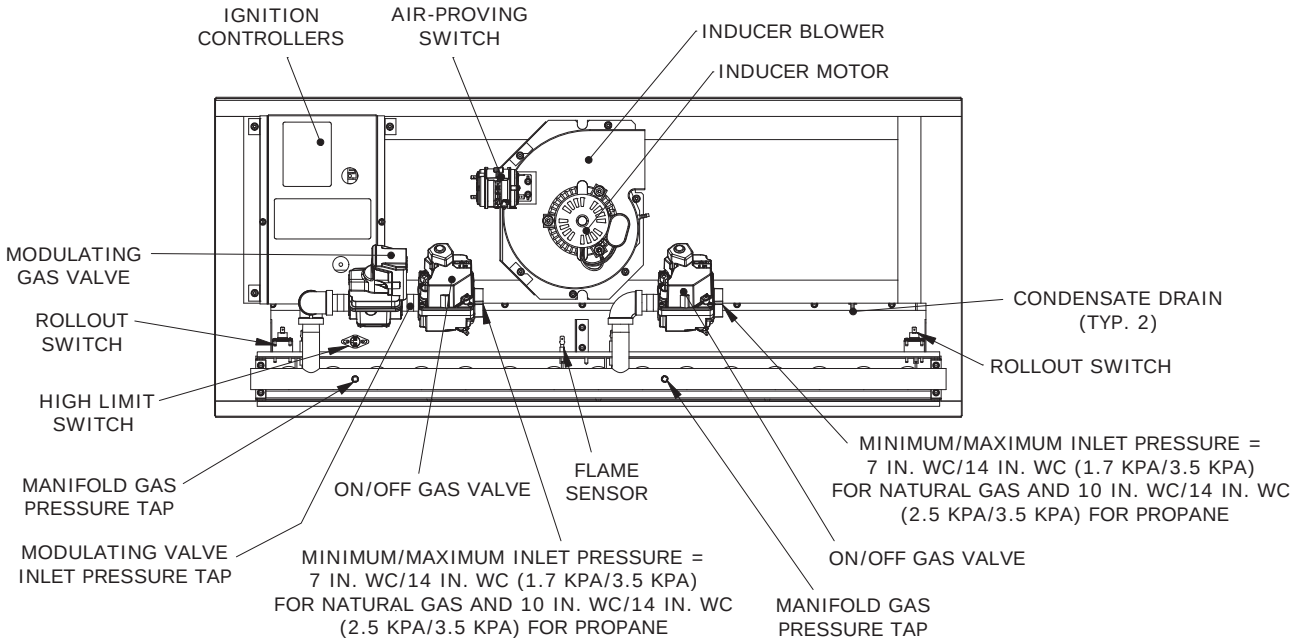


Figure 33. OAD power entrance

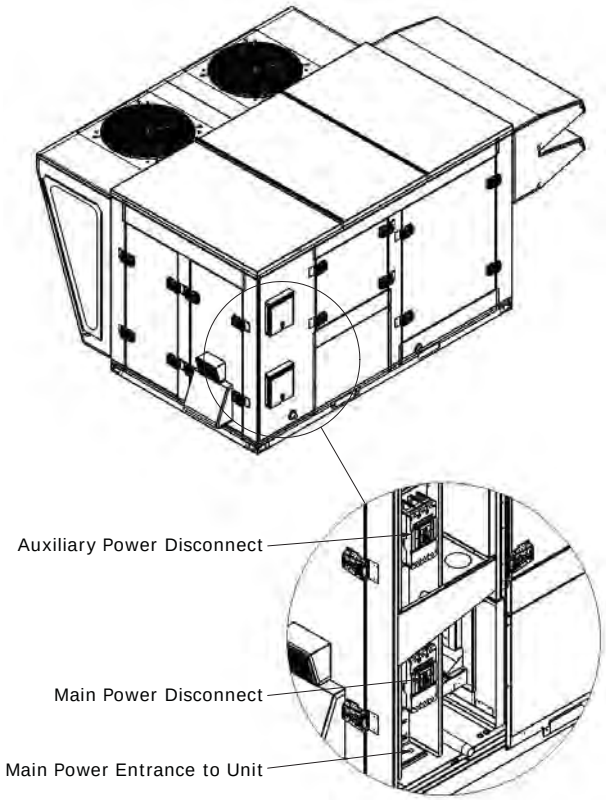
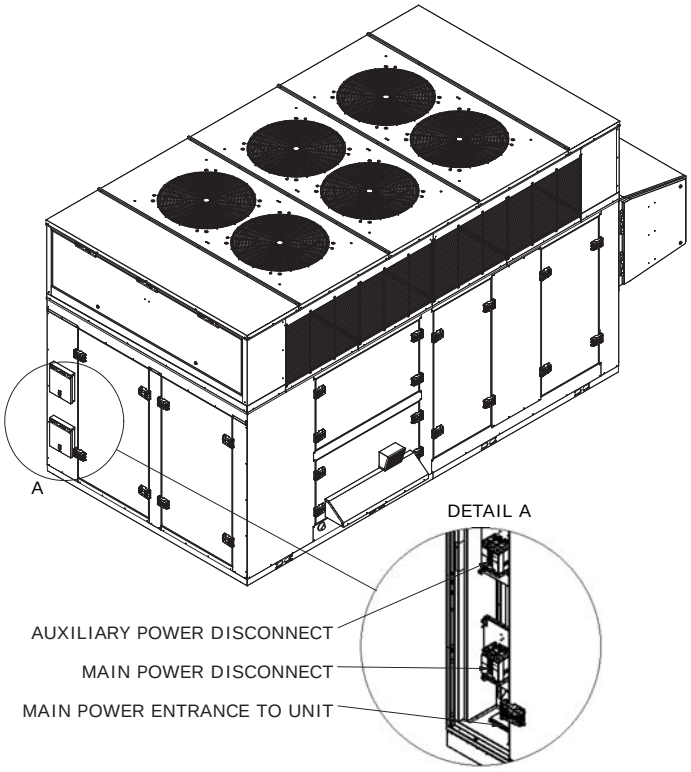


Figure 34. OAN power entrance



Unit Weight and Rigging

Unit Weight

Table 8. Typical unit weight and center-of-gravity (CG)

Configuration	Tonnage	Operating Weight, lb (kg)		Center-of-gravity, in. (cm)	
		Minimum	Maximum	Length	Width
Standard Cabinet	OAD/No cooling/chilled water	1502 (681.3)	2492 (1130.4)	54.8 (139.2)	30.5 (77.5)
With Powered Exhaust	OAD/No cooling/chilled water	1677 (760.7)	2840 (1288.2)	64.5 (163.8)	31.8 (80.8)
With ERV	OAD/No cooling/chilled water	2347 (1064.6)	3911 (1774.0)	91.2 (231.6)	31.0 (78.7)
Standard Cabinet	OAD/10–15	2209 (1002.0)	3099 (1405.7)	50.5 (128.3)	41.2 (104.6)
With Powered Exhaust	OAD/10–15	2417 (1096.3)	3447 (1563.5)	58.4 (148.3)	41.1 (104.4)
With ERV	OAD/10–15	3099 (1405.7)	4519 (2049.8)	81.1 (206.0)	38.0 (96.5)
Standard Cabinet	OAD/17–20	2430 (1102.2)	3415 (1549.0)	49.8 (126.5)	41.0 (104.1)
With Powered Exhaust	OAD/17–20	2637 (1196.1)	3764 (1707.3)	57.1 (145.0)	41.0 (104.1)
With ERV	OAD/17–20	3320 (1505.9)	4835 (2193.1)	78.8 (200.2)	38.5 (97.8)
Standard Cabinet	OAN/No cooling	4266 (1935.0)	6085 (2760.1)	92.7 (235.5)	51.8 (131.6)
With Powered Exhaust	OAN/No cooling	5380 (2440.3)	7904 (3585.2)	135.2 (343.4)	50.4 (128.0)
With ERV	OAN/No cooling	6630 (3007.3)	9577 (4344.1)	169.4 (430.3)	49.5 (125.7)
Standard Cabinet	OAN/chilled water	4266 (1935.0)	6085 (2760.1)	94.5 (240.0)	51.3 (130.3)
With Powered Exhaust	OAN/chilled water	5380 (2440.3)	7904 (3585.2)	118 (299.8)	50.8 (129.0)
With ERV	OAN/chilled water	6630 (3007.3)	9577 (4344.1)	157.4 (399.8)	49.8 (126.5)
Standard Cabinet	OAN/40–50	6220 (2821.3)	8111 (3679.1)	87.2 (221.5)	50.1 (127.2)
With Powered Exhaust	OAN/40–50	7327 (3323.5)	9888 (4485.1)	106.8 (271.2)	49.9 (126.7)
With ERV	OAN/40–50	8536 (3871.9)	11563 (5244.9)	143.4 (364.2)	49.2 (124.9)
Standard Cabinet	OAN/55–60	6565 (2977.8)	8505 (3857.8)	91.4 (232.2)	50.2 (127.5)
With Powered Exhaust	OAN/55–60	7674 (3480.9)	10282 (4663.8)	115.9 (294.3)	49.9 (126.7)
With ERV	OAN/55–60	8883 (4029.3)	11957 (5423.6)	146.2 (371.3)	49.3 (125.2)
Standard Cabinet	OAN/70	6881 (3121.2)	8883 (4029.3)	96 (243.8)	50.5 (127.7)
With Powered Exhaust	OAN/70	7990 (3624.2)	10660 (4835.3)	120.5 (306.1)	50 (127.0)
With ERV	OAN/70	9199 (4172.6)	12335 (5595.1)	149.4 (397.5)	49.4 (125.5)
Standard Cabinet	OAN/80	7038 (3192.4)	9058 (4108.6)	95.6 (242.8)	50.7 (128.7)
With Powered Exhaust	OAN/80	8147 (3695.4)	10834 (4914.2)	125 (317.5)	50.5 (128.2)
With ERV	OAN/80	9356 (4243.8)	12510 (5674.4)	151.8 (385.6)	49.5 (125.7)

Rigging and Center-of-Gravity

Figure 35. Four-point lift (OAD cabinet with no exhaust fan or ERV)

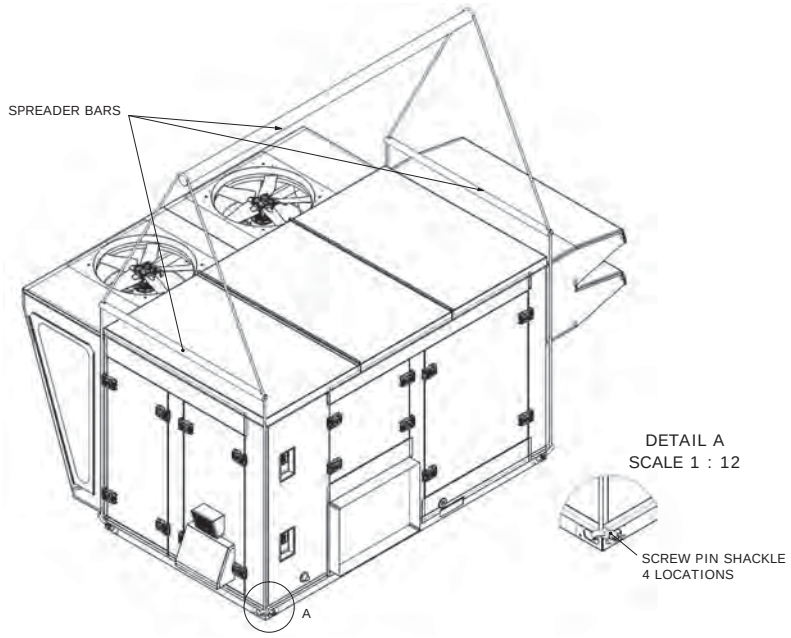


Figure 36. Four-point lift (OAD cabinet with exhaust fan and no ERV)

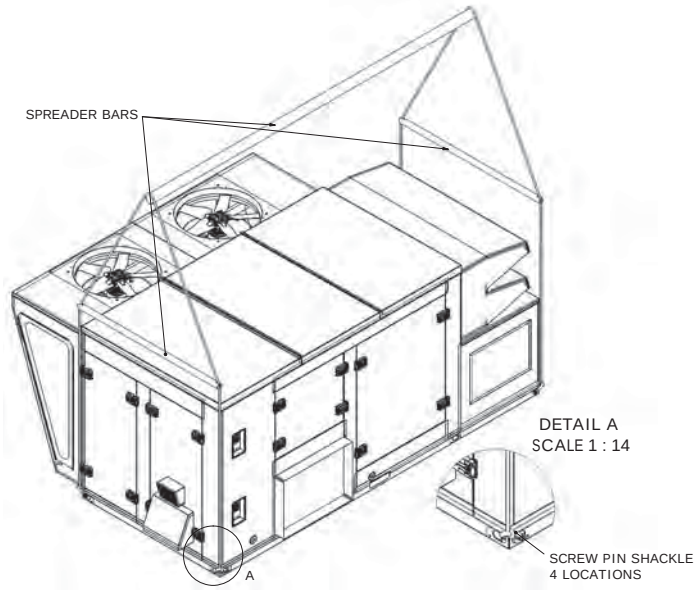


Figure 37. Six-point lift (OAD cabinet with ERV section)

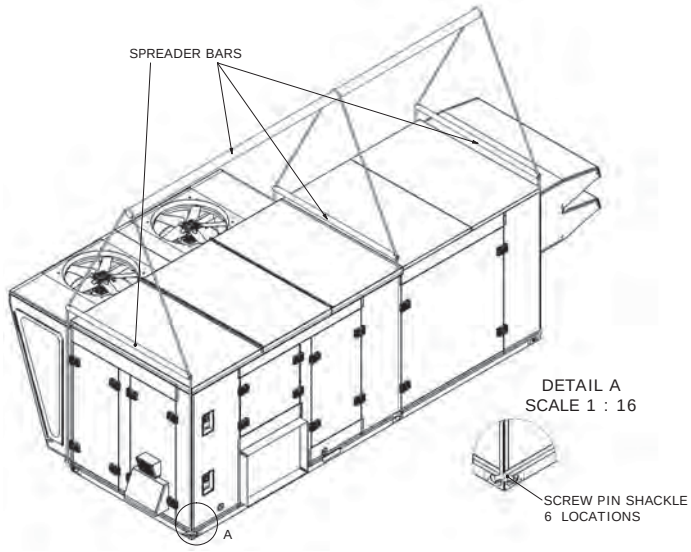


Figure 38. Eight-point lift (OAN cabinet with no exhaust fan or ERV)

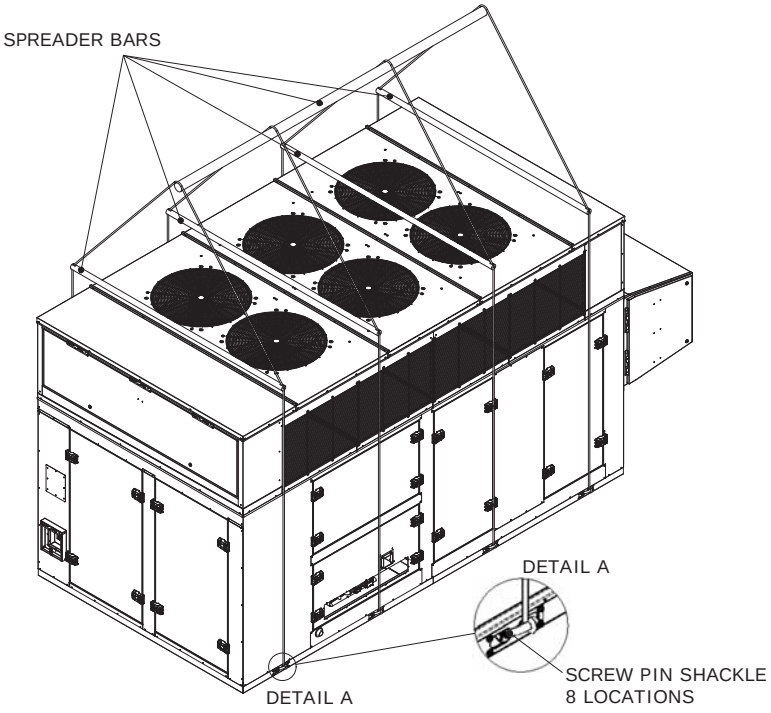


Figure 39. Ten-point lift (OAN cabinet with exhaust fan and no ERV)

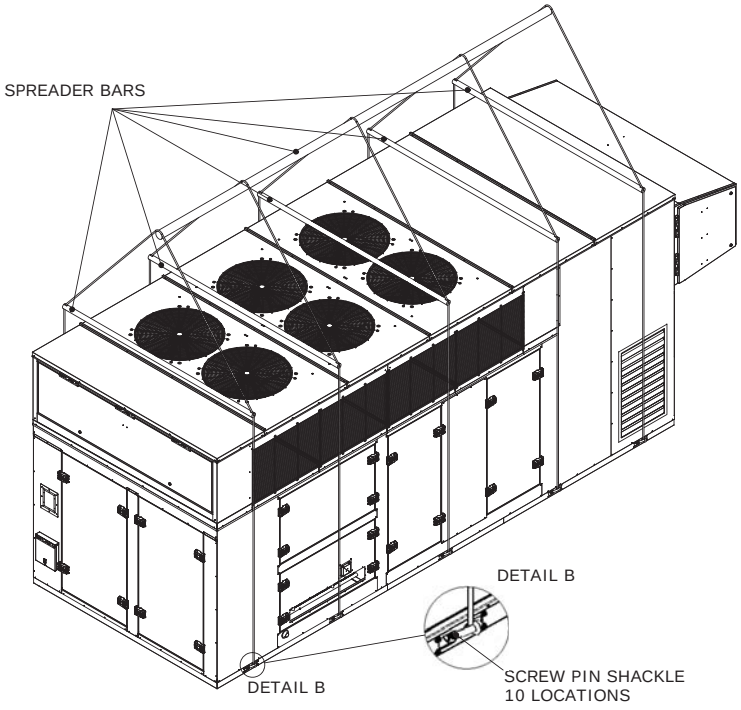
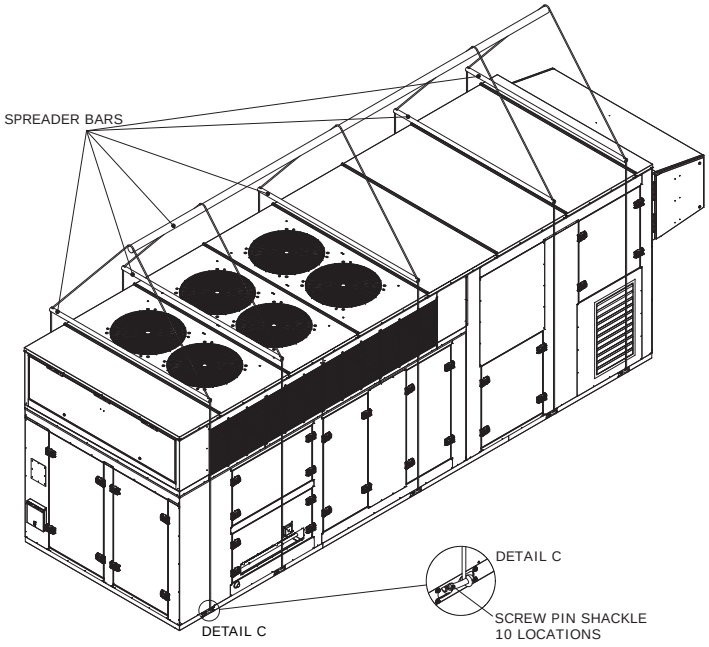


Figure 40. Ten-point lift (OAN cabinet with ERV)



For rigging instructions, please refer to OAU-SVX006*-EN (Installation, Operation, and Maintenance: Horizon Outdoor Air Unit - Model: OADG).

Mechanical Specifications

Horizon Outdoor Air Mechanical Specifications

General

The supply and return openings shall be available as vertical or horizontal airflow. Cooling performance shall be rated in accordance with ETL testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M40 for Central Cooling Air Conditioners. Canadian units shall be CSA Certified.

Casing

Unit casing will be provided with a thermal break and shall constructed of zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Unit shall have a 2-in. thick Antimicrobial Insulation with an R-value of 13, including unit floor and roof panels. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.

Drain Pan

The drain pan is a single-walled assembly made of Type 430 stainless steel. It is sloped in two planes and is fully drainable. The coils are mounted above the drain pan to allow easy inspection and cleaning of the drain pan.

Refrigeration and Dehumidification Systems

Compressors

All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Each compressor has a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

Evaporator and Condenser Coils

Refer to Figure 41. Internally finned copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig. The condenser coil shall have a fin design with slight gaps for ease of cleaning. Evaporator coil will have four or six interlaced rows for superior sensible and latent cooling.

Figure 41. Evaporator and reheat coil



Chilled Water Coils

The chilled water coil is AHRI performance certified and shall bear the AHRI symbol. Tubes are to be mechanically expanded into fins (secondary surface) for maximum heat transfer and shall be 6 rows. Materials are to be 1/2 in. diameter x (0.020) wall thickness. Secondary surface (fins) shall be of the plate-fin design using aluminum with die-formed collars. Fin design is waffle in a staggered tube pattern to meet performance requirements. Collars will hold fin spacing at specified density, and cover the entire tube surface. Fins are to be free of oils and oxidation. The coil shall have MPT connections constructed of copper.

The optional Cooney Freeze Block is designed to allow ice to form within the tubes, without restriction, by discharging a small amount of water into the drain pan. Each expansion header has a factory installed Cooney Freeze Block Valve that is both pressure and thermally activated. The valve will open when outside air below 35°F comes in contact with the header or return end of the coil, or when the internal pressure of the coil exceeds 300 psi. The valve will automatically reset and allow the coil to resume normal operation, when the pressure decreases, or when the temperature increases.

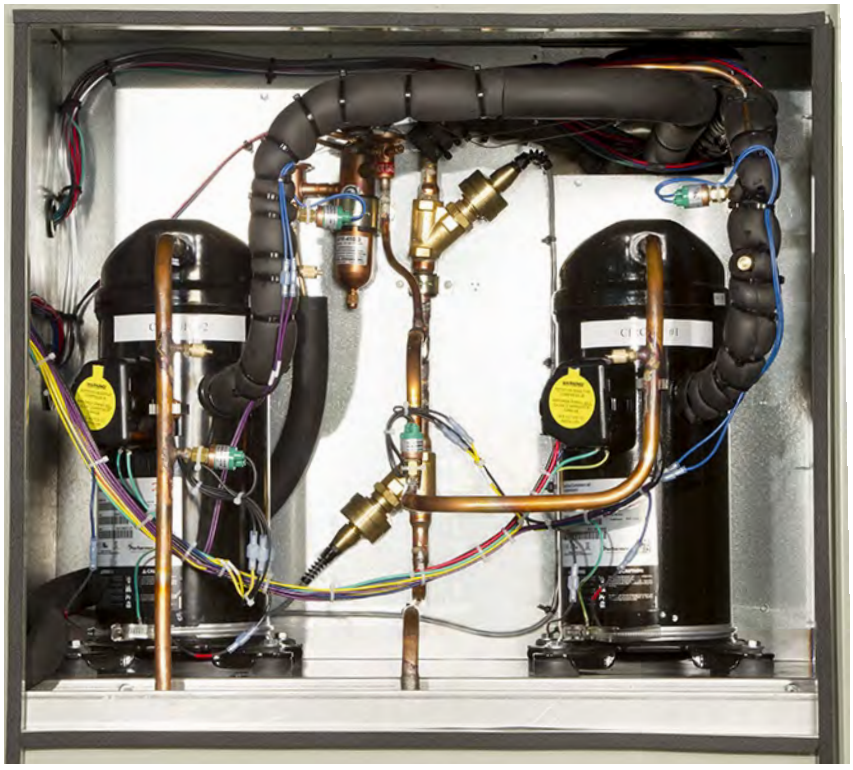
Refrigerant Capacity Control

Units with standard scroll compressors shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to ensure proper modulation of cooling. The RCC uses mechanical means to monitor and inject hot gas into the suction side of the compressor, unloading the compressor in part load conditions. The RCC is factory-set at 114 psig, which will maintain evaporator coil temperature at 38°F.

Units with eFlex™ variable speed scroll compressors are matched with a specially designed variable frequency drive that allows a modulating ratio of up to 4:1. This allows for unmatched control of leaving air temperatures to meet space loads. The eFlex compressors also include brushless permanent magnet motors designed to operate at higher efficiency resulting in significant part load energy savings. This makes units with eFlex technology the most efficient products in their class at part load.

Units with digital scroll type compressors shall have direct-drive, hermetic compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included. Compressor shall be able to fully modulate from 20 percent to 100 percent.

Figure 42. Refrigerant capacity control



Total Energy Wheel (Composite)

The rotating wheel heat exchanger is composed of a rotating cylinder in an insulated cassette frame complete with seals, drive motor, and drive belt. The total-energy recovery wheel is coated with silica gel desiccant permanently bonded by a patented and proprietary process without the use of binders or adhesives, which may degrade desiccant performance. The substrate is a lightweight polymer and will not degrade nor require additional coatings for application in marine or coastal environments. Coated segments are washable with detergent or alkaline coil cleaner and water. Desiccant will not dissolve nor deliquesce in the presence of water or high humidity. As the wheel rotates between the ventilation and exhaust air streams it picks up sensible and latent heat energy and releases it into the colder air stream. The driving force behind the exchange is the difference in temperatures between the opposing air streams which is also called the thermal gradient. Bypass dampers will be provided on both the outside and exhaust air paths.

Total Energy Wheel (Aluminum)

The rotor media shall be lightweight and be made of aluminum. The rotor media shall be coated to prohibit corrosion; etched or oxidized surfaces are not acceptable. All surfaces must be coated with a non-migrating adsorbent layer of desiccant prior to being formed into the honeycomb media structure to insure that all surfaces are coated and that adequate latent capacity is provided. The desiccant must be designed for the adsorption of water vapor. The media shall be cleanable with low temperature steam, hot water or light detergent without degrading the latent recovery. Bypass dampers will be provided on both the outside and exhaust air paths.

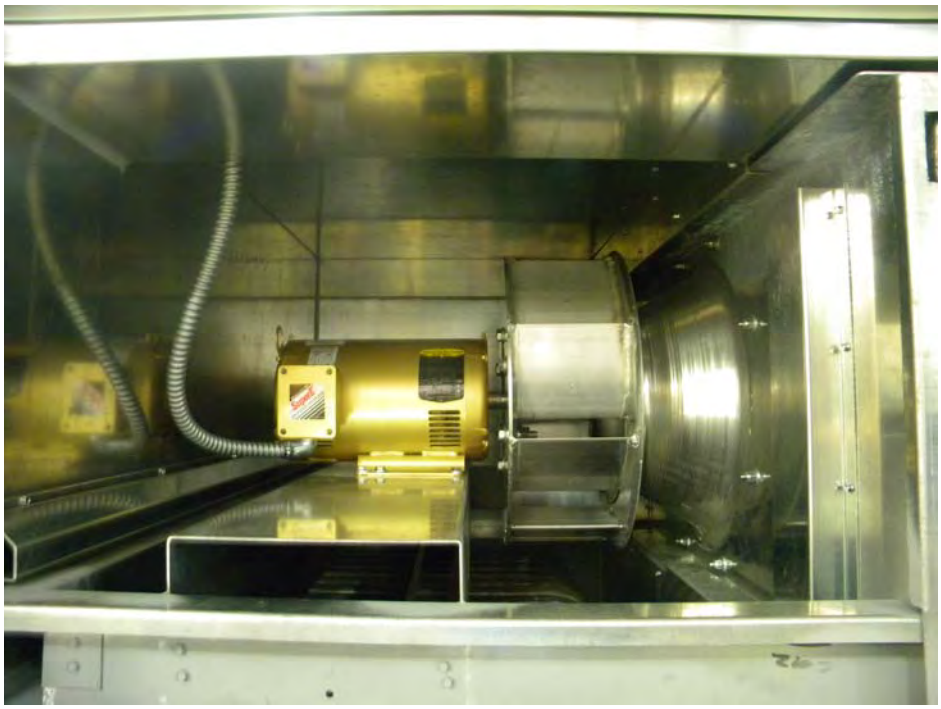
Figure 43. Total-energy wheel module



Supply and Exhaust Fan and Motors

Fan motor shall be direct drive type with factory installed Variable Frequency Drive. All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 2005 (EPACT). Neoprene isolation pads will be provided under fan base. Refer to the following figure.

Figure 44. Indoor fan and motor



Condenser Fans and Motors

The outdoor fans shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.

Dampers—Low Leak

The outside air damper has a unit-controlled actuator with parallel-blades. The blade construction is a 14-gage galvanized steel, roll-formed airfoil-type.

Electrical and Controls

Controls

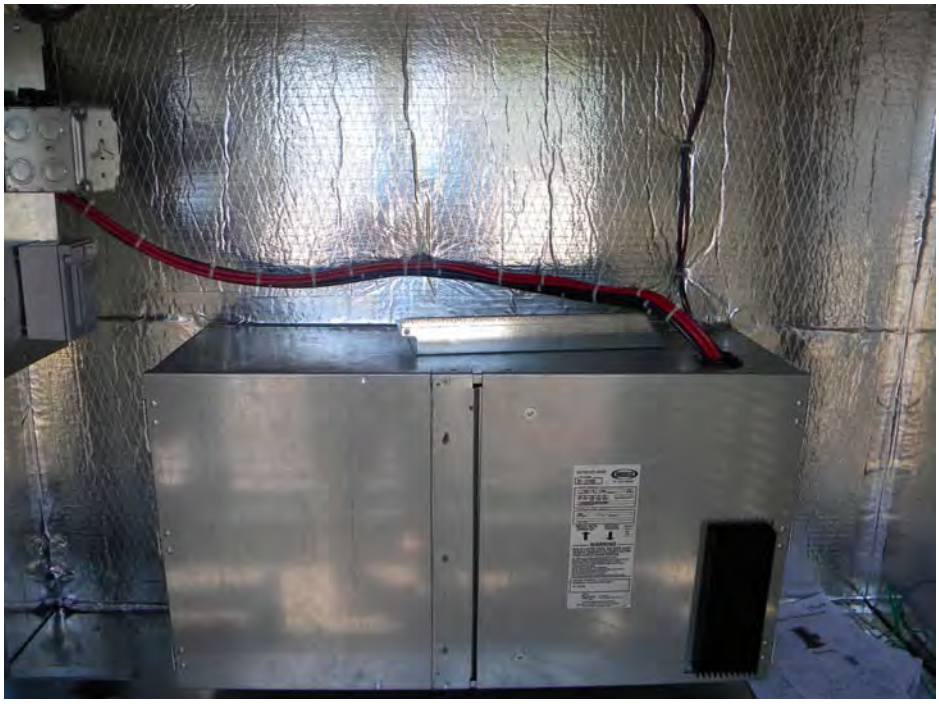
Unit is completely factory-wired with necessary controls and contactor pressure lugs for power wiring. Units will provide an external location for mounting fused disconnect device. Micro-processor controls are provided for all 24-volt control functions. The resident control algorithms will make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring outdoor temperature and humidity. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized micro-processor (RTRM) will provide anti-short cycle timing for a higher level of machine protection. Terminals are provided for a field installed dry contact or switch closure to put the unit in the Occupied or Unoccupied modes.

Options

Electric Heating Option

Primary heat is supplied using Electric Resistance heaters. Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment. Heating elements shall be open coil, 80 percent nickel, 20 percent chromium, Grade A resistance wire. Type C alloys containing iron or other alloys are not acceptable. Coils shall be machine crimped into stainless steel terminals extending at least 1 in. into the air stream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into supporting brackets. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover. Heaters shall be furnished with a disc type, automatic reset thermal cutout for primary over temperature protection. All heaters shall also be furnished with disc type, load-carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible over temperature devices are not acceptable. Control will be SCR type. Unit shall be suitable for use with Electric Resistance Heat. Refer to the following figure.

Figure 45. ER Heater



Indirect Gas-Fired Heating Option

Primary heat is supplied using indirect fired gas heating. The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and Type 409 stainless steel tubes. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DS) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the unit. Units shall be comply with the California requirement for low NO_x emissions. Unit shall be suitable for use with Natural Gas.

Hydronic Heat Option

A factory installed one, two, or three row hydronic heating coil will be provided downstream of the fan. The unit controller provides a modulating output to control a factory-provided/field-installed water valve and accepts a low temperature limit input signal. Openings in the unit side panels for piping must also be field constructed.

Condenser Hot Gas Reheat

This option shall consist of a modulating hot-gas reheat coil located on the leaving air side of the evaporator coil pre-piped and circuited with a low pressure switch. For detailed unit control and operational modes, please refer to the "Sequence of Operations" in OAU-SVX006*-EN (Installation, Operation, and Maintenance: Horizon Outdoor Air Unit - Model: OADG).

Return Air

Air returns vertically through the unit base or horizontally through the cabinet. Dampers are low-leak. Each damper has a unit-controlled actuator. Inputs are provided for economizer control, based upon either comparative enthalpy or outside air and return air dry bulb conditions. Refer to the following figure.

Figure 46. Return air damper



Corrosion-Inhibiting Coating

Options include stainless steel interior walls with prepainted exterior walls, ECO-coated coils, and stainless steel coil casing.

Filters

Adjustable 6-in. filter rack with options for 2-in. MERV-8, 2-in. MERV-13, and 4-in. MERV-14 installed just upstream of the evaporator coil. In addition, 2-inch aluminum mesh mist eliminators are located in the intake hood. An additional option is a 120 V UVC downstream of the evaporator coil.

Filter Status Switch

This option indicates when filters require cleaning or replacement. The Filter Status switch triggers an information-only diagnostic message on the human interface and will allow continued unit operation.

Non-Fused Disconnect Switch

A 3-pole, molded case, disconnect switch with provisions for through the base electrical connections shall be installed. The disconnect switch will be installed in the unit in a water tight enclosure. Wiring will be provided from the switch to the unit high voltage terminal block. The switch will be UL/CSA agency recognized. The disconnect switch will be sized per NEC and UL guidelines but will not be used in place of unit overcurrent protection.

Convenience Outlet

A convenience outlet is provided on the control side of the unit. The GFI outlet is 115 volt, and capable of manual resetting. The convenience outlet will remain powered regardless of the position of the unit disconnect.

Figure 47. Convenience outlet



Roof Mounting Curb

The roof mounting curb is fabricated of 14-gage galvanized steel with a nominal 2-in. x 2-in. nailer setup. The curb ships knocked down with a curb gasket. Curb height options are 14 or 24 inches.

Sound Attenuation Package

The unit will be equipped with variable speed, ECM condenser fans to reduce sound and increase performance. When a unit is selected with the Sound Attenuation Package, it will also be equipped with head pressure control to allow the condenser fans to run as slow as possible while maintaining the performance of the unit. This option increases the overall height of the unit at the condenser section. Refer to the submittal for unit dimensional data when Sound Attenuation Package is selected. An optional compressor sound blanket may also be selected.

Appendix

OAU Filter Guide

Table 9. OAD units

Evaporator					
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8, 13	6	25 (63.5)	18 (45.7)
	4 (10.2)	14	6	25 (63.5)	18 (45.7)
ERV Module					
	Return Air				
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8	6	20 (50.8)	20 (50.8)
	Outside Air[a]				
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8	6	20 (50.8)	20 (50.8)
Inlet Hood					
	Thickness, in. (cm)	**Material**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	Aluminum Mesh	6	20 (50.8)	20 (50.8)

(a) No filters will be provided on the outside air path of the ERV section if electric preheat is provided.

Table 10. OAN units

Evaporator (40 to 50 ton - 4 and 6 row coils; 55 to 100 ton - 6 row coils)					
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8, 13	15	20 (50.8)	18 (45.7)
	4 (10.2)	14	15	20 (50.8)	18 (45.7)
Evaporator (55 to 100 ton - 4 row coils)					
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8, 13	12	20 (50.8)	25 (63.5)
	4 (10.2)	14	12	20 (50.8)	25 (63.5
ERV Module					
	Return Air				
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8	15	24 (61.0)	18 (45.7)
	Outside Air[a]				
	Thickness, in. (cm)	**MERV**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	8	15	24 (61.0)	18 (45.7)
Inlet Hood					
	Thickness, in. (cm)	**Material**	**Qty**	**Height, in. (cm)**	**Width, in. (cm)**
	2 (5.1)	Aluminum Mesh	12	24 (61.0)	24 (61.0)

(a) No filters will be provided on the outside air path of the ERV section if electric preheat is provided.



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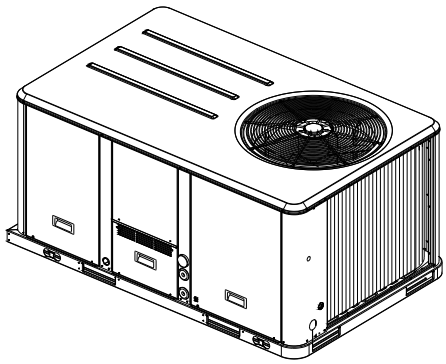
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We are committed to using environmentally conscious print practices.

OAU-PRC004B-EN 01 Oct 2018
Supersedes OAU-PRC004A-EN (Nov 2017)

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Installation, Operation, and Maintenance

Packaged Rooftop Air Conditioners
Precedent™ with eFlex™ Technology, Gas/Electric
3 to 10 Tons - 60 Hz



Model Numbers

YZC036E
YZC048F
YZC060E
YZC072F
YZC090F
YZC102F
YZC120F

⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

January 2017

RT-SVX46E-EN

Ingersoll Rand

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

NOTICE: Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS/SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

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Revision History

- Update includes addition of 6 to 10 ton eFlex™ models

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Model Number Description

Digit 1 - Unit Type
T DX Cooling
Y DX Cooling, Gas Heat

Digit 2 - Efficiency
Z Ultra High Efficiency

Digit 3 - Airflow
C Convertible

Digit 4,5,6 - Nominal Gross Cooling Capacity (MBh)
036 3 Ton
048 4 Ton
060 5 Ton
072 6 Ton
090 7.5Ton
102 8.5 Ton
120 10 Ton

Digit 7 - Major Design Sequence
E R-410A Refrigerant
F Microchannel Type Condenser Coils with R-410A Refrigerant[11]

Digit 8 - Voltage Selection
3 208-230/60/3
4 460/60/3
W 575/60/3

Digit 9 - Unit Controls
R ReliaTel™ Microprocessor

Digit 10 - Heating Capacity
Note: *Applicable to Digit 1, T models only*
0 No Electric Heat
B 6 kW (3 phase)
C 9 kW (3 phase)
E 12 kW (3 phase)
G 18 kW (1&3 phase)
J 23 kW (3 phase)
K 27 kW (3 phase)
N 36 kW (3 phase)
P 54 kW (33 phase)

Note: *Applicable to Digit 1, Y models only*
L Low Heat
M Medium Heat
H High Heat
X Low Heat, Stainless Steel Heat Exchanger
Y Medium Heat, Stainless Steel Heat Exchanger
Z High Heat, Stainless Steel Heat Exchanger
V Modulating Gas Heat

Digit 11 - Minor Design Sequence
A First Sequence

Digit 12,13 - Service Sequence
** Factory Assigned

Digit 14 - Fresh Air Selection
0 No Fresh Air
C Economizer, Dry Bulb 0-100% without Barometric Relief[2]
D Economizer, Dry Bulb 0-100% with Barometric Relief[2]
E Economizer, Reference Enthalpy 0-100% without Barometric Relief[2]
F Economizer, Reference Enthalpy 0-100% with Barometric Relief[2]
G Economizer, Comparative Enthalpy 0-100% without Barometric Relief[2]
H Economizer, Comparative Enthalpy 0-100% with Barometric Relief[2]
K Low Leak Economizer with Barometric Relief
M Low Leak Economizer with Reference Enthalpy with Barometric Relief
P Low Leak Economizer with Comparative Enthalpy with Barometric Relief

Digit 15 - Supply Fan/Drive Type/ Motor
6 Single Zone VAV[10]
E VAV Supply Air Temperature Control Standard Motor

Digit 16 - Hinged Service Access/Filters
0 Standard Panels/Standard Filters
A Hinged Access Panels/Standard Filters
B Standard Panels/2" MERV 8 Filters
C Hinged Access Panels/2" MERV 8 Filters
D Standard Panels/2" MERV 13 Filters
E Hinged Access Panels/2" MERV 13 Filters

Digit 17 - Condenser Coil Protection
0 Standard Coil
1 Standard Coil with Hail Guard
2 Black Epoxy Pre-Coated Condenser Coil[12]
3 Black Epoxy Pre-Coated Condenser Coil with Hail Guard[12]
4 CompleteCoat™ Condenser Coil
5 CompleteCoat™ Condenser Coil with Hail Guard

Digit 18 - Through the Base Provisions
0 No Through-the-Base Provisions
A Through-the-Base Electric[3]
B Through-the-Base Gas Piping[7]
C Through-the-Base Electric and Gas Piping[7]

Digit 19 - Disconnect/Circuit Breaker (three-phase only)
0 No Disconnect/No Circuit Breaker
1 Unit Mounted Non-Fused Disconnect[3]
2 Unit Mounted Circuit Breaker[3]

Digit 20 - Convenience Outlet
0 No Convenience Outlet
A Unpowered Convenience Outlet
B Powered Convenience Outlet (three-phase only)[4]

Digit 21 - Communications Options
0 No Communications Interface
2 LonTalk® Communications Interface
6 BACnet® Communications Interface
7 Air-Fi™ Wireless Communications[16]

Digit 22 - Refrigeration System Option
0 Standard Refrigeration System[5]

Digit 23 - Refrigeration Controls
0 Without Refrigeration Controls[1]

Digit 24 - Smoke Detector[8]
0 No Smoke Detector
A Return Air Smoke Detector[6]
B Supply Air Smoke Detector
C Supply and Return Air Smoke Detectors[6]
D Plenum Smoke Detector

Digit 25 - System Monitoring Controls[14]
0 Standard Monitoring System
1 Clogged Filter Switch
2 Fan Failure Switch
4 Clogged Filter Switch and Fan Failure Switch
A Condensate Drain Pan Overflow Switch
B Clogged Filter Switch and Condensate Drain Pan Overflow Switch
C Fan Failure Switch and Condensate Drain Pan Overflow Switch
E Clogged Filter Switch, Fan Failure Switch and Condensate Drain Pan Overflow Switch

Digit 26 - System Monitoring Controls
0 No Monitoring Controls
A Demand Control Ventilation (CO_2)[9,13]
B Low Leak Economizer with FDD (Fault Detection & Diagnostics)
C FDD (Fault Detection & Diagnostics) with DCV (Demand Control Ventilation)

Digit 27 - Unit Hardware Enhancements

0 No Enhancements
1 Stainless Steel Drain Pan

Digit 31 - Advanced Unit Controls

0 Standard Unit Controls
1 Human Interface

Model Number Notes

1. Standard on all eFlex™ and eDrive™ units.
2. Economizer with Barometric Relief is for downflow configured units only. Order Economizer without Barometric Relief for horizontal configuration. Barometric Relief for horizontal configured units must be ordered as field installed accessory.
3. Through the base electric required when ordering disconnect/circuit breaker options.
4. Requires use of Disconnect or Circuit Breaker.
5. Standard metering devices are TXVs.
6. The return air smoke detector may not fit up or work properly on the Precedent units when used in conjunction with 3rd party accessories such as bolt on heat wheels, economizers and power exhaust. Do not order the return air smoke detectors when using this type of accessory.
7. Includes gas piping and shutoff (field assembly required).
8. Not available with high temperature duct sensor accessory.
9. Demand Control Ventilation Option includes wiring only. The CO_2 sensor is a field-installed only option.
10. Discharge Air Temperature Sensor is also standard equipment on units with Single Zone.
11. Standard on T/YZC 4 ton models.
12. Epoxy coil and epoxy with hail guard option not available for units with microchannel condenser coil.
13. Requires selection of 2″ pleated filters (option B or C) for Digit 16.
14. Discharge Air Sensing Tube is standard.
15. Field installed only.
16. Must be used with BACnet® open protocol.

General Information

Unit Inspection

As soon as the unit arrives at the job site

- Verify that the nameplate data matches the data on the sales order and bill of lading (including electrical data).
- Verify that the power supply complies with the unit nameplate specifications.
- Visually inspect the exterior of the unit, including the roof, for signs of shipping damage.

If the job site inspection of the unit reveals damage or material shortages, file a claim with the carrier immediately. Specify the type and extent of the damage on the "bill of lading" before signing.

- Visually inspect the internal components for shipping damage as soon as possible after delivery and before it is stored. Do not walk on the sheet metal base pans.
- If concealed damage is discovered, notify the carrier's terminal of damage immediately by phone and by mail. Concealed damage must be reported within 15 days.
- Request an immediate joint inspection of the damage by the carrier and the consignee. Do not remove damaged material from the receiving location. Take photos of the damage, if possible. The owner must provide reasonable evidence that the damage did not occur after delivery.
- Notify the appropriate sales representative before installing or repairing a damaged unit.

Storage

Take precautions to prevent condensate from forming inside the unit's electrical compartments and motors if:

1. the unit is stored before it is installed; or,
2. the unit is set on the roof curb, and temporary heat is provided in the building. Isolate all side panel service entrances and base pan openings (e.g., conduit holes, Supply Air and Return Air openings, and flue openings) from the ambient air until the unit is ready for startup.

Note: *Do not use the unit's heater for temporary heat without first completing the startup procedure detailed in the Unit Startup chapter.*

The manufacturer will not assume any responsibility for equipment damage resulting from condensate accumulation on the unit's electrical and/or mechanical components.

Unit Nameplate

A Mylar unit nameplate is located on the unit's corner support next to the filter access panel. It includes the unit model number, serial number, electrical characteristics, refrigerant charge, as well as other pertinent unit data.

Compressor Nameplate

The nameplate for the compressors are located on the side of the compressor. Variable speed compressors are not marked with a RLA. This value is derived from testing.

Microchannel Condenser Barcode ID

Barcode decal used for condenser coil part identification can be located on the vertical header and top of coil's inlet/outlet side.

Unit Description

Before shipment, each unit is leak tested, dehydrated, charged with refrigerant and compressor oil, and run tested for proper control operation.

The condenser coils are either aluminum fin, mechanically bonded to copper tubing or all aluminum microchannel.

Direct-drive, vertical discharge condenser fans are provided with built-in thermal overload protection.

The ReliaTel™ control module is a microelectronic control system that is referred to as "Refrigeration Module" (RTRM). The acronym RTRM is used extensively throughout this document when referring to the control system network.

This module through proportional/integral control algorithms performs specific unit functions that govern unit operation in response to zone temperature, supply air temperature, and/or humidity conditions depending on the application. The stages of capacity control for these units are achieved by starting and stopping the compressors.

The RTRM is mounted in the control panel and is factory wired to the respective internal components. The RTRM receives and interprets information from other unit modules, sensors, remote panels, and customer binary contacts to satisfy the applicable request for cooling.

Clogged Filter Switch (Optional)

The unit mounted clogged filter switch monitors the pressure differential across the return air filters. It is mounted in the filter section and is connected to the RTOM. A diagnostic SERVICE signal is sent to the remote panel if the pressure differential across the filters is at least 0.5" wc. The contacts will automatically open when the pressure differential across the filters decreases to approximately 0.4" wc. The clogged filter output is energized when the supply fan is operating and the clogged filter switch has been closed for at least 2 minutes. The system will continue to operate regardless of the status of the filter switch.

Note: *On units equipped with factory installed MERV 13 filters, a clogged filter switch with different pressure settings will be installed. This switch will close when the differential pressure is*

approximately 0.8' wc and open when the differential falls to 0.7" wc.

Compressor Disable (CPR1/2)

This input incorporates the low pressure control (LPC) of each refrigeration circuit and can be activated by opening a field supplied contact installed on the LTB.

If this circuit is open before the compressor is started, the compressor will not be allowed to operate. Anytime this circuit is opened for 1 continuous second during compressor operation, the compressor for that circuit is immediately turned "Off". The compressor will not be allowed to restart for a minimum of 3 minutes should the contacts close.

If four consecutive open conditions occur during the first three minutes of operation, the compressor for that circuit will be locked out, a diagnostic communicated to the remote panel (if installed), and a manual reset will be required to restart the compressor.

Compressor/Inverter Protection

The ReliaTel™ control receives input from the inverter drive for any errors encountered by the drive (refer to RT-SVD05*-EN and RT-SVD007*-EN for VF-S15 inverter error code details). If an error is encountered before the compressor has run for 3 minutes, ReliaTel™ begins counting errors. The drive will automatically reset when the error condition clears and ReliaTel™ will try to start the compressor again, if a call for cooling remains and 3 minutes have passed since the compressor last ran.

If ReliaTel™ counts 4 such errors within 30 minutes, the system will go to manual lock out mode. Refer to RT-SVD05*-EN (for VF-S15 inverters, refer to RT-SVD007*-EN) for potential causes.

Condensate Drain Pan Overflow Switch (Optional) - ReliaTel™

This input incorporates the Condensate Overflow Switch (COF) mounted on the drain pan and the ReliaTel™ Options Module (RTOM). When the condensate level reaches the trip point for 6 continuous seconds, the RTOM will shut down all unit functions until the overflow condition has cleared. The unit will return to normal operation after 6 continuous seconds with the COF in a non-tripped condition. If the condensate level causes unit shutdown more than 2 times in a 3 days period, the unit will be locked-out of operation requiring manual reset of diagnostic system through Zone Sensor or Building Automation System (BAS). Cycling unit power will also clear the fault.

Discharge Line Temp Switch (DLTS)

The DLTS is looped in series with HPC and LPC. It prevents compressor from overheating (over 300 F° dome temp) in case of indoor fan failure (cooling) or outdoor fan failure (heating).

Duct Mounted Relative Humidity Sensor (BAYSENS037*)

Field installed, duct mounted humidity sensor is used to control activation of enhanced dehumidification and the hot gas reheat dehumidification options. Humidity set points can be selected for relative humidity levels between 40% and 60% by adjusting the DEHUMID setting on the ReliaTel™ options module. See Figure 61, p. 34.

Economizer Control Actuator (Optional) - ReliaTel™ Control

The ECA monitors the mixed air temperature, return air temperature, minimum position setpoint (local or remote), power exhaust setpoint, CO_2 setpoint, CO_2, and ambient dry bulb/enthalpy sensor or comparative humidity (return air humidity against ambient humidity) sensors, if selected, to control dampers to an accuracy of +/- 5% of stroke. The actuator is spring returned to the closed position any time that power is lost to the unit. It is capable of delivering up to 25 inch pounds of torque and is powered by 24 VAC.

Evaporator Frost Control (Standard)

This input incorporates the Frostat™ control (FOS) mounted in the indoor coil circuit and can be activated by closing a field supplied contact installed in parallel with the FOS.

If this circuit is closed before the compressor is started, the compressor will not be allowed to operate. Anytime this circuit is closed for 1 continuous second during compressor operation, the compressor for that circuit is immediately turned "Off". The compressor will not be allowed to restart for a minimum of 3 minutes should the FOS open.

Frostat™ is standard on single zone VAV products (SZVAV).

High Pressure Control - ReliaTel™ Control

The high pressure controls are wired in series between the compressor outputs on the VSM and the compressor contactor coils (3 to 5 ton eFlex™) or compressor drive (7.5 to 10 ton eFlex™). If the high pressure control switch opens, the VSM senses a lack of current while calling for cooling and locks the compressor out.

If four consecutive open conditions occur during an active call for cooling, the compressor will be locked out, a diagnostic communicated to ICS™, if applicable, and a manual reset required to restart the compressor. On dual compressor units only the affected compressor circuit is locked out.

High Temperature Sensor (BAYFRST001*)

This sensor connects to the RTRM Emergency Stop Input on the LTB and provides high limit "shutdown" of the unit. The sensor is used to detect high temperatures due to a high thermal event in the air conditioning or ventilation ducts. The sensor is designed to mount directly to the

sheet metal duct. Each kit contains two sensors. The return air duct sensor (X1310004001) is set to open at 135°F. The supply air duct sensor (X1310004002) is set to open at 240°F. The control can be reset after the temperature has been lowered approximately 25°F below the cutout setpoint.

Human Interface - 5 Inch Color Touchscreen (Optional)

Note: *For more information, see RT-SVX49*-EN.*

The 5 inch color touchscreen human interface provides an intuitive user interface to the rooftop unit that speeds up unit commissioning, shortens unit troubleshooting times, and enhances preventative maintenance measures. The human interface includes several features including:

- Data trending capabilities by means of time series graphs
- Historical alarm messages
- Real-time sensor measurements
- On board system setpoints
- USB port that enables the downloading of component runtime information as well as trended historical sensor data
- Customized reports

Low Pressure Control - ReliaTel™ Control

When the LPC is opened for 1 continuous second, the compressor for that circuit is turned off immediately. The compressor will not be allowed to restart for a minimum of 3 minutes.

If four consecutive open conditions occur during an active call for cooling, the compressor will be locked out, a diagnostic communicated to ICS™, if applicable, and a manual reset required to restart the compressor. On dual compressor units only the affected compressor circuit is locked out.

Multiple-Zone VAV Control

Multiple-zone VAV (MZVAV) control shall vary the speed of the indoor fan to maintain the duct static pressure at a setpoint. In cooling mode, the compressors shall be cycled (or economizer modulated) to maintain the supply air temperature (SAT) at the desired setpoint. In heating mode, the indoor fan shall operate at maximum speed whenever the heater is operating.

Phase Monitor

Note: *Not available on T/YZC072-120.*

This sensor monitors voltage between the 3 conductors of the 3 phase power supply. Two LED lights are provided:

- The green light indicates that a balanced 3 phase supply circuit is properly connected.
- The red light indicates that unit operation has been prevented. There are two conditions that will prevent unit operation:
  - The power supply circuit is not balanced with the proper phase sequence of L1, L2, L3 for the 3 conductors of a 3 phase circuit.
  - The line to line voltage is not between 180 volts and 633 volts.

Power Exhaust Control (Optional) - ReliaTel™

The power exhaust fan is started whenever the position of the economizer dampers meets or exceed the power exhaust setpoint when the indoor fan is on.

With the optional ventilation override accessory, the power exhaust fan is independent of the indoor fan.

The power exhaust setpoint potentiometer is located on the Reliatel Options Module (RTOM R-40) and must be set while the indoor fan is at maximum speed. This is best done while in test mode during 100% cooling or in any stage of heat.

Programmable Zone Sensor - (BAYSENS119*)

This 7 day programmable sensor features 2, 3 or 4 periods for Occupied or Unoccupied programming per day. If the power is interrupted, the program is retained in permanent memory. If power is off for an extended period of time, only the clock and day may have to be reset.

The Zone Sensor allows selection of 2, 3 or 4 system modes (Heat, Cool, Auto, and Off), two fan modes (On and Auto). It has dual temperature selection with programmable start time capability.

The occupied cooling set point ranges between 45 and 98 ° F. The heating set point ranges between 43 and 96°F.

A liquid crystal display (LCD) displays zone temperature, temperature set points, day of the week, time, and operational mode symbols.

The Option Menu is used to enable or disable applicable functions, i.e.; Morning Warm-up, Economizer minimum position override during unoccupied status, Fahrenheit or Centigrade, Supply air tempering, Remote zone temperature sensor, 12/24 hour time display, Smart fan, and Computed recovery.

During an occupied period, an auxiliary relay rated for 1.25 amps @ 30 volts AC with one set of single pole double throw contacts is activated.

RBCI - ReliaTel™ BACnet Communications Interface (Optional)

This module is used when the application calls for an open BACnet protocol. It allows the control and monitoring of the system through an ICS panel. The module can be ordered from the factory or as a kit to be field installed. Follow the installation instructions that ships with each kit when field installation is necessary.

Remote Zone Sensor (BAYSENS016*)

This bullet type temperature sensor can be used for outside air (ambient) sensing, return air temperature sensing, supply air temperature sensing, remote

temperature sensing (uncovered). Wiring procedures vary according to the particular application and equipment involved. Refer to the unit's wiring diagrams for proper connections.

Remote Zone Sensor (BAYSENS073*)

This electronic sensor features remote zone sensing and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

Remote Zone Sensor (BAYSENS074*)

This electronic sensor features single setpoint capability and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

Remote Zone Sensor (BAYSENS077*)

This electronic sensor can be used with BAYSENS106*, 108*, 110*, 119* Remote Panels. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to the specific Remote Panel for wiring details.

RLCI - ReliaTel™ LonTalk® Communication Interface (Optional)

This module is used when the application calls for an ICSTM building management type control system that is LonTalk®™. It allows the control and monitoring of the system through an ICS panel. The module can be ordered from the factory or ordered as a kit to be field installed. Follow the installation instruction that ships with each kit when field installation is necessary.

RTCI - ReliaTel™ Trane Communication Interface (Optional)

This module is used when the application calls for an ICSTM building management type control system. It allows the control and monitoring of the system through an ICS panel. The module can be ordered as a kit to be field installed. Follow the installation instruction that ships with each kit when field installation is necessary.

RTOM - ReliaTel™ Options Module (Standard)

The RTOM monitors the supply fan proving, clogged filter, supply air temperature, exhaust fan setpoint, supply air tempering, Frostat™, smoke detector, and Variable Speed Fan Control (17 Plus units only). Refer to system input devices and functions for operation.

Single Zone Variable Air Volume (Standard), Displacement Ventilation (Optional)

This sensor offers full supply fan modulation across the available airflow range. In addition to full supply fan modulation, the unit controls the discharge air temperature to a varying discharge air temperature setpoint in order to maintain space temperature.

Smoke Detector Sensor (Optional)

This sensor provides high limit "shutdown" of the unit and requires a manual reset. The sensor is used to detect smoke in the air conditioning or ventilation ducts.

Note:

- *Consult smoke detector manufacturer if daisy chaining is required.*

The supply air smoke detector samples supply air. The return and plenum air smoke detectors sample return air. The smoke detectors are designed to shut off the unit if smoke is sensed. This function is performed by sampling the airflow entering the unit at the return air opening. Follow the instructions provided below to assure that the airflow through the unit is sufficient for adequate sampling. Failure to follow these instructions will prevent the smoke detectors from performing its design function.

Airflow through the unit is affected by the amount of dirt and debris accumulated on the indoor coil and filters. To insure that airflow through the unit is adequate for proper sampling by the return air smoke detector, complete adherence to the maintenance procedures, including recommended intervals between filter changes, and coil cleaning is required.

Periodic checks and maintenance procedures must be performed on the smoke detector to insure that it will function properly. For detailed instructions concerning these checks and procedures, refer to the appropriate section(s) of the smoke detector Installation and Maintenance Instructions provided with the literature package for this unit.

In order for the supply air smoke detector or return air smoke detector to properly sense smoke in the supply air stream or return air stream, the air velocity entering the smoke detector unit must be in accordance with manufacturers recommended airflow limits.

Status Inputs (4 Wires Optional)

The ZSM can be wired to receive four (4) operating status signals from the RTRM (HEAT, COOL, SYSTEM "ON", SERVICE).

Four (4) wires from the RTRM should be connected to the appropriate terminals (7, 8, 9 & 10) on the ZSM.

Supply Fan Failure Input (Optional)

The Fan Failure Switch can be connected to sense indoor fan operation:

FFS (Fan Failure Switch) If air flow through the unit is not proven by the differential pressure switch connected to the RTOM (factory set point 0.07 "w.c.) within 40 seconds nominally, the RTRM will shut off all mechanical operations, lock the system out, send a diagnostic to ICS, and the SERVICE output will flash. The system will remain locked out until a reset is initiated either manually or through ICS.

System Input Devices & Functions

The RTRM must have a zone sensor or thermostat input in order to operate the unit. The flexibility of having several mode capabilities depends upon the type of zone sensor or thermostat selected to interface with the RTRM.

The descriptions of the following basic Input Devices used within the RTRM network are to acquaint the operator with their function as they interface with the various modules. Refer to the unit's electrical schematic for the specific module connections.

The following controls are available from the factory for field installation.

Wall Mounted Relative Humidity Sensor (BAYSENS036*)

Field installed, wall mounted humidity sensor is used to control activation of Enhanced Dehumidification and the Hot Gas Reheat Dehumidification options. Humidity set points can be selected for relative humidity levels between 40% and 60% by adjusting the DEHUMID setting on the ReliaTel™ Options Module. See Figure 61, p. 34.

Wireless Zone Sensor (BAYSENS050*)

This electronic sensor features five system settings (Auto, Off, Cool, Heat, and Emergency Heat) and with On and Auto fan settings. It is a manual or auto changeover control with dual setpoint capability. Other features include a timed override function, lockable system settings, and Fahrenheit or Celsius temperature display. Included with the wireless zone sensor will be a receiver that is to be mounted inside the unit, a mounting bracket, and a wire harness.

Zone Sensor Module (ZSM) (BAYSENS106*)

This electronic sensor features three system switch settings (Heat, Cool, and Off) and two fan settings (On and Auto). It is a manual changeover control with single setpoint. (Cooling Setpoint Only)

Zone Sensor Module (ZSM) (BAYSENS108*)

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto). It is a manual or auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Zone Sensor (BAYSENS110*)

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto) with four system status LED's. It is a manual or auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Pre-Installation

⚠WARNING

Fiberglass Wool!

Exposition to glass wool fibers without all necessary PPE equipment could result in cancer, respiratory, skin or eye irritation, which could result in death or serious injury. Disturbing the insulation in this product during installation, maintenance or repair will expose you to airborne particles of glass wool fibers and ceramic fibers known to the state of California to cause cancer through inhalation. You MUST wear all necessary Personal Protective Equipment (PPE) including gloves, eye protection, a NIOSH approved dust/mist respirator, long sleeves and pants when working with products containing fiberglass wool.

Precautionary Measures

- Avoid breathing fiberglass dust.
- Use a NIOSH approved dust/mist respirator.
- Avoid contact with the skin or eyes. Wear long-sleeved, loose-fitting clothing, gloves, and eye protection.
- Wash clothes separately from other clothing: rinse washer thoroughly.
- Operations such as sawing, blowing, tear-out, and spraying may generate fiber concentrations requiring additional respiratory protection. Use the appropriate NIOSH approved respiration in these situations.

First Aid Measures

Eye Contact - Flush eyes with water to remove dust. If symptoms persist, seek medical attention.

Skin Contact - Wash affected areas gently with soap and warm water after handling.

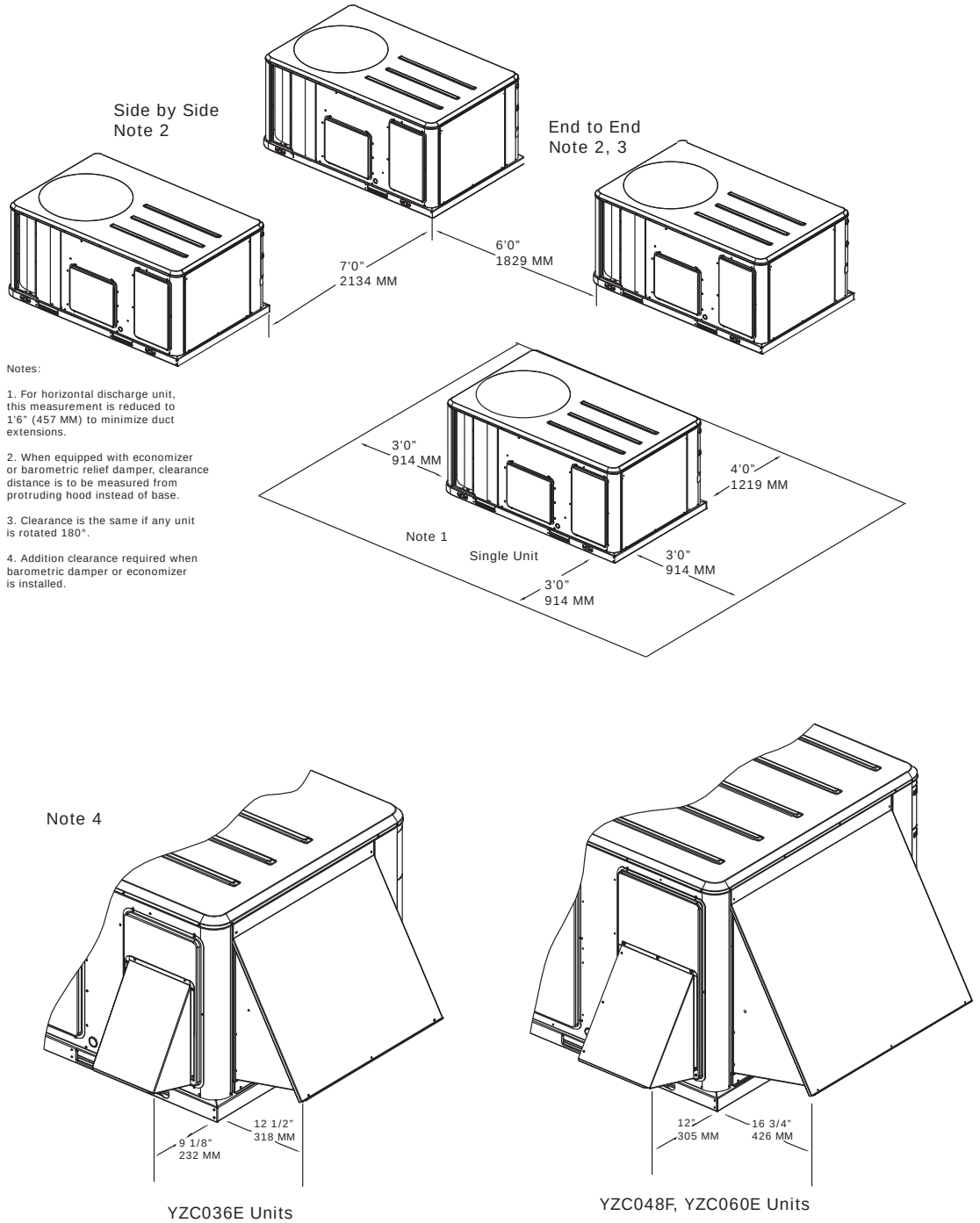
Dimensions and Weights

Unit Clearances

Figure 1, p. 14 illustrates the minimum operating and service clearances for either a single or multiple unit installation. These clearances are the minimum distances necessary to assure adequate serviceability, cataloged unit capacity, and peak operating efficiency.

Providing less than the recommended clearances may result in condenser coil starvation, “short-circuiting” of exhaust and economizer airflows, or recirculation of hot condenser air.

Figure 1. Typical installation clearances for single & multiple unit applications

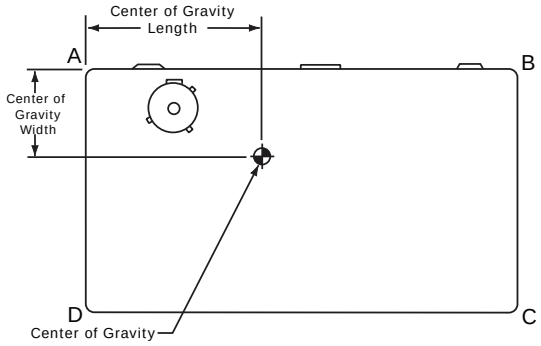


⚠WARNING

Heavy Objects!

Failure to follow instructions below or properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift.

Figure 2. Corner weights



⚠WARNING

Improper Unit Lift!

Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level.

Table 1. Maximum base unit & corner weights (lbs) and center of gravity dimensions (in.) - gas/electric models

Tons	Unit Model No.	Maximum Base Model Weights[a]		Corner Weights[b]				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
3	YZC036E	690	615	154	196	73	192	33	19
4	YZC048F	848	753	196	258	126	173	40	23
5	YZC060E	949	854	200	293	121	240	40	23
6	YZC072F	966	868	321	184	262	101	64	22
7.5	YZC090F	1007	909	248	210	261	190	51	26
8.5	YZC102F	1007	909	248	210	261	190	51	26
10	YZC120F	1428	1234	346	344	306	238	56	28

(a) Weight are approximate for 1st 10 digit model number.
(b) Corner weights are given for information only.

Figure 3. Rigging and center of gravity

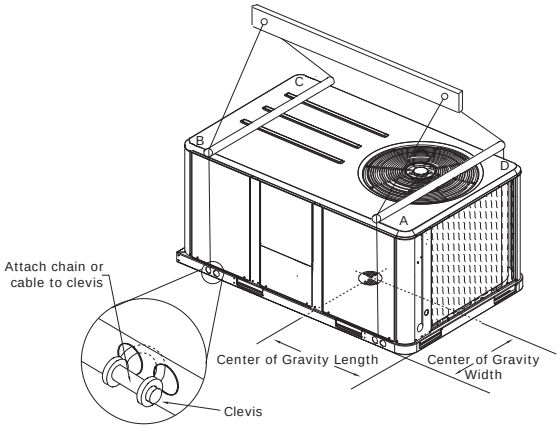
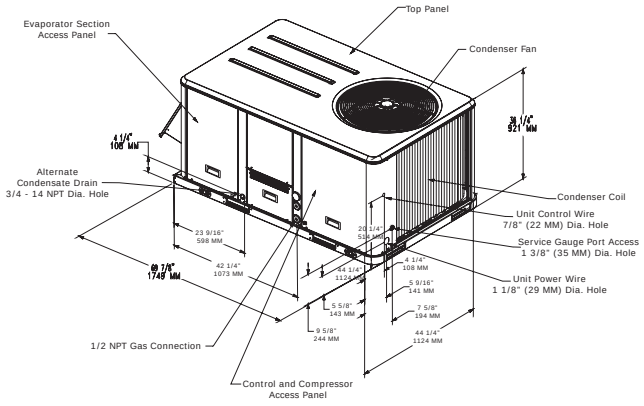


Table 2. Factory installed options (fiops)/accessory net weights (lbs)[a],[b]

Accessory	T/YZC036E Net Weight 3 Tons	T/YZC048F-060E Net Weight 4 to 5 Tons	T/YZC072F Net Weight 6 Tons	T/YZC090-102F Net Weight 7.5 to 8.5 Tons	T/YZC120F Net Weight 10 Tons
Barometric Relief	7	10	10	10	10
Coil Guards	12	20	20	20	30
Economizer	26	36	36	36	36
Electric Heaters[c]	15	30	30	44	50
Hinged Doors	10	12	12	12	12
Low Leak Economizer	68	93	93	93	93
Powered Convenience Outlet[d]	38	38	38	38	50
Powered Exhaust	40	40	80	80	80
Roof Curb	61	78	78	78	89
Smoke Detector, Supply	5	5	5	5	5
Smoke Detector, Return	7	7	7	7	7
Stainless Steel Heat Exchanger[e]	4	6	6	6	6
Through-the-Base Electrical	8	13	13	13	13
Through-the-Base Gas	5	5	5	5	5
Unit Mounted Circuit Breaker	5	5	5	5	5
Unit Mounted Disconnect	5	5	5	5	5

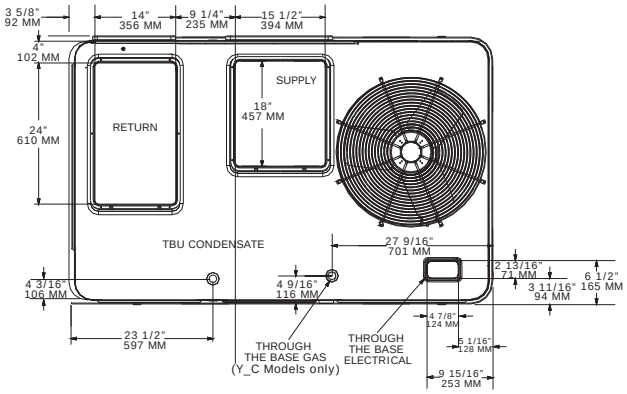
(a) Weights for options not listed are <5 lbs.
(b) Net weight should be added to unit weight when ordering factory-installed accessories.
(c) Applicable to cooling units only.
(d) Applicable for 208-230V 3-10 Ton units and 460V 6-10 Ton units only.
(e) Applicable to gas/electric units only.

Figure 4. Cooling and gas/electric - 3 tons ultra high efficiency[a],[b]



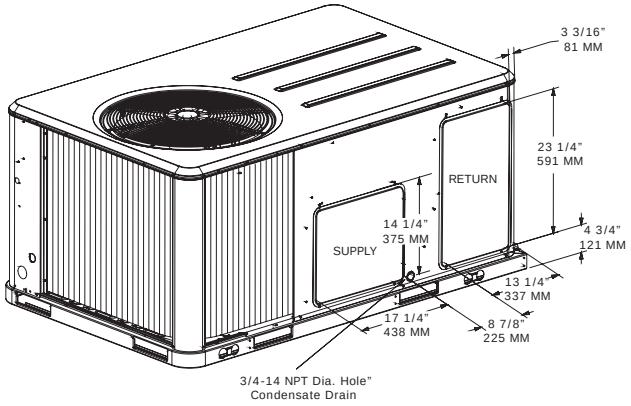
(a) All dimensions are in inches/millimeters.
(b) ½ NPT Gas Connection = (Y_C Models only); 2" Electrical Connection: Single Point Power When Heat Installed (T_C Models only.)

Figure 5. Cooling and gas/electric - 3 tons - downflow airflow supply/return - through-the-base utilities[a]



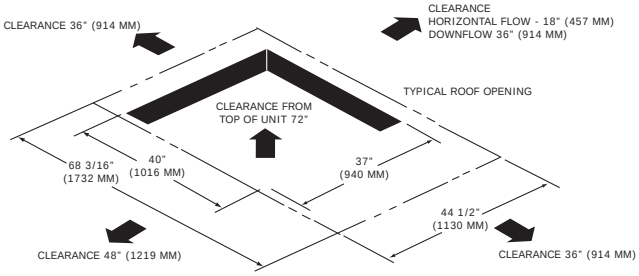
(a) All dimensions are in inches/millimeters.

Figure 6. Cooling and gas/electric - 3 tons - horizontal airflow supply/return[a]



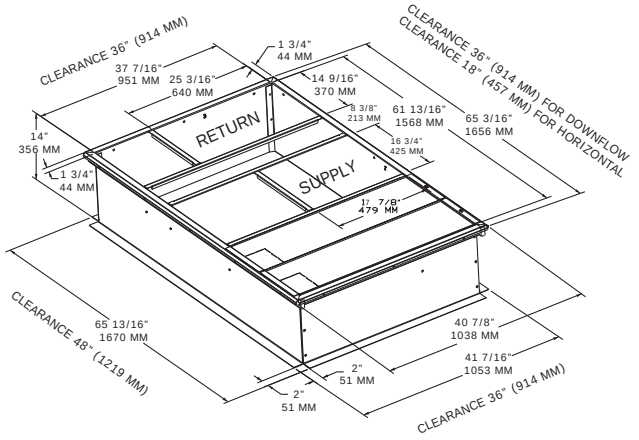
(a) All dimensions are in inches/millimeters.

Figure 7. Cooling and gas/electric - 3 tons ultra high efficiency - unit clearance and roof opening[a]



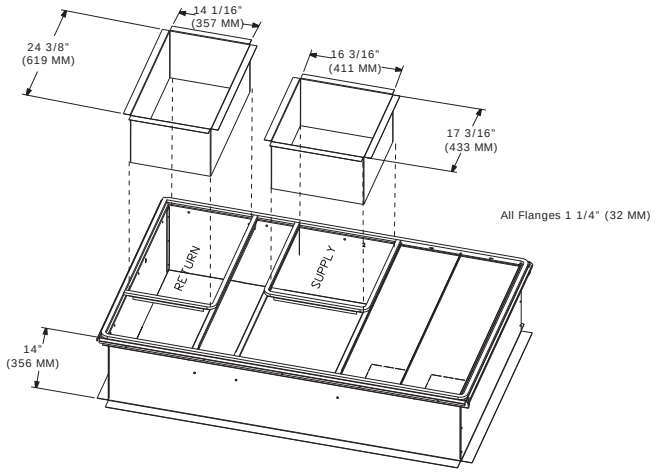
(a) All dimensions are in inches/millimeters.

Figure 8. Cooling and gas/electric - 3 tons ultra high efficiency - roof curb[a]



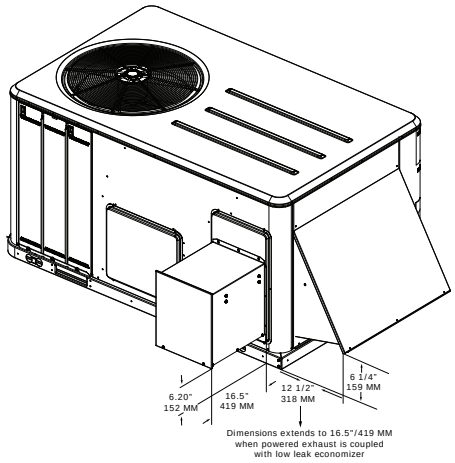
(a) All dimensions are in inches/millimeters.

Figure 9. Cooling and gas/electric - 3 tons ultra high efficiency - downflow duct connections - field fabricated[a]



(a) All dimensions are in inches/millimeters.

Figure 10. Cooling and gas/electric - 3 tons ultra high efficiency- economizer, manual or motorized fresh air damper; power exhaust[a]



(a) All dimensions are in inches/millimeters.

Figure 11. Cooling and gas/electric - 3 tons ultra high efficiency- economizer & barometric relief damper hood(a)

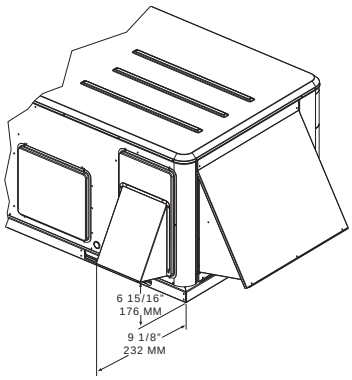
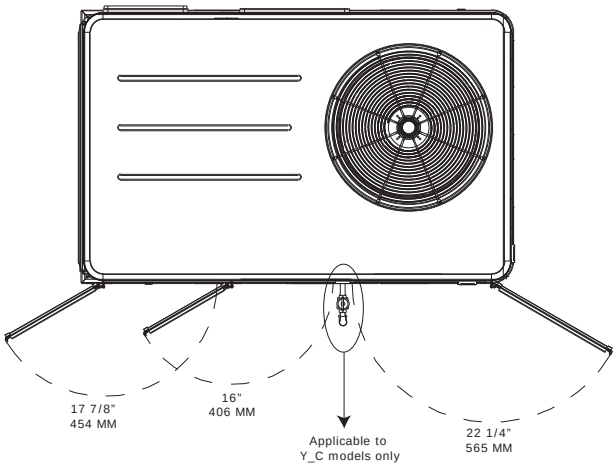


Figure 12. Cooling and gas/electric models - 3 tons ultra high efficiency- swing diameter for hinged door(s) option(a)



(a) All dimensions are in inches/millimeters.

Figure 13. Gas/electric models - 3 tons ultra high efficiency- height of gas pipe required from inside base of unit to gas shut off assembly (factory provided) - Y_C models only

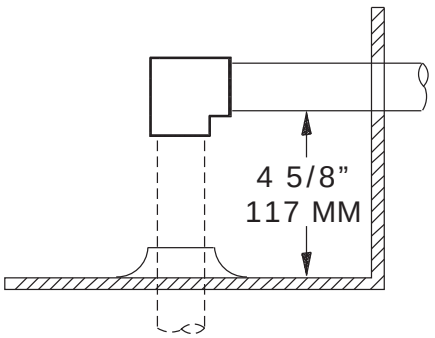
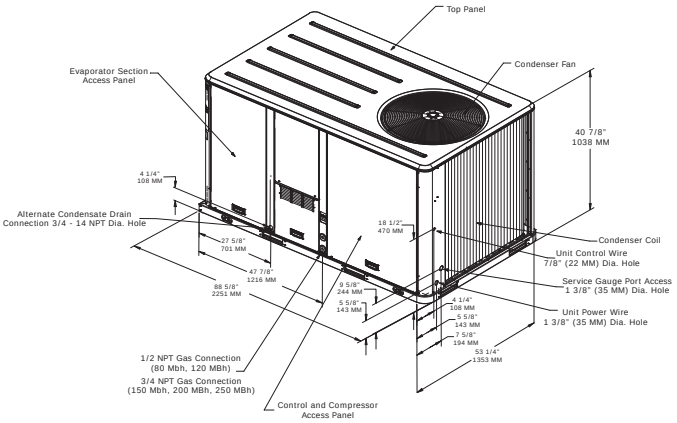
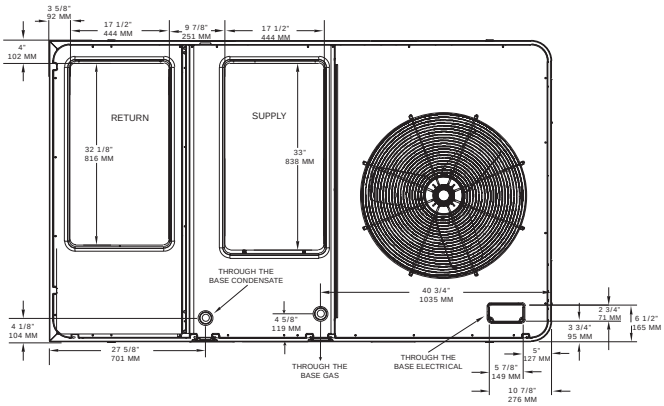


Figure 14. Cooling and gas/electric - 4 to 5 tons ultra high efficiency(a)



(a) All dimensions are in inches/millimeters.

Figure 15. Cooling and gas/electric - 4 to 5 tons ultra high efficiency- downflow airflow supply/ return - through-the-base utilities(a)



(a) All dimensions are in inches/millimeters.

Figure 16. Cooling and gas/electric - 4 to 5 tons ultra high efficiency- horizontal airflow supply and return

Note: All dimensions are in inches/millimeters.

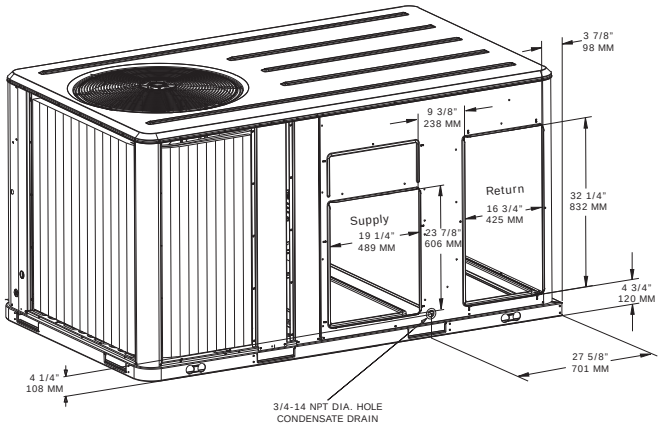


Figure 17. Cooling and gas/electric - 4 to 5 tons ultra high efficiency- unit clearance and roof opening

Note: All dimensions are in inches/millimeters.

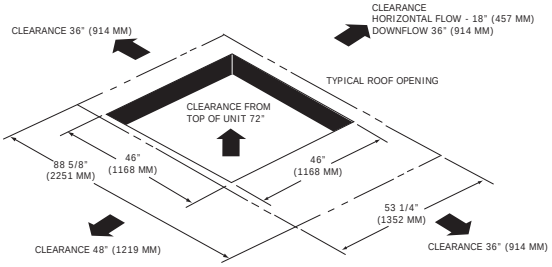
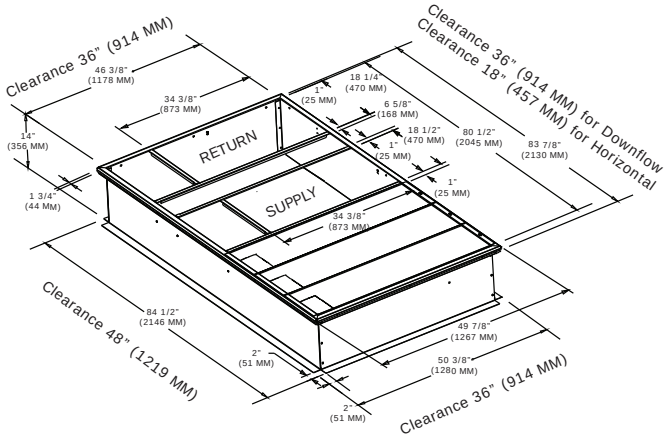
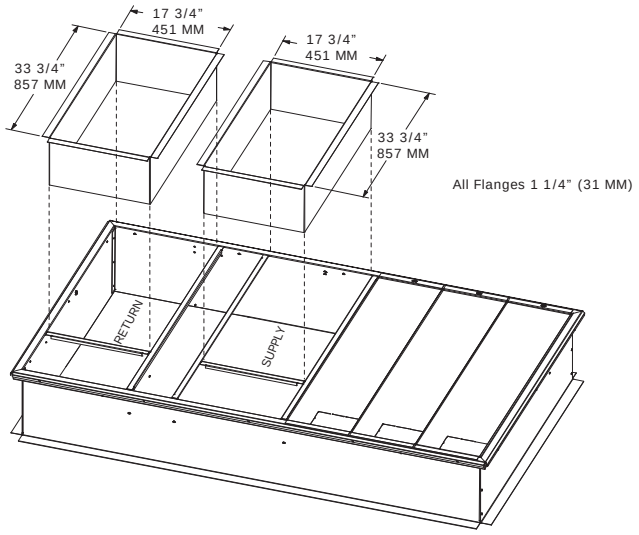


Figure 18. Cooling and gas/electric - 4 to 5 tons ultra high efficiency - roof curb[(a)]



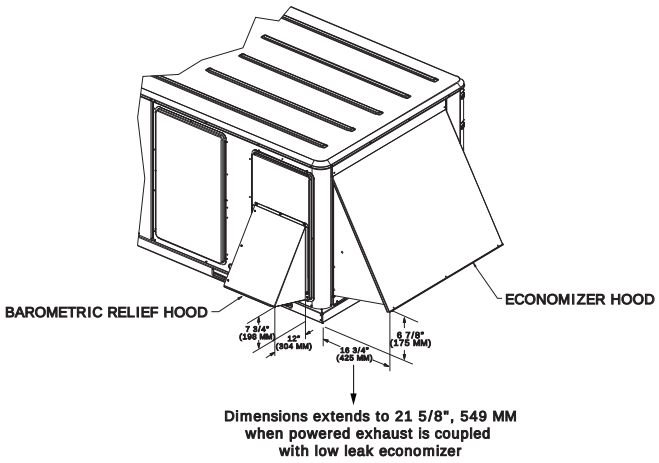
(a) All dimensions are in inches/millimeters.

Figure 19. Cooling and gas/electric - 4 to 5 tons ultra high efficiency- downflow duct connections field fabricated[(a),(b)]



(a) All dimensions are in inches/millimeters.
(b) See the clearance requirement table in the Application Consideration chapter for duct clearance to combustible materials.

Figure 20. Cooling and gas/electric - 4 to 5 tons ultra high efficiency - economizer, manual or motorized fresh air damper[(a)]



(a) All dimensions are in inches/millimeters.

Figure 21. Cooling and gas/electric - 4 to 5 tons ultra high efficiency- swing diameter for hinged door(s) option

Note: All dimensions are in inches/millimeters.

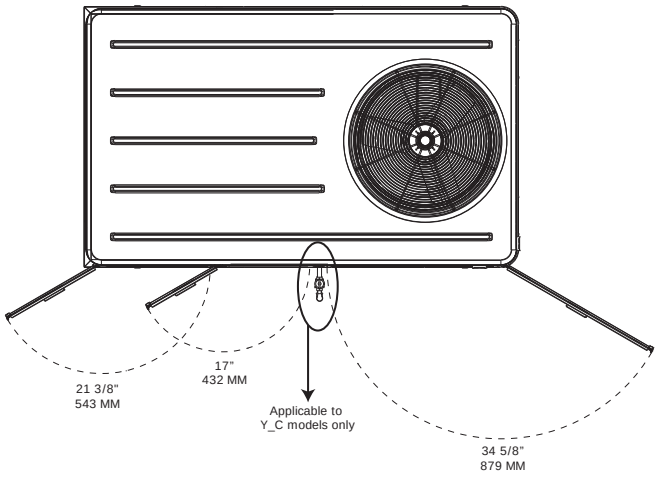


Figure 22. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency

Note: All dimensions are in inches/millimeters.

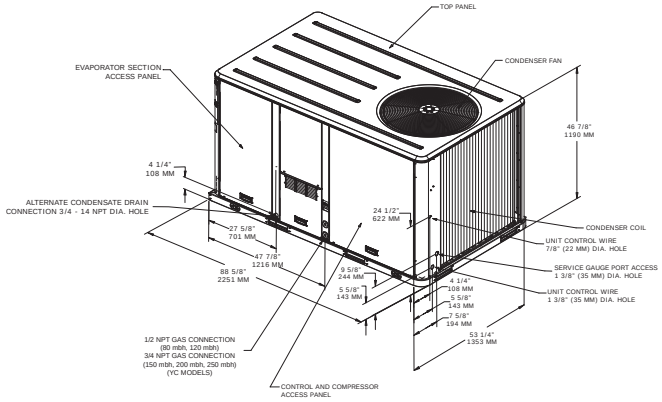


Figure 23. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - downflow supply/return through-the-base utilities

Note: All dimensions are in inches/millimeters.

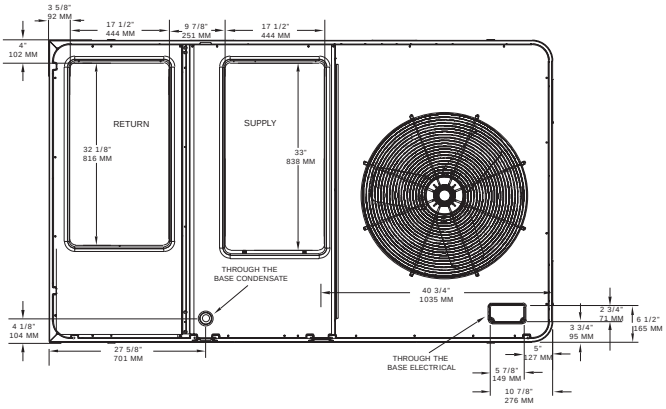


Figure 24. Cooling and gas/electric - 6 to 10 tons ultra high efficiency - horizontal airflow supply and return

Note: All dimensions are in inches/millimeters.

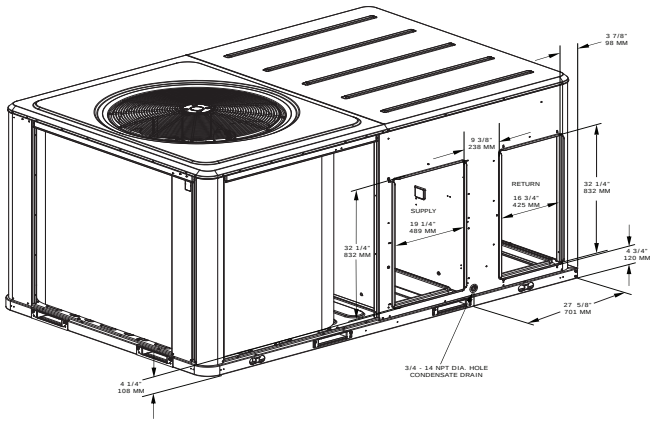


Figure 25. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - unit clearance and roof opening

Note: All dimensions are in inches/millimeters.

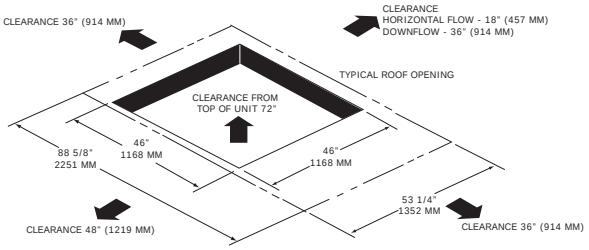


Figure 26. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - roof curb

Note: All dimensions are in inches/millimeters.

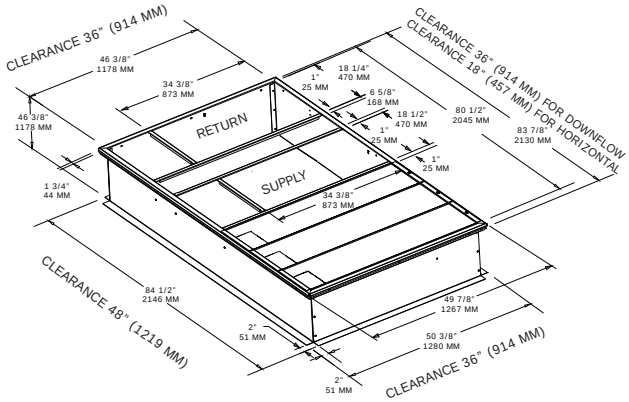


Figure 27. Cooling and gas/electric - 6 to 10 tons ultra high efficiency - duct connections field fabricated

Note: All dimensions are in inches/millimeters.

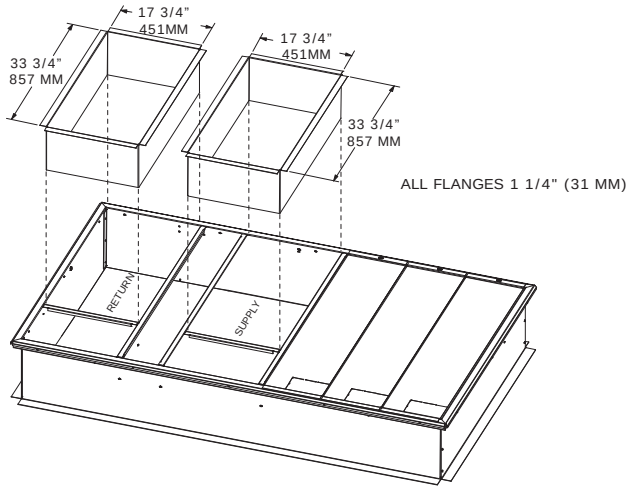


Figure 28. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - power exhaust

Note: All dimensions are in inches/millimeters.

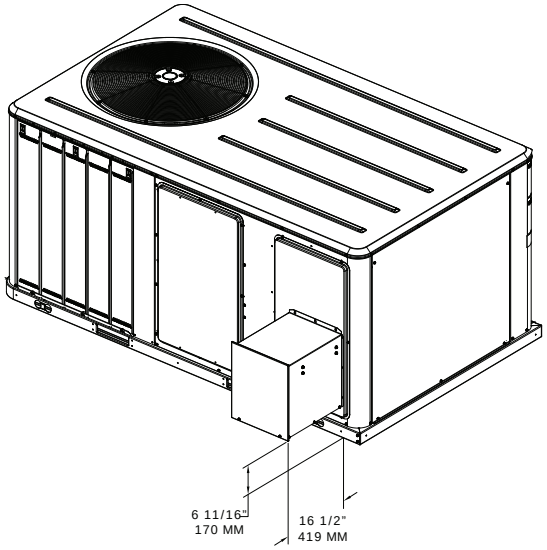


Figure 29. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - swing diameter for hinged door(s) option

Note: All dimensions are in inches/millimeters.

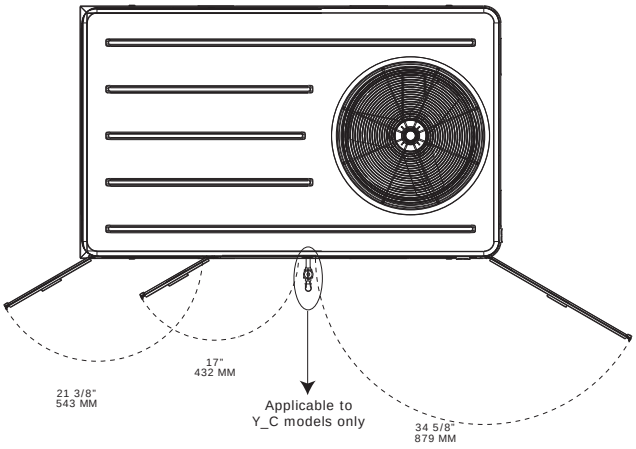


Figure 30. Cooling and gas/electric - 6 to 10 tons ultra high efficiency - economizer, manual or motorized fresh air damper

Note: All dimensions are in inches/millimeters.

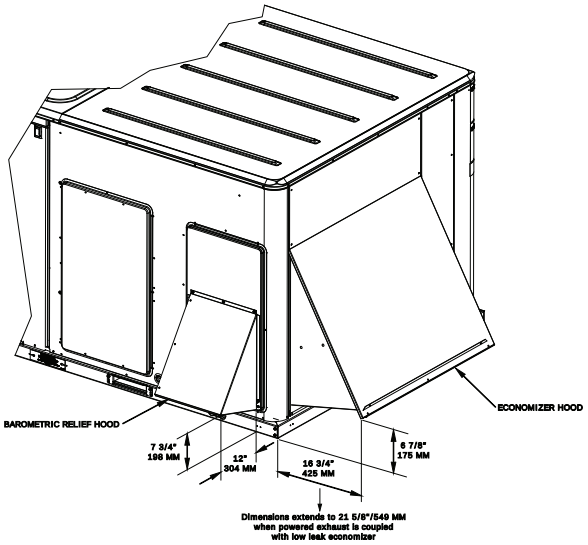


Figure 31. Gas/electric - 6 to 10 tons ultra high efficiency - height of gas pipe required from inside of base of unit to gas shut-off assembly (factory provided) YZC models only

Note: All dimensions are in inches/millimeters.

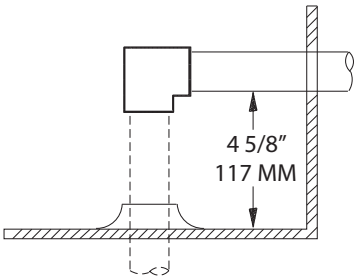


Figure 32. Cooling and gas/electric - 10 tons ultra high efficiency

Note: All dimensions are in inches/millimeters.

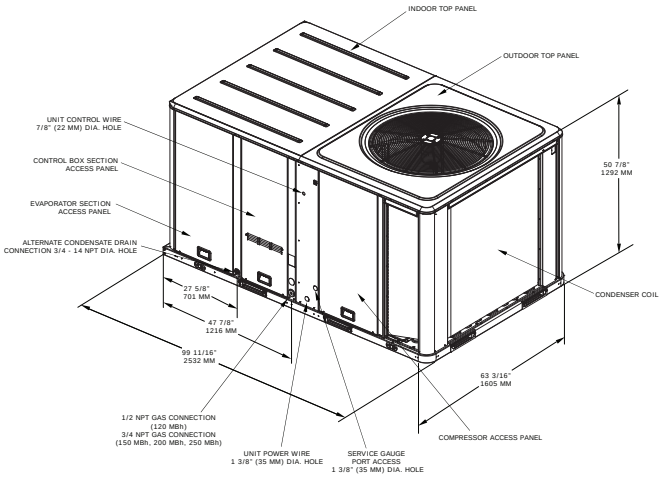


Figure 33. Cooling and gas/electric - 10 tons ultra high efficiency - downflow airflow supply/return, through-the-base utilities

Note: All dimensions are in inches/millimeters.

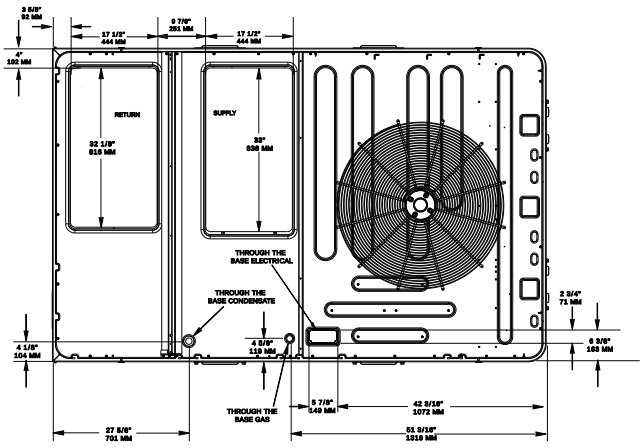


Figure 34. Cooling and gas/electric - 10 tons ultra high efficiency - unit clearance and roof opening

Note: All dimensions are in inches/millimeters.

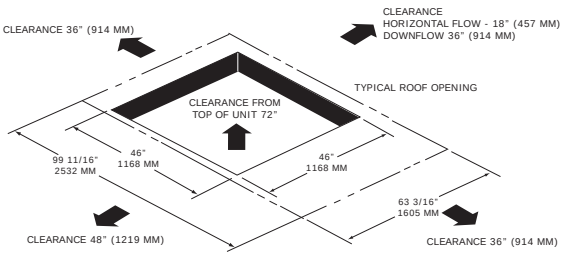


Figure 35. Cooling and gas/electric - 10 tons ultra high efficiency - roof curb

Note: All dimensions are in inches/millimeters.

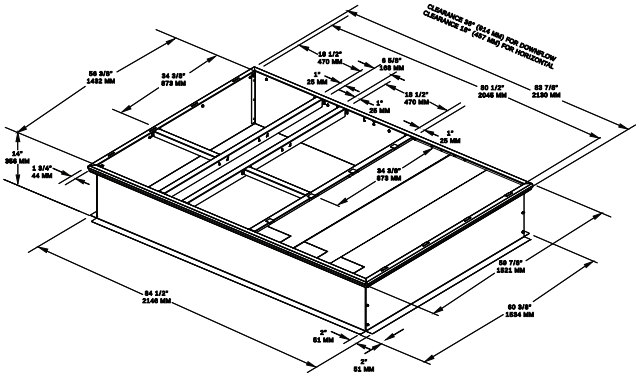


Figure 36. Cooling and gas/electric - 10 tons ultra high efficiency - power exhaust

Note: All dimensions are in inches/millimeters.

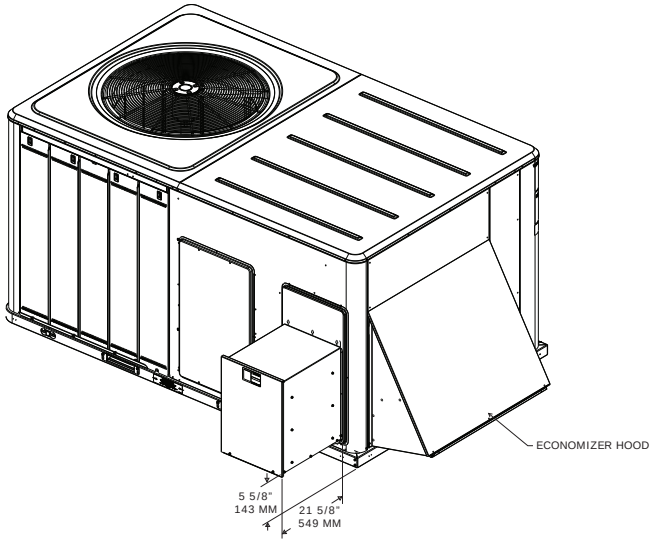
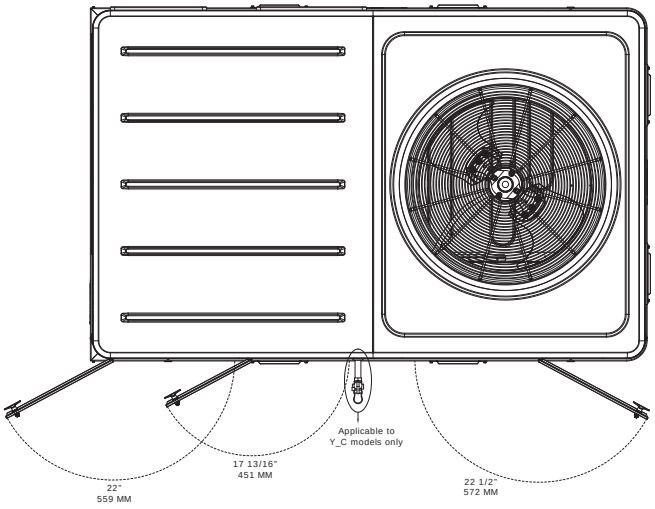


Figure 37. Cooling and gas/electric - 10 tons ultra high efficiency - swing diameter for hinged door(s) option

Note: All dimensions are in inches/millimeters.



Installation

Foundation

Horizontal Units

If the unit is installed at ground level, elevate it above the snow line. Provide concrete footings at each support location with a “full perimeter” support structure or a slab foundation for support. For the unit’s operating and point loading weights when constructing a footing foundation.

If anchoring is required, anchor the unit to the slab using hold down bolts or isolators. Isolators should be installed to minimize the transmission of vibrations into the building.

⚠WARNING

Risk of Roof Collapsing!

Failure to ensure proper structural roof support could cause the roof to collapse, which could result in death or serious injury and property damage. Confirm with a structural engineer that the roof structure is strong enough to support the combined weight of the roofcurb and the unit. Refer to the weights section for typical unit and curb weights.

For rooftop applications, ensure the roof is strong enough to support the combined unit and support structural weight. If anchoring is required, anchor the unit to the roof with hold-down bolts or isolators.

Check with a roofing contractor for proper waterproofing procedures.

Ductwork

Supply and return air openings as viewed from the rear of the unit are shown in the following drawings.

Figure 38. 3 tons ultra high efficiency - horizontal supply & return air openings

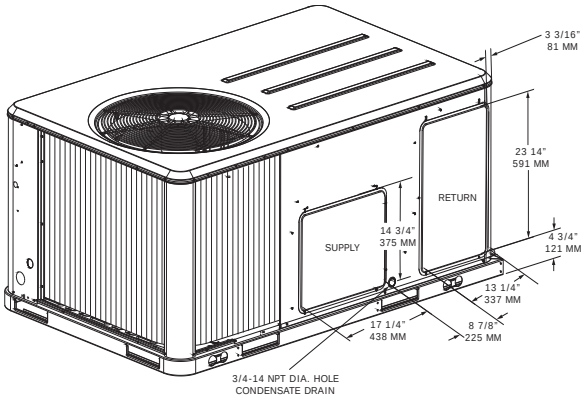


Figure 39. 4, 5 tons ultra high efficiency - horizontal supply & return air openings

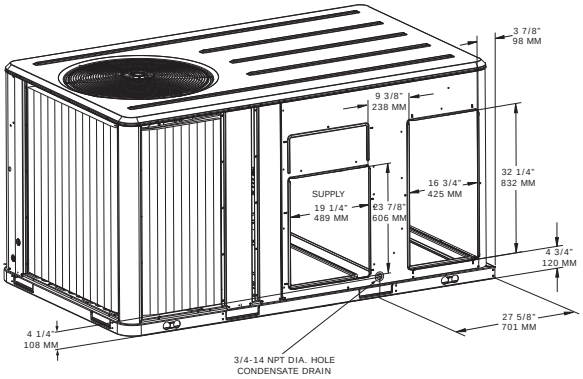
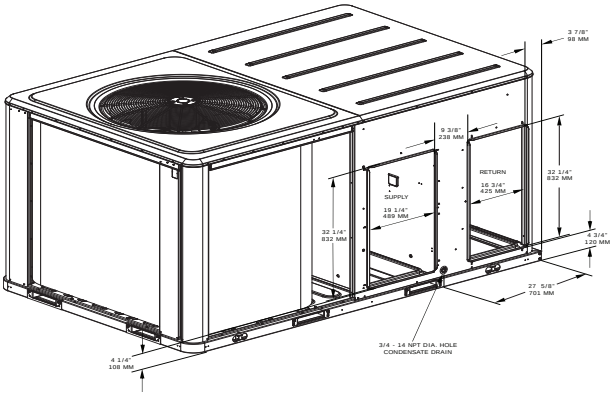


Figure 40. 6 to 10 tons ultra high efficiency - horizontal airflow supply and return air openings



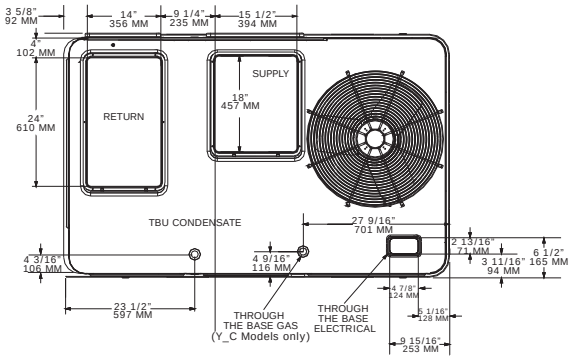
Supply and return air openings as viewed from a downflow configuration are shown in the following drawings.

Elbows with turning vanes or splitters are recommended to minimize air noise due to turbulence and to reduce static pressure.

When attaching the ductwork to the unit, provide a water tight flexible connector at the unit to prevent operating sounds from transmitting through the ductwork.

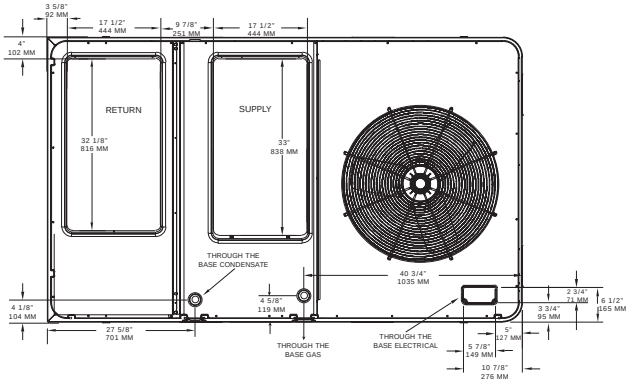
All outdoor ductwork between the unit and the structure should be weather proofed after installation is completed.

Figure 41. 3 tons ultra high efficiency - downflow airflow supply/return - through-the-base utilities[a]



(a) All dimensions are in inches/millimeters.

Figure 42. 4 to 5 tons ultra high efficiency- downflow airflow supply/return - through-the-base utilities[a]



(a) All dimensions are in inches/millimeters.

Figure 43. Cooling and gas/electric - 6 to 8.5 tons ultra high efficiency - downflow supply/return through-the-base utilities

Note: All dimensions are in inches/millimeters.

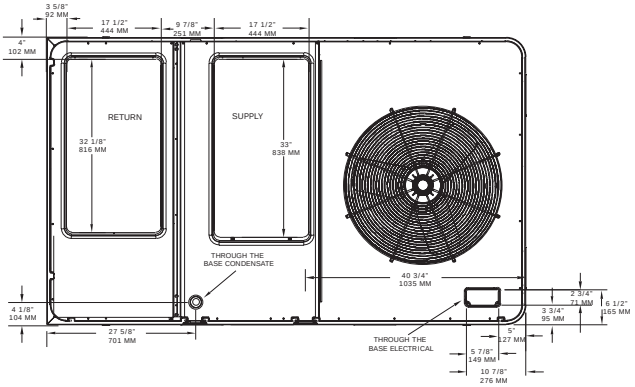
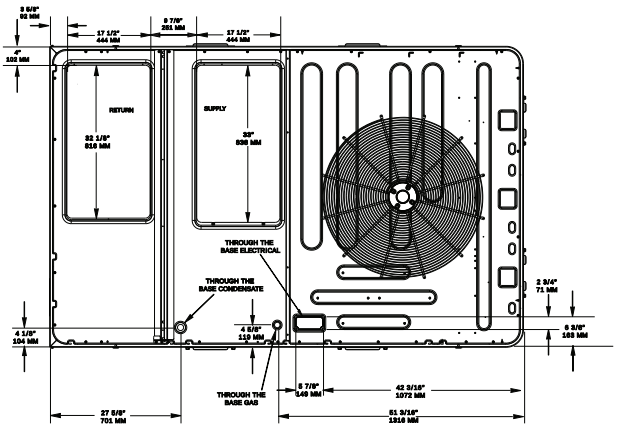


Figure 44. Cooling and gas/electric - 10 tons ultra high efficiency - downflow airflow supply/return, through-the-base utilities

Note: All dimensions are in inches/millimeters.



Roof Curb

Downflow

The roof curbs for these units consists of a “full perimeter” enclosure to support the unit just inside of the unit base rail.

Before installing any roof curb, verify;

- it is the correct curb for the unit,
- it includes the necessary gaskets and hardware,
- the purposed installation location provides the required clearance for proper operation,
- the curb is level and square and the top surface of the curb must be true to assure an adequate curb-to-unit seal.

⚠WARNING

Combustible Materials!

Failure to maintain proper clearance between the unit heat exchanger, vent surfaces and combustible materials could cause a fire which could result in death or serious injury or property damage. Refer to unit nameplate and installation instructions for proper clearances.

Verify that appropriate materials were used in the construction of roof and ductwork. Combustible materials should not be used in the construction of ductwork or roof curb that is in close proximity to heater elements or any hot surface. Any combustible material on the inside of the unit base should be removed and replaced with appropriate material.

Step-by-step curb assembly and installation instructions ship with each accessory roof curb kit. Follow the instructions carefully to assure proper fit-up when the unit is set into place.

Note: *To assure proper condensate flow during operation, as well as proper operation of the condensate overflow switch (if equipped), the unit and curb must be level.*

If the unit is elevated, a field constructed catwalk around the unit is strongly recommended to provide easy access for unit maintenance and service.

Recommendations for installing the supply air and return air ductwork joining the roof curb are included in the curb instruction booklet. Curb ductwork must be fabricated and installed by the installing contractor before the unit is set into place.

Note: *For sound consideration, cut only the holes in the roof deck for the ductwork penetrations. Do not cut out the entire roof deck within the curb perimeter.*

If a curb accessory kit is not used:

- The ductwork can be attached directly to the factory-provided flanges around the unit's supply and return air openings. Be sure to use flexible duct connections at the unit.
- For "built-up" curbs supplied by others, gaskets must be installed around the curb perimeter flange and the supply and return air opening flanges.

Rigging

⚠WARNING

Heavy Objects!

Failure to follow instructions below or properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift.

A rigging illustration and center-of-gravity dimensional data table is shown in the weights section. Refer to the typical unit operating weights table before proceeding.

1. Remove all drill screws fastening wood protection to metal base rail. Remove all screws securing wooden protection to wooden top crate.
2. Remove wooden top crate.

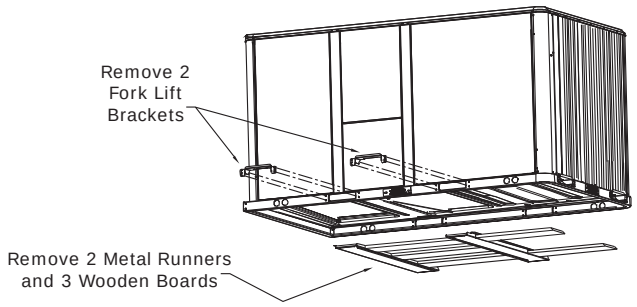
⚠WARNING

Improper Unit Lift!

Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level.

3. Rig the unit as shown in the weights section. Attach adequate strength lifting slings to all four lifting brackets in the unit base rail. Do not use cables, chains, or slings except as shown.
4. Install a lifting bar, as shown in the weights section to protect the unit and to facilitate a uniform lift. The minimum distance between the lifting hook and the top of the unit should be 7 feet.
5. Test-lift the unit to ensure it is properly rigged and balanced, make any necessary rigging adjustments.

Figure 45. Fork pockets - all units



6. Lift the unit enough to allow the removal of base fork pocket protection components as shown in the following figure.
7. Down flow units; align the base rail of the unit with the curb rail while lowering the unit onto the curb. Make sure that the gasket on the curb is not damaged while positioning the unit.

General Unit Requirements

The checklist listed below is a summary of the steps required to successfully install a commercial unit. This checklist is intended to acquaint the installing personnel with what is required in the installation process. It does not replace the detailed instructions called out in the applicable sections of this manual.

- Check the unit for shipping damage and material shortage; file a freight claim and notify appropriate sales representative.
- Verify correct model, options and voltage from unit nameplate.
- Verify that the installation location of the unit will provide the required clearance for proper operation.

- If applicable, assemble and install the roof curb. Refer to the latest edition of the curb installers guide that ships with each curb kit.
- Fabricate and install ductwork; secure ductwork to curb.
- If applicable, install pitch pocket for power supply through building roof.
- Rigging the unit.
- Set the unit onto the curb; check for levelness.
- Ensure unit-to-curb seal is tight and without buckles or cracks.
- Install and connect a condensate drain line to the evaporator drain connection.

Note: *Condensate Overflow Switch (if equipped) will not work if unit is not leveled properly.*

Factory Installed Economizer

- Ensure the economizer has been pulled out into the operating position. Refer to the economizer installers guide for proper position and setup.
- Install all access panels.

Temperature Limit Switch Usage for Gas Heat Units

Units are factory shipped in the down flow discharge configuration but can be field converted to a horizontal discharge configuration. Some, but not all units require a different TCO1 limit switch, which is attached to the combustion blower motor if horizontal discharge configuration is used.

If any of the aforementioned units are installed in the down flow discharge configuration, remove the additional TCO1 limit switch from the combustion blower motor and discard.

Table 3. TCO1 tripping values

Unit Model	TCO1 Tripping Values - Downflow/ Horizontal	TCO Location
YZC036E**(L,X)	190°F	Top
YZC036E**(M,Y)	170°F/220°F	Top
YZC036E**(H,Z)	220°F	Top
YZC048F**(L,X)	145°F/155°F	Bottom
YZC048F**(M,Y)	170°F	Bottom
YZC048F**(H,Z)	220°F	Bottom
YZC060E**(L,X)	140°F	Bottom
YZC060E**(M,Y)	170°F	Bottom
YZC060E**(H,Z)	170°F	Bottom
YZC072F**(L,X)	180°F/200°F	Bottom
YZC072F**(M,Y)	180°F/230°F	Bottom
YZC072F**(H,Z,V)	180°F/230°F	Bottom
YZC090F**(L,X)	200°F/220°F	Bottom
YZC090F**(M.Y)	190°F/225°F	Bottom
YZC090F**(H,Z,V)	200°F/210°F	Bottom

Table 3. TCO1 tripping values (continued)

Unit Model	TCO1 Tripping Values - Downflow/ Horizontal	TCO Location
YZC102F**(L,X)	200°F/220°F	Bottom
YZC102F**(M,Y)	190°F/225°F	Bottom
YZC102F**(H,Z,V)	200°F/210°F	Bottom
YZC120F**(L,X)	170°F/200°F	Bottom
YZC120F**(M,Y)	170°F/190°F	Bottom
YZC120F**(H,Z,V)	135°F/155°F	Top

Horizontal Discharge Conversion (3 to 5 Ton Units)

Note: *3 ton unit supply cover to supply opening and return cover to return opening. 4 and 5 ton unit return cover to supply opening and supply cover to return opening.*

Supplies needed by installer for conversion: 3 oz. tube of high temperature RTV sealant. (500°F / 260°C: similar to Dow Corning 736)

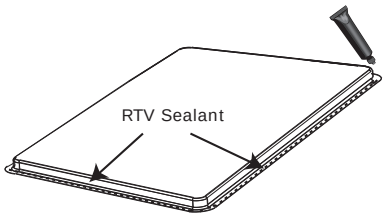
Important: *Failure to use recommended sealant could result in unit performance loss.*

If a unit is to be converted to a horizontal discharge, the following conversion must be performed:

1. Remove RETURN and SUPPLY duct covers.
2. Apply ¼ in. (6mm.) continuous bead of 500°F RTV sealant to the flange of the duct cover to be installed in the supply opening of the base pan.

Note: *Perform the same task for the 3 ton duct cover to be installed in the return opening.*

Figure 46. Duct cover



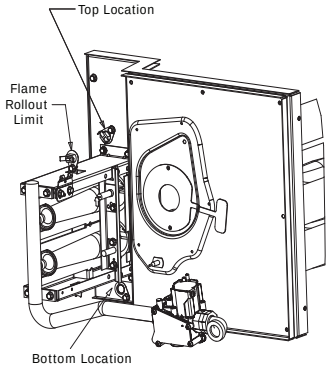
3. For the 3 ton unit, slide duct cover with insulation side up into duct openings until inward edge of duct cover engages with the 2 retaining clips on the duct flanges. Secure the outward edge of each duct cover with 2 screws.
4. For the 4 and 5 ton units, slide RETURN DUCT COVER (insulation side up) into supply opening until inward edge of duct cover engages with the 2 retaining clips on the duct flange. Secure outward edge of the duct cover with two screws. Place the supply duct cover over the return opening (insulation side down). Secure the cover with 4 screws using the dimples on the top surface to initiate screw engagement.
5. After completing installation of the duct covers for horizontal discharge, proceed to TCO-1 instructions.

TCO-1 Instructions

If the unit being installed is listed in the following list, the limit control TCO1 must be replaced with the extra limit control shipped in the heater compartment. Replace TCO1 following the instructions in steps 1 through 3 below. If the unit being installed does not correspond to any in the following list, skip steps 1 through 3 and go on to next step in the installation process.

Note: *See Table 3, p. 27 for the TCO limit locations.*

Figure 47. TCO1 location



⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

1. Remove the heat section access panel.
2. Remove TCO1 from shipping location, attached to the combustion blower.
3. Replace and discard the existing TCO1 originally installed at the factory for down flow operation with the TCO1 shipped attached to the combustion blower for horizontal operation.
4. Replace heat section access panel.

Horizontal Discharge Conversion (6 to 10 Ton Units)

Note: *6 to 10 ton units the supply cover to return opening & return cover to supply opening.*

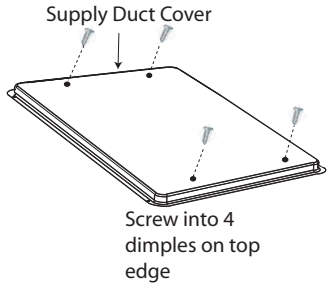
Supplies Needed by Installer for Conversion: 3 oz. tube of high Temperature RTV sealant (500°F / 260°C: Similar to Dow Corning 736).

Important: *Failure to use recommended sealant could result in unit performance loss.*

If a unit is to be converted to a Horizontal discharge, the following conversion must be performed:

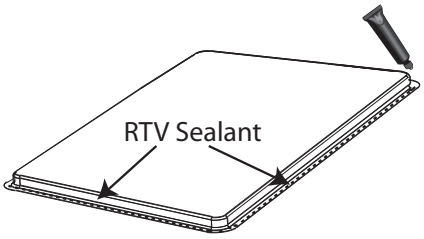
1. Remove RETURN and SUPPLY duct covers.
2. Place SUPPLY DUCT COVER over down-flow return opening. (insulation side down)
3. Using self-drilling screws, (or screws removed from duct cover), screw through dimples to attach DUCT COVER to base.

Figure 48. Duct cover



4. On original RETURN DUCT COVER, apply ¼"(6mm.) continuous bead of 500°F RTV sealant around flange (opposite insulation side), as shown.

Figure 49. Duct cover

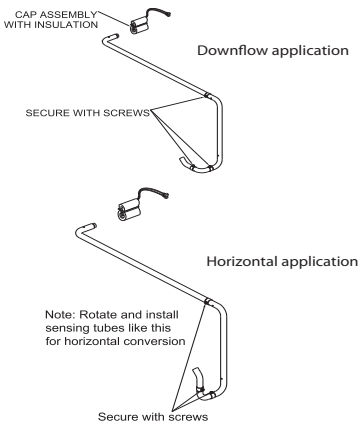


5. Slide RETURN DUCT COVER (insulation side up) into supply opening until inward edge of duct cover engages with the 2 retaining clips on the duct flange. Secure outward edge of the duct cover with two screws.

Note: *If unit is equipped with Return Air Smoke Detector, refer to field conversion instructions for horizontal discharge before installing return air duct.*

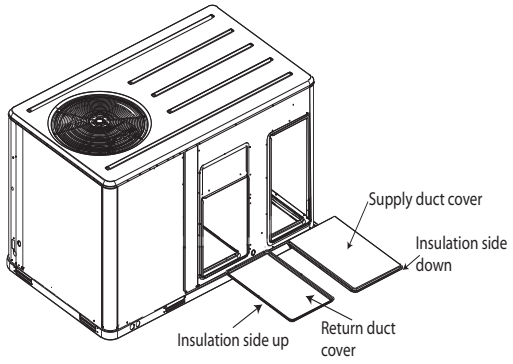
Note: *If unit is equipped with Discharge Air Sensing option refer to the following figure for proper tube positioning based on unit tonnage.*

Figure 50. For YZC072F-120F



6. After completing installation of the duct covers for horizontal discharge, proceed to TCO1 instructions.

Figure 51. Supply and return covers



Return Air Smoke Detector

Note: *Consult smoke detector manufacturer if daisy chaining is required.*

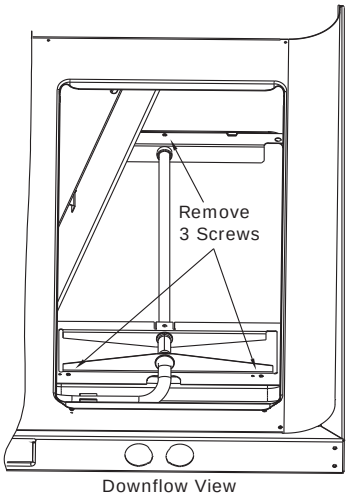
The factory installed return air smoke detector is installed in the downflow discharge position. No additional field setup is required.

If a unit is to be converted to horizontal discharge, the following conversion must be performed:

1. If the unit has an economizer, it must be pulled out in the operating position.
2. Remove the 3 screws from the mounting brackets.

Note: *Refer to downflow view for screws locations.*

Figure 52. Downflow view

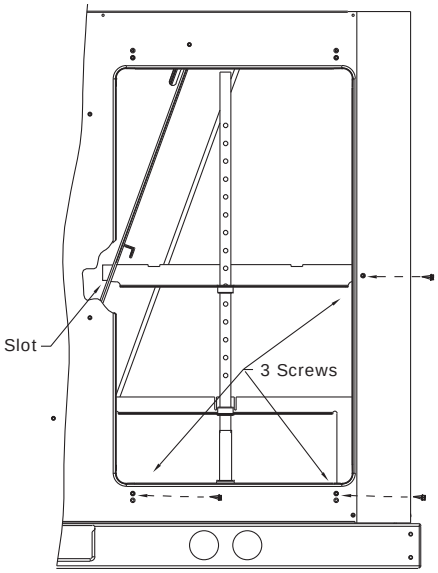


Downflow View

3. Lift the tube and bracket from the downflow duct opening. Rotate the tube and bracket assembly 180° ensuring that the holes on the copper sensing tube face away from the unit and face the return air ductwork.

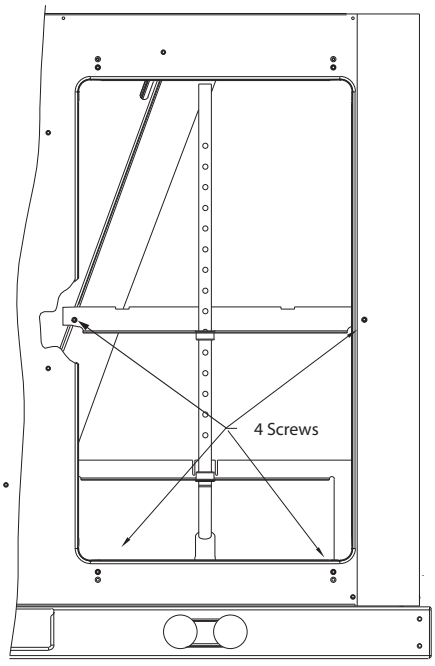
Note: *Refer Figure 53, p. 29 and Figure 54, p. 29 for screws location.*

Figure 53. Horizontal view 1



Horizontal View

Figure 54. Horizontal view 2



Horizontal View 2

Note: *Check to insure that the flexible tubing lies flat on the base pan surface.*

4. Slide the top bracket down the copper sensing tube. For YZC036E units insert the tab on the left side into the slot on the indoor coil block off and secure the right side of the bracket with one of the 3 screws removed in step 2. Refer to Figure 53, p. 29. For YZC048F, YZC060E, YZC072F-120F units secure the tab on left side to the indoor coil block off with one of the screws removed in

step 2 and secure the right side of the bracket with one of the screws removed from the access panel. Refer to Figure 54, p. 29.

5. Using the remaining 2 screws removed in step 2, secure the bottom bracket. Refer to Figure 53, p. 29.

Note: *Larger diameter holes on bottom bracket line up with the dimples on the rear panel. The smaller diameter holes line up with the screw holes in the rear panel.*

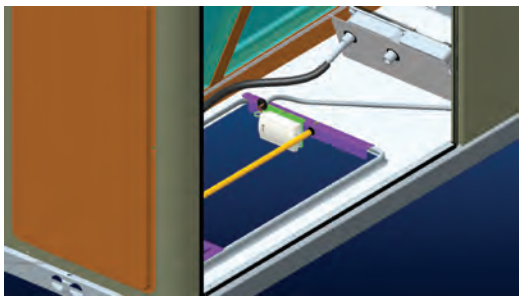
Air-Fi™ Wireless Communication Interface

The factory installed wireless communications interface is installed in the downflow discharge position.

If a unit is to be converted to horizontal discharge, the following conversion must be performed:

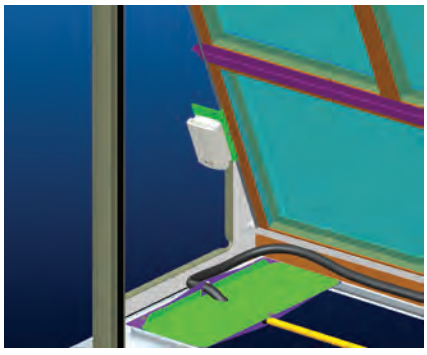
1. If the unit has an economizer, it must be pulled out in the operating position.
2. Remove the screw from the mounting bracket. Refer to downflow view for screw and bracket location.

Figure 55. Wireless communication interface - downflow



3. Mount the bracket in the horizontal discharge location. Refer to horizontal view for screw and bracket location.

Figure 56. Wireless communication interface - horizontal



Note: *Cable ties must be removed to allow the cable to extend to the horizontal mounting location.*

Main Electrical Power Requirements

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

Verify that the power supply complies with the unit nameplate specifications.

- Inspect all control panel components; tighten any loose connections.
- Connect properly sized and protected power supply wiring to a field-supplied/installed disconnect switch and to the main power terminal block (HTB1) in the unit control panel.
- Install proper grounding wires to an earth ground.

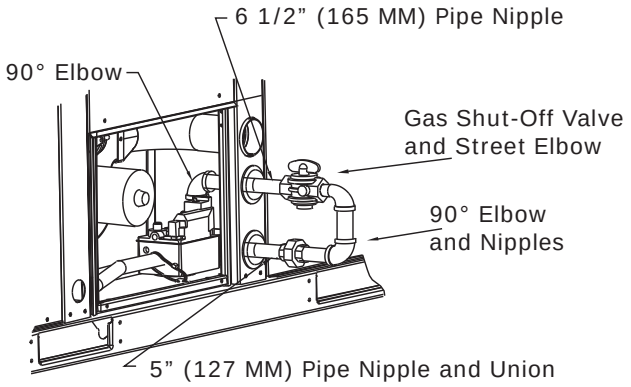
Through-the-Base Gas Installation

The gas supply line must extend 4⅝" above the base pan. The "Through-the-Base Gas" kit is located in the Heat Vestibule compartment. To gain access to the kit, remove the Heat Compartment access panel.

1. Remove the pipe assembly strapped to the manifold. Unscrew 90° elbow from 6½" nipple and slide rubber grommet off of nipple.
2. Remove the plastic plug from the hole in the center post and insert the grommet removed from 6½" pipe nipple.
3. Using pipe sealant, attach the 90° elbow to the gas supply line.
4. Disconnect the 5" pipe nipple and union from the "Through-the-Base Gas" kit assembly.

5. Using pipe sealant, attach the 6½" nipple and gas shutoff assembly to the 90° elbow on the gas supply line.
6. Using pipe sealant, attach the 5" pipe nipple and union to the street el attached to the gas valve.
7. Connect 5" pipe nipple and union to 6½" nipple and gas shutoff assembly.

Figure 57. Typical through-the-base gas installation



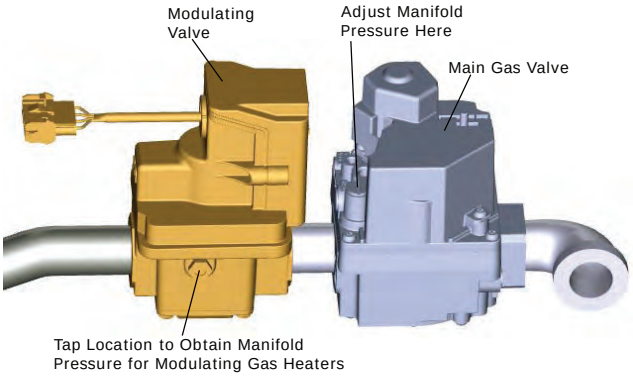
Requirements for Gas Heat

Note: *The unit gas train and optional through-the-base gas shut-off valve are rated at 1/2 PSIG maximum. A pressure reducing regulator is recommended to prevent this maximum from being exceeded. These components must be isolated during field gas piping test that exceed 1/2 PSIG. It is recommended that the field piping be capped prior to the unit gas train or optional through-the-base gas shut-off valve if present.*

- Gas supply line properly sized and connected to the unit gas train.
- All gas piping joints properly sealed.
- Gas piping leak checked with a soap solution. If piping connections to the unit are complete, do not pressurize piping in excess of 0.50 psig or 14" wc to prevent component failure.
- Drip leg Installed in the gas piping near the unit.
- Minimum gas supply pressure should be 4.5" wc
- Minimum gas supply pressure for modulating "V" models should be 5.5" wc
- Maximum gas supply pressure must not exceed 14.0" wc
- Manifold pressure for single stage heaters should be set to 3.3" wc
- Manifold pressure for two stage heaters should be set to 3.5" wc on high fire and 1.8" wc on low fire.
- Manifold pressure for modulating heaters is 3.5" wc at high fire.

Note: *Modulating valve must have 10 VDC signal voltage to achieve high fire. See the following image for manifold pressure tap location.*

Figure 58. Manifold pressure tap location



- Flue exhaust clear of any obstruction.

Condensate Drain Configuration

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

An evaporator condensate drain connection is provided on each unit. Refer to Figure 38, p. 24 and Figure 39, p. 24 for the appropriate drain location.

The condensate drain pan is factory installed to drain condensate to the back side of the unit. See Figure 38, p. 24 and Figure 39, p. 24. It can be converted to drain condensate out the front side of the unit or through-the-base.

To convert drain condensate out the front of unit:

1. Remove evaporator access panel and supply air access panels.
2. Remove the support panel that the condensate drain pan exits through.
3. Slide the condensate drain pan out of the unit and rotate 180°.
4. Slide the condensate drain pan back into the unit, align the drain with the grommeted opening in the rear support panel and push until the coupling is seated in the grommet.
5. Replace the front support panel by aligning the panel with tabs in the raceway. Align the condensate drain pan support in the grommeted hole as the panel is put in place.
6. Replace evaporator access panel and supply air access panels.

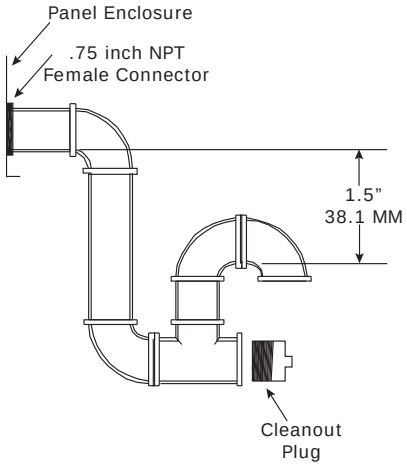
To convert drain condensate through-the-base of unit:

1. Remove evaporator access panel and supply air access panels.
2. Remove the support panel that the condensate drain pan exits through.
3. Slide the condensate drain pan out of the unit.
4. Place on a level surface in the position it was removed from the unit.
5. Remove the plug knockout in the bottom of the drain pan to convert it to through-the-base drainage.
6. Plug the original condensate drain opening with a field supplied 3/4" NPT plug.
7. Slide the condensate drain pan back into the unit, align the drain support with the grommeted opening in the rear support panel and push until the support is seated in the grommet.
8. Replace the front support panel by aligning the panel with tabs in the raceway. Align the plugged condensate drain pan coupling in the grommeted hole as the panel is put in place.
9. Replace evaporator access panel and supply air access panels.

A condensate trap must be installed at the unit due to the drain connection being on the "negative pressure" side of the fan. Install the P-Trap using the guidelines in Figure 59, p. 32.

A condensate drain line must be connected to the P-Trap. Pitch the drain lines at least 1/2 inch for every 10 feet of horizontal run to assure proper condensate flow. Do not allow the horizontal run to sag causing a possible double-trap condition which could result in condensate backup due to "air lock".

Figure 59. Condensate trap installation



Drain Pan Removal (Units with Condensate Overflow Switch Option)

Before drain pan removal, the switch wire must be disconnected from wire tie on panel and/or any tape before drain pan can be removed.

Care must be taken so the wire does not catch on the bottom of indoor coil or any protrusion.

Note: *When reversing the drain pan, on some units, the condensate overflow switch will need to be moved to the second hole in its bracket to avoid contact with headers or indoor coil.*

Filter Installation

The quantity of filters is determined by unit size. Access to the filters is obtained by removing the filter access panel. Refer to the unit Service Facts (shipped with each unit) for filter requirements.

Note: *Do not operate the unit without filters.*

Field Installed Power Wiring

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

An overall dimensional layout for the field installed wiring entrance into the unit is illustrated in the Dimensions and Weights chapter. To insure that the unit's supply power wiring is properly sized and installed, follow the following guidelines.

Verify that the power supply available is compatible with the unit's nameplate ratings. The available supply power must be within 10% of the rated voltage stamped on the nameplate. Use only copper conductors to connect the power supply to the unit.

NOTICE:

Use Copper Conductors Only!

Failure to use copper conductors could result in equipment damage as unit terminals are not designed to accept other types of conductors.

Note: *If the unit is not equipped with an optional factory installed non-fused disconnect switch or circuit breaker, a field supplied disconnect switch must be installed at or near the unit in accordance with the National Electrical Code (NEC latest edition).*

Main Unit Power

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

Standard Wiring

1. Location of the applicable electrical service entrance is illustrated in the Dimensions and Weights chapter. Complete the unit's power wiring connections at Compressor Contactor # 1 (CC1) inside the unit control panel. Refer to the customer connection diagram that is shipped with the unit for specific termination points
2. Provide proper grounding for the unit in accordance with local and national codes.

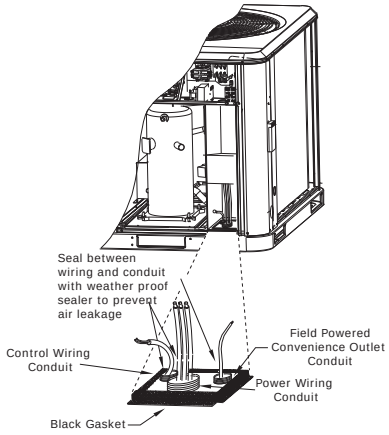
Optional TBUE Wiring (Through-the-Base Electrical Option)

1. Location of the applicable electrical service is illustrated below. Refer to the customer connection diagram that is shipped with the unit for specific termination points. The termination points, depending on the customer option selected would be a factory mounted non-fused disconnect switch (UDC) or circuit breaker (UCB). If neither a factory mounted non-fused disconnect switch (UDC) or circuit breaker (UCB) was factory mounted, field wiring connections should be terminated in the control box at Compressor Contactor # 1 (CC1).
2. Provide proper grounding for the unit in accordance with local and national codes.

Note: *Black gasket is shipped from the factory and is located in the literature ship-with bag in the control box. Apply black gasket around conduit plate on all 4 sides after installation to prevent air leakage from the building entering the electrical enclosures.*

Note: *Seal between wiring and conduit with black gasket or weather proof sealer to prevent air leakage from the building entering the electrical enclosures. Also seal around conduit and wiring at all roof and curb penetrations.*

Figure 60. 3 to 8.5 ton ultra high efficiency units



Field-Installed Control Wiring

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

An overall layout of the various control options available with the required number of conductors for each control device is illustrated in Figure 57, p. 31.

Note: *All field wiring must conform to NEC guidelines as well as state and local codes.*

Control Power Transformer

The 24 volt control power transformers are to be used only with the accessories called out in this manual. Transformers rated greater than 50 VA are equipped with internal circuit breakers. If a circuit breaker trips, turn "Off" all power to the unit before attempting to reset it.

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

The transformer is located in the control panel. The circuit breaker is located on the left side of the transformer and can be reset by pressing in on the black reset button.

Controls using DC Analog Input/Outputs (Standard Low Voltage Multi-Conductor Wire)

Before installing any connecting wiring between the unit and components utilizing a DC analog input\output signal, refer to the Dimensions and Weights chapter for the electrical access locations provided on the unit.

- Table 4, p. 34 lists the conductor sizing guidelines that must be followed when interconnecting the DC binary output devices and the system components utilizing a DC analog input/output signal to the unit.

Note: *Resistance in excess of 2.5 ohms per conductor can cause deviations in the accuracy of the controls.*

Note: *Ensure that the wiring between controls and the unit's termination point does not exceed two and a half (2.5) ohms/conductor for the length of the run.*

- Do not run the electrical wires transporting DC signals in or around conduit housing high voltage wires.
- Route low voltage wiring per illustrations on page 35.

DC Conductors

Table 4. Zone sensor module wiring

Distance from Unit to Control	Recommended Wire Size
0 - 150 feet	22 gauge
0 - 45.7 m	.33 mm2
151 - 240 feet	20 gauge
46 - 73.1 m	.50 mm2
241 -385 feet	18 gauge
73.5 - 117.3 m	.75 mm2
386 - 610 feet	16 gauge
117.7 - 185.9 m	1.3 mm2
611 - 970 feet	14 gauge
186.2 - 295.7 m	2.0 mm2

Figure 61. ReliaTel™ options module

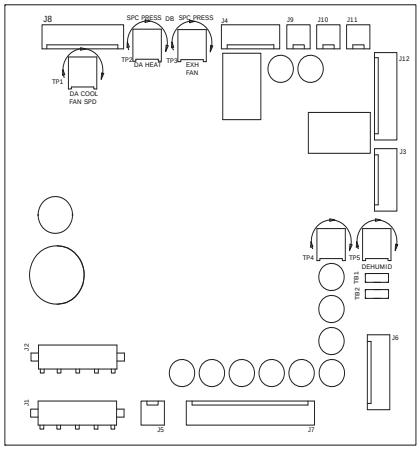


Figure 62. ReliaTel™ relative humidity sensor (enhanced dehumidification operation)

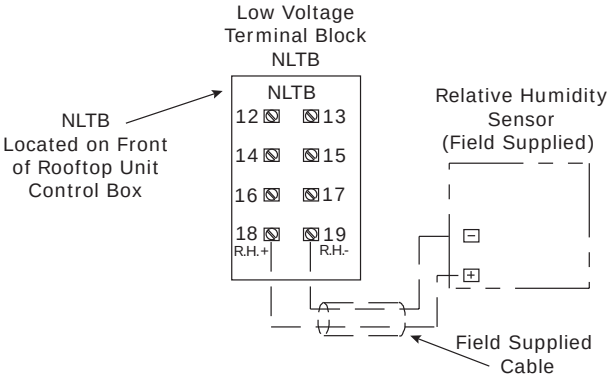
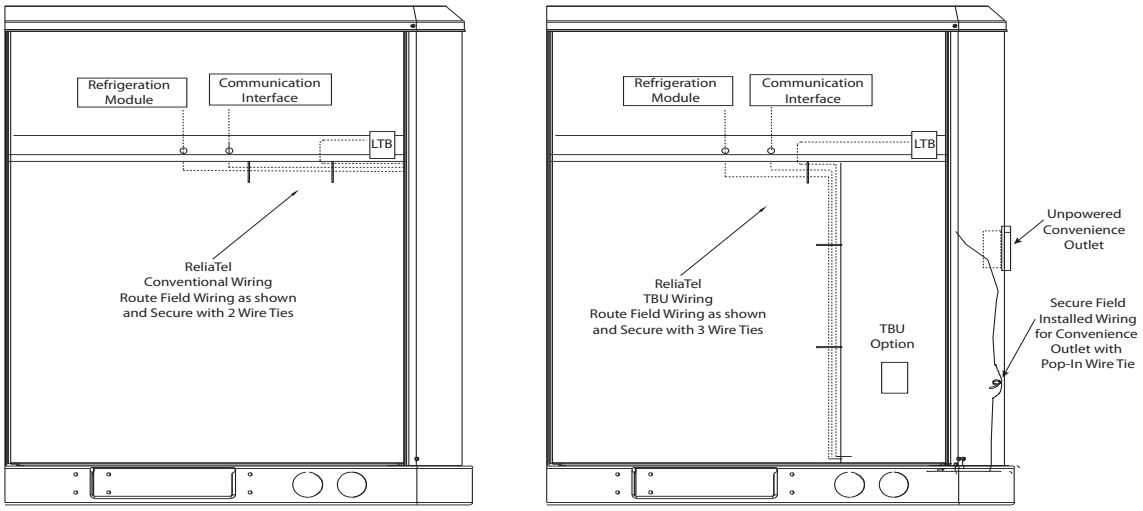


Figure 63. ReliaTel™ control customer low voltage routing (all units)



Space Temperature Averaging (ReliaTel™ Only)

Space temperature averaging is accomplished by wiring a number of remote sensors in a series/parallel circuit.

Using the BAYSENS016* or BAYSENS077*, at least four sensors are required to accomplish space temperature averaging. See diagram below.

- Example #1 illustrates two series circuits with two sensors in each circuit wired in parallel. The square of any number of remote sensors is required.
- Example #2 illustrates three sensors squared in a series/parallel circuit. Using BAYSENS077*, two sensors are required to accomplish space temperature averaging.
- Example #3 illustrates the circuit required for this sensor. Table 5, p. 37 lists the temperature versus resistance coefficient for all sensors.

Figure 64. Examples

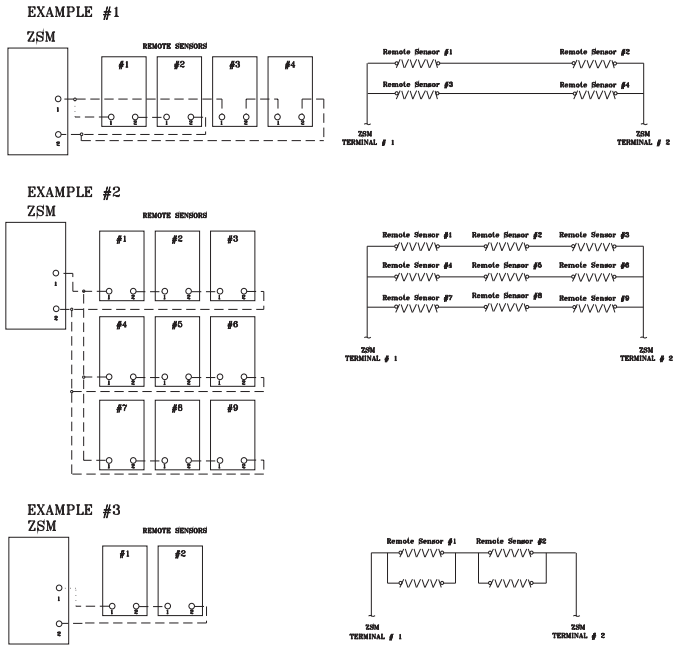


Figure 65. Typical field wiring diagrams for optional controls (ReliaTel™ only)

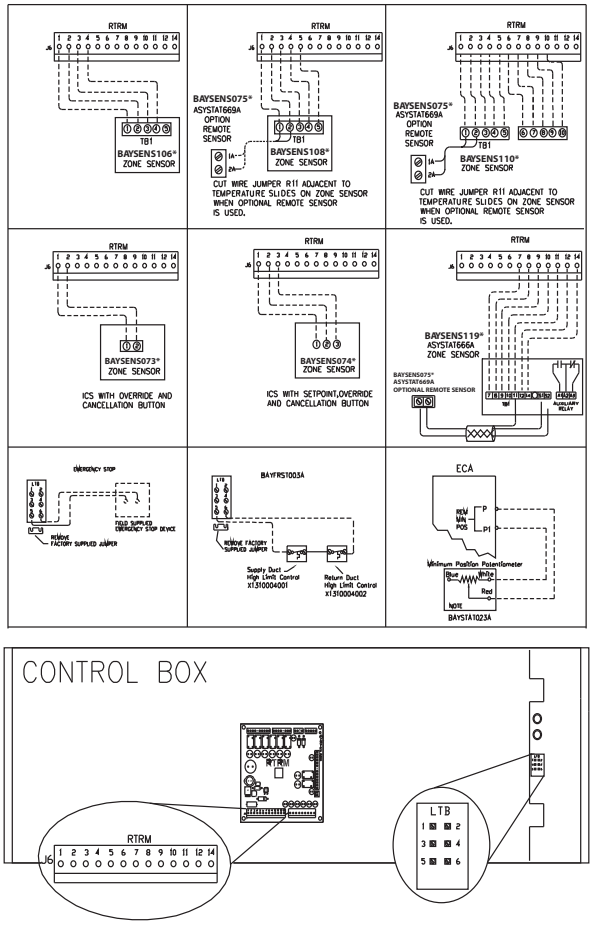


Table 5. Temperature vs. resistance

Temperature		Nominal Resistance
Degrees F°	Degrees C°	
-20°	-28.9°	170.1 K - Ohms
-15°	-26.1°	143.5 K - Ohms
-10°	-23.3°	121.4 K - Ohms
-5°	-20.6°	103.0 K - Ohms
0°	-17.8°	87.56 K - Ohms
5°	-15.0°	74.65 K - Ohms
10°	-12.2°	63.80 K - Ohms
15°	-9.4°	54.66 K - Ohms
20°	-6.7°	46.94 K - Ohms
25°	-3.8°	40.40 K - Ohms
30°	-1.1°	34.85 K - Ohms
35°	1.7°	30.18 K - Ohms
40°	4.4°	26.22 K - Ohms
45°	7.2°	22.85 K - Ohms
50°	10.0°	19.96 K - Ohms
55°	12.8°	17.47 K - Ohms
60°	15.6°	15.33 K - Ohms
65°	18.3°	13.49 K - Ohms
70°	21.1°	11.89 K - Ohms
75°	23.9°	10.50 K - Ohms
80°	26.7°	9.297 K - Ohms
85°	29.4°	8.247 K - Ohms
90°	32.2°	7.330 K - Ohms
95°	35.0°	6.528 K - Ohms

Table 6. Sizing natural gas pipe mains and branches

Length of Pipe (Ft.)	Iron Pipe Size (IPS) Inches				
	½" Pipe	¾" Pipe	1" Pipe	1¼" Pipe	1½" Pipe
15	76	176	345	750	1220
30	52	120	241	535	850
45	43	99	199	435	700
60	38	86	173	380	610
75		77	155	345	545

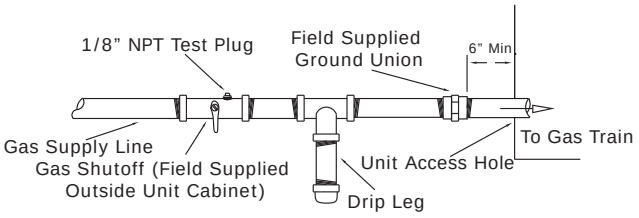
Note: Capacity of Pipe of Different Diameters and Lengths in Cu. Ft. Per Hr. with Pressure Drop of 0.3" and Specific Gravity of 0.60

Table 7. Iron pipe size (SI) millimeters

Length of Pipe (Meters)	Iron Pipe Size (SI) Millimeters				
	15 mm Pipe	20 mm Pipe	25 mm Pipe	32 mm Pipe	40 mm Pipe
4.6	2.15	4.98	9.76	21.23	34.54
9.1	1.47	3.39	6.82	15.14	24.06
13.7	1.21	2.80	5.63	12.31	19.82
18.3	1.07	2.43	4.89	10.76	17.27
22.9	—	2.18	4.38	9.76	15.40

Note: Capacity of Pipe of Different Diameters and Lengths in Cu. Meter Per Hr. with Pressure Drop of 74.6 Pa and Specific Gravity of 0.60.

Figure 66. Schematic diagram for field gas piping to unit



Pre-Start

Use the checklist provided below in conjunction with the "General Unit Requirements" checklist to ensure that the unit is properly installed and ready for operation.

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN

Verify that the condenser airflow will be unobstructed.

⚠WARNING

Rotating Components!

Failure to follow all safety precautions below could result in rotating components cutting and slashing technician which could result in death or serious injury. During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks.

- Verify that the condenser fan and indoor blower turn freely without rubbing and are properly tightened on the shafts.
- Verify that a condensate trap is installed and the piping is properly sized and pitched.
- Verify that the correct size and number of filters are in place.
- Inspect the interior of the unit for tools and debris and install all panels in preparation for starting the unit.

Voltage Imbalance

Three phase electrical power to the unit must meet stringent requirements for the unit to operate properly.

Measure each leg (phase-to-phase) of the power supply. Each reading must fall within the utilization range stamped on the unit nameplate. If any of the readings do not fall within the proper tolerances, notify the power company to correct this situation before operating the unit.

Excessive three phase voltage imbalance between phases will cause motors to overheat and eventually fail. The maximum allowable voltage imbalance is 2%. Measure and record the voltage between phases 1, 2, and 3 and calculate the amount of imbalance as follows:

$$\% \text{ Voltage Imbalance} = \frac{100 \times AV - VD}{AV} \text{ where;}$$

$$AV \text{ (Average Voltage)} = \frac{\text{Volt 1} + \text{Volt 2} + \text{Volt 3}}{3}$$

V1, V2, V3 = Line Voltage Readings

VD = Line Voltage reading that deviates the farthest from the average voltage.

Example:

If the voltage readings of the supply power measured 221, 230, and 227, the average volts would be:

$$\frac{221 + 230 + 227}{3} = 226 \text{ Avg.}$$

VD (reading farthest from average) = 221

The percentage of imbalance equals:

$$\frac{100 \times 226 - 221}{226} = 2.2\%$$

The 2.2% imbalance in this example exceeds the maximum allowable imbalance of 2.0%. This much imbalance between phases can equal as much as a 20% current imbalance with a resulting increase in motor winding temperatures that will decrease motor life. If the voltage imbalance is over 2%, notify the proper agencies to correct the voltage problem before operating this equipment.

Electrical Phasing (Three Phase Motors)

The compressor motor(s) and the supply fan motor are internally connected for the proper rotation when the incoming power supply is phased as A, B, C.

Proper electrical supply phasing can be quickly determined and corrected before starting the unit by using an instrument such as an Associated Research Model 45 Phase Sequence Indicator and following the steps below:

- Turn the field supplied disconnect switch that provides power to the main power terminal block or to the "Line" side of the optional factory mounted disconnect switch to the "Off" position.
- Connect the phase sequence indicator leads to the terminal block or to the "Line" side of the optional factory mounted disconnect switch as follows;

  Black (phase A) to L1

  Red (phase B) to L2

  Yellow (phase C) to L3
- Close the field supplied main power disconnect switch or circuit protector switch that provides the supply power to the unit.

Note: *Upon closing main power disconnect and the unit mounted disconnect switch or circuit breaker, the phase monitor will verify proper phasing. If LED on*

face of the monitor is red, correct supply power fault.

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

To prevent injury or death from electrocution, it is the responsibility of the technician to recognize this hazard and use extreme care when performing service procedures with the electrical power energized.

- Observe the ABC and CBA phase indicator lights on the face of the sequencer. The ABC indicator light will glow if the phase is ABC. If the CBA indicator light glows, open the disconnect switch or circuit protection switch and reverse any two power wires.
- Restore the main electrical power and recheck the phasing. If the phasing is correct, open the disconnect switch or circuit protection switch and remove the phase sequence indicator.

Compressor Crankcase Heaters

Each compressor can be equipped with a crankcase heater. The proper operation of the crankcase heater is important to maintain an elevated compressor oil temperature during the "Off" cycle to reduce oil foaming during compressor starts. Oil foaming occurs when refrigerant condenses in the compressor and mixes with the oil. In lower ambient conditions, refrigerant migration to the compressor could increase.

When the compressor starts, the sudden reduction in crankcase pressure causes the liquid refrigerant to boil rapidly causing the oil to foam. This condition could damage compressor bearings due to reduced lubrication and could cause compressor mechanical failures.

Before starting the unit in the "Cooling" mode, set the system switch to the "Off" position and turn the main power disconnect to the "On" position and allow the crankcase heater to operate a minimum of 8 hours.

Before closing the main power disconnect switch, insure that the "System" selection switch is in the "Off" position and the "Fan" selection switch is in the "Auto" position.

Close the main power disconnect switch and the unit mounted disconnect switch, if applicable.

Note: *Upon closing main power disconnect and the unit mounted disconnect switch or circuit breaker, the phase monitor will verify proper phasing. If LED on face of the monitor is red, correct supply power fault.*

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

To prevent injury or death from electrocution, it is the responsibility of the technician to recognize this hazard and use extreme care when performing service procedures with the electrical power energized.

ReliaTel™ Controls

Upon power initialization, the RTRM performs self-diagnostic checks to insure that all internal controls are functional. It also checks the configuration parameters against the components connected to the system. The Liteport LED located on the RTRM module is turned "On" within one second of power-up if internal operation is okay.

Use one of the following "Test" procedure to bypass some time delays and to start the unit at the control panel. Each step of unit operation can be activated individually by temporarily shorting across the "Test" terminals for two to three seconds. The Liteport LED located on the RTRM module will blink when the test mode has been initiated. The unit can be left in any "Test" step for up to one hour before it will automatically terminate, or it can be terminated by opening the main power disconnect switch. Once the test mode has been terminated, the Liteport LED will glow continuously and the unit will revert to the "System" control.

Table 8. Service test guide for component operation

Test Step	Mode	Fan	Econ [a]	Comp 1	Comp 2	Heat 1	Heat 2	Modulating Heat	Resistance	Supply Fan Output[b]	
										Cool & Staged Heat	Modulating Heat
1	Fan	On	Minimum Position Setpoint 0%	Off	Off	Off	Off	0%	2.2KΩ	50%	
	Minimum Ventilation	On	Selectable	Off	Off	Off	Off	0%			
2	Economizer Test Open	On	Open	Off	Off	Off	Off	0%	3.3KΩ	50%[c]	
3	Cool Stage 1	On	Minimum Position	On[d]	Off	Off	Off	0%	4.7KΩ	82%	
4[e]	Cool Stage 2	On	Minimum Position	On[d]	On[d]	Off	Off	0%	6.8KΩ	100%	
5[e]	Cool Stage 3	On	Minimum Position	On [d]	On[d]	Off	Off	0%	8.2KΩ	100%	
6[e]	Reheat	On	Minimum	On	On	Off	Off	0%	33KΩ	100%[f]	—
7[e]	Heat Stage 1	On	Minimum	Off	Off	On/50%[g]	Off	50%	10KΩ	100%	50%[g]
8[e]	Heat Stage 2	On	Minimum	Off	Off	On/ 100%[g]	On	100%	15KΩ	100%	100%[g]

(a) The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.
(b) The supply fan output is in reference to the user selected maximum unit fan speed.
(c) Regardless of the economizer mode configuration, the unit will run the supply fan at the minimum speed during the economizer step of the service test.
(d) The condenser fans will operate any time a compressor is 'On' providing the outdoor air temperatures are within the operating values.
(e) Steps for optional accessories and non-applicable modes in unit will be skipped.
(f) Units with enhanced dehumidification only will not perform this step during service test.
(g) Supply fan output for modulating gas heat will be a percentage of the user selected maximum supply fan speed. Values shown represent SZVAV/MZVAV.

Test Modes

There are three methods in which the "Test" mode can be cycled at LTB-Test 1 and LTB-Test 2.

1. Step Test Mode - This method initiates the different components of the unit, one at a time, by temporarily shorting across the two test terminals for two to three seconds. For the initial startup of the unit, this method allows the technician to cycle a component "On" and have up to one hour to complete the check.
2. Resistance Test Mode - This method can be used for startup providing a decade box for variable resistance outputs is available. This method initiates the different components of the unit, one at a time, when a specific resistance value is placed across the two test terminals. The unit will remain in the specific test mode for approximately one hour even though the resistance is left on the test terminals.
3. Auto Test Mode - This method is not recommended for startup due to the short timing between individual component steps. This method initiates the different components of the unit, one at a time, when a jumper is installed across the test terminals. The unit will start the first test step and change to the next step every 30 seconds.

   At the end of the test mode, control of the unit will automatically revert to the applied "System" control method.

For unit test steps, test modes, and step resistance values to cycle the various components, refer to Table 8, p. 40.

ReliaTel™ Controls

Upon power initialization, the Gas Ignition Module (IGN) performs self-diagnostic checks to insure that all internal controls are functional. It also checks the configuration parameters against the components connected to the system. The System LED located on the IGN module is turned "On" within one second of power-up if internal operation is okay.

Unit Startup

Verifying Proper Air Flow

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

Sequence of Operation

General Standby Mode

During normal occupied periods, when there is no space cooling or heating demands, the user will be able to choose Constant or Cycling supply fan operation. During this period, if the supply fan is operating due to a Constant Fan Mode selection or due to a ventilation request, the supply fan will operate at 50% of the user selected, application specific, maximum airflow. The unit controls will be compatible with BACnet™ and LonTalk™ Building Automation System communication interfaces.

Cooling Operation

Default Operation: During Cooling operation, the control will monitor the Space Temperature and Space Cooling setpoint and with a PI control algorithm determine if active cooling capacity is required. As the Space Temperature deviates from the Space Cooling Setpoint, the unit controller will calculate an active Discharge Air Cooling setpoint that the economizer (if installed) and compressor and outdoor fan outputs will be modulated to meet. This active Discharge Air Cooling setpoint will be calculated between the Space Cooling setpoint and a user adjustable minimum (65°F default for Single Zone Variable Air Volume SZVAV). Once the control determines that a discharge air temperature equal to the user selected minimum (65°F default) is required to meet the space cooling demand, if the space demand continues to increase, the supply fan speed will be allowed to increase above its minimum speed proportionally to meet the additional demand.

Alternate Economizer Operation: Under the Default Operation, as described above, the supply fan speed will remain at minimum speed, as determined by the active cooling stages, until the space demand requires an increase in supply airflow. The customer will have the ability to choose to allow the supply fan speed to increase when the economizer is enthalpy enabled in order to realize the maximum cooling capacity of the economizer, prior to energizing compressor outputs, when the space requires active cooling capacity. All cooling capacity demand decisions will function as described in the "Default Operation" section above with the exception of the supply fan speed when the unit has an active cooling demand and the economizer is enthalpy enabled.

Heating Operation

During staged heating operation, the control will monitor the space temperature and space heating setpoint and with a PI control algorithm determine if active heating capacity is required. As the space temperature deviates from the space heating setpoint, the unit controller will increase the supply airflow up to the user selected, application specific, maximum airflow and begin to stage heating outputs (gas or electric) to meet the space demand. The customer will also have the ability to enable supply air tempering control which will allow the unit to bring on one stage of heating when the discharge air temperature falls below the space heating setpoint - 10°F and the unit is operating in a minimum ventilation state with the supply fan running (not actively heating or cooling). The supply fan output will increase to the user selected, application specific, maximum airflow during supply air tempering operation.

During modulating gas heating operation, the control will monitor the space temperature and space heating setpoint and with a PI control algorithm determine if active heating is required. On a single-zone VAV unit, as the active discharge air temperature setpoint deviates from the active supply air heating setpoint, the unit controller will modulate airflow between the user selected maximum and minimum fan speed to maintain the active discharge air temperature setpoint. On a multi-zone VAV unit, the control will modulate the airflow between the user selected maximum and minimum fan speed to maintain the duct static pressure.

Enhanced Dehumidification

Enhanced Dehumidification will be available on all units equipped with a Space Humidity sensor. Once the Space Humidity value exceeds the Dehumidification Setpoint and dehumidification is enabled the unit will maintain the compressor operation and reduce the indoor fan airflow to increase latent capacity. If the Space Humidity value exceeds the Dehumidification Setpoint during no active call for cooling, the unit will energize the compressor and fans to an optimum capacity for dehumidification. If during active enhanced dehumidification the Space Humidity falls below the Dehumidification Setpoint – 2%, Dehumidification will be terminated and the unit will transition back to normal Cooling or Heating control.

Supply Air Temperature Control with an Economizer

The economizer is utilized to control the supply air cooling at +1.5°F around the supply air temperature setpoint range of 40°F and 90°F providing the outside air conditions are suitable. To reduce the risk of evaporator coil freeze-up supply air temperature should not be set below 50° F.

While economizing, the mechanical cooling is disabled until the economizer dampers have been fully open for three minutes. If the economizer is disabled due to unsuitable conditions, the mechanical cooling will cycle as though the unit had no economizer.

Note: *The RTRM is designed to maintain a selectable supply air temperature of 40°F to 90°F with a +/- 3.5°F deadband. However, to reduce the risk of evaporator coil freeze-up in Precedent and Voyager Light Commercial applications, supply air temperature should not be set below 50°F.*

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Cooling

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and RTRM J6-12, both the economizer and the mechanical cooling will be disabled.

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Heating

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and J6-12 and DWU is enabled, the zone temperature will be controlled at 10°F below the Morning Warm-up setpoint, but not less than 50°F, by cycling one or two stages of either gas or electric heat, whichever is applicable.

Morning Warm-up (MWU) Control

Note: *Heating control only used on Multi-Zone VAV applications.*

Morning warm-up is activated if the zone temperature is at least 1.5°F below the MWU setpoint whenever the system switches from unoccupied to occupied status. The MWU setpoint may be set from the unit mounted potentiometer or a remotely mounted potentiometer. The setpoint ranges are from 50°F to 90°F. When the zone temperature meets or exceeds the MWU setpoint, the unit will switch to the "Cooling" mode. The economizer will be held closed during the morning warm-up cycle.

Daytime Warm-up (DWU) Control

Note: *Heating control only used on Multi-Zone VAV applications.*

Daytime warm-up is applicable during occupied status and when the zone temperature is below the initiation temperature. It can be activated or deactivated through ICS or a night setback zone sensor. If ICS or a night setback zone sensor is not utilized, DWU can be activated by setting the DWU enable DIP switch (RTAM) to ON and supplying a valid morning warm-up setpoint.

The unit is shipped with a morning warm-up setpoint configured and the daytime warm-up function is activated (switch on). Opening the DWU enable switch will disable this function.

If the system control is local, the DWU initiation setpoint is 3°F below the morning warm-up setpoint. The termination setpoint is equal to the morning warm-up setpoint.

If the system control is remote (Tracer™), the DWU setpoint is equal to the Tracer™ occupied heating setpoint. The initiation and termination setpoints are selectable setpoints designated by Tracer™ .

When the zone temperature meets or exceeds the termination setpoint while the unit is in an occupied, "Auto" mode or switched to the "Cooling" mode, the unit will revert to the cooling operation.

If an occupied "Heating" mode is selected, the unit will only function within the DWU perimeters until the system

is switched from the "Heat" mode or enters an unoccupied status.

Return Air Smoke Detector

The return air smoke detector is designed to shut off the unit if smoke is sensed in the return air stream. Sampling the airflow entering the unit at the return air opening performs this function.

In order for the smoke detector to properly sense smoke in the return air stream, the air velocity entering the unit must be in accordance with manufacturers recommended airflow limits.

Economizer Startup

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

Minimum Position Setting

⚠WARNING

Rotating Components!

Failure to follow all safety precautions below could result in rotating components cutting and slashing technician which could result in death or serious injury. During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks.

ReliaTel™ Control:

Momentarily jump across the Test 1 & Test 2 terminals on LTB1 one additional time if continuing from

previous component startup or until the desired startup component test is started.

1. Verify that the dampers stroked to the full open position.
2. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or proceed to the next component startup procedure. Remove electromechanical test mode connections (if applicable).

Compressor Startup

1. Attach a set of service gauges onto the suction and discharge gauge ports for each circuit. Refer to the refrigerant circuit illustration in the Service Facts.

   ReliaTel™ Control:

   Momentarily jump across the Test 1 & Test 2 terminals on LTB1 one additional time if continuing from previous component startup or until the desired startup component test is started.

   Scroll Compressors

   a. Once each compressor has started, verify that the rotation is correct. If a scroll compressor is rotating backwards, it will not pump and a loud rattling sound can be observed.

   b. If the electrical phasing is correct, before condemning a compressor, interchange any two leads (at the compressor Terminal block) to check the internal phasing. If the compressor runs backward for an extended period (15 to 30 minutes), the motor winding can overheat and cause the motor winding thermostat to open.
2. After the compressor and condenser fan have started and operated for approximately 30 minutes, observe the operating pressures. Compare the operating pressures to the operating pressure curve in the Service Facts.
3. Check system superheat. Follow the instruction listed on the superheat charging curve in the Service Facts.

   Superheat should be within ±5 F of the superheat chart value.
4. Repeat steps 1 through 4 for each refrigerant circuit.
5. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or proceed to the next component startup procedure. Remove electromechanical test mode connections (if applicable).

Gas Heat Units

Open the main disconnect switch to shut the unit off and to reset the RTRM.

ReliaTel™ Control:

Follow the Test Guide in Table 8, p. 40 to start the unit in the heating mode. Momentarily jump across the Test 1 & Test 2 terminals on LTB1 one additional time if continuing from previous component startup or until the desired startup component Test is started.

When starting the unit for the first time or servicing the heaters, it is a good practice to start the heater with the main gas supply turned "Off".

Once the ignition system and components have been checked, open the main power disconnect switch to reset the unit.

Dip Switch Settings

Verify that the dip switch settings match the unit model as indicted in Figure 67 through Figure 69.

Figure 67. 3T ultra high efficiency unit

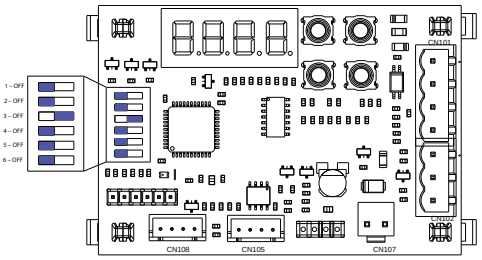


Figure 68. 4T ultra high efficiency unit

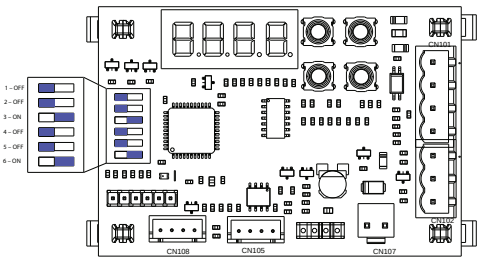
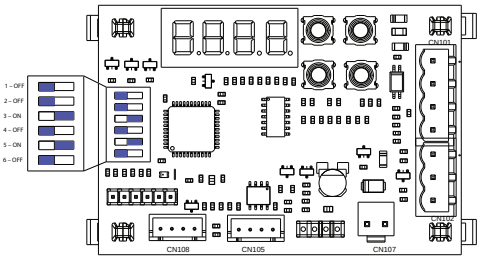


Figure 69. 5T ultra high efficiency unit[a]



(a) For YZC060E3 dip switch settings, reference RT-SVD007*-EN.

Final System Setup

After completing all of the pre-start and startup procedures outlined in the previous sections (i.e., operating the unit in each of its Modes through all available stages of cooling & heating), perform these final checks before leaving the unit:

- Program the Night Setback (NSB) panel (if applicable) for proper unoccupied operation. Refer to the programming instructions for the specific panel.

Unit Startup

- Verify that the Remote panel “System” selection switch, “Fan” selection switch, and “Zone Temperature” settings for automatic operation are correct.
- Inspect the unit for misplaced tools, hardware, and debris.
- Verify that all exterior panels including the control panel doors and condenser grilles are secured in place.
- Close the main disconnect switch or circuit protector switch that provides the supply power to the unit’s terminal block or the unit mounted disconnect switch.

Maintenance

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.
Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

⚠WARNING

Rotating Components!

During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.

Monthly Maintenance

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

Before completing the following checks, turn the unit OFF and lock the main power disconnect switch open.

Filters

Inspect the return air filters. Clean or replace them if necessary. If included, leave filter removal tool in unit. Refer to the unit Service Facts for filter information.

Return Air Smoke Detector Maintenance

Note: *Consult smoke detector manufacturer if daisy chaining is required.*

Airflow through the unit is affected by the amount of dirt and debris accumulated on the indoor coil and filters. To insure that airflow through the unit is adequate for proper sampling by the return air smoke detector, complete adherence to the maintenance procedures, including recommended intervals between filter changes, and coil cleaning is required.

Periodic checks and maintenance procedures must be performed on the smoke detector to insure that it will function properly. For detailed instructions concerning these checks and procedures, refer to the appropriate section(s) of the smoke detector Installation and Maintenance Instructions provided with the literature package for this unit.

Condensate Overflow Switch

During maintenance, the switch float (black ring) must be checked to ensure free movement up and down.

Cooling Season

- Check the unit's drain pans and condensate piping to ensure that there are no blockages.
- Inspect the evaporator and condenser coils for dirt, bent fins, etc. If the coils appear dirty, clean them according to the instructions described in "Coil Cleaning" later in this section.
- Manually rotate the condenser fan(s) to ensure free movement and check motor bearings for wear. Verify that all of the fan mounting hardware is tight.
- Inspect the F/A-R/A damper hinges and pins to ensure that all moving parts are securely mounted. Keep the blades clean as necessary.
- Verify that all damper linkages move freely; lubricate with white grease, if necessary.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Check the fan shaft bearings for wear. Replace the bearings as necessary.
- Check the supply fan belt. If the belt is frayed or worn, replace it. Refer to the "Fan Belt Adjustment" section for belt replacement and adjustments.
- Verify that all wire terminal connections are tight.
- Remove any corrosion present on the exterior surfaces of the unit and repaint these areas.
- Generally inspect the unit for unusual conditions (e.g., loose access panels, leaking piping connections, etc.)
- Make sure that all retaining screws are reinstalled in the unit access panels once these checks are complete.
- With the unit running, check and record the: ambient temperature; compressor suction and discharge pressures (each circuit); superheat (each circuit);

- Record this data on an "operator's maintenance log" like the one shown in Table 9, p. 47. If the operating pressures indicate a refrigerant shortage, measure the system superheat. For guidelines, refer to the "Compressor Startup" section.

Important: *Do not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state and local laws.*

Heating Season

- Inspect the unit's air filters. If necessary, clean or replace them.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Inspect both the main unit control panel and heat section control box for loose electrical components and terminal connections, as well as damaged wire insulation. Make any necessary repairs.
- Clean burner area, verify gas heat system operates properly.

Coil Cleaning

Regular coil maintenance, including annual cleaning, enhances the unit's operating efficiency by minimizing: compressor head pressure and amperage draw, evaporator water carryover, fan brake horsepower due to increase static pressure losses, airflow reduction.

At least once each year, or more often if the unit is located in a "dirty" environment, clean the evaporator and condenser coils using the instructions outlined below. Be sure to follow these instructions as closely as possible to avoid damaging the coils.

Note: *For units equipped with hail guards follow removal procedure listed below.*

Hail Guard Removal

- Unlatch hail guard.
- Pull the top of the hail guard outward until the fastener studs are free of the retaining nuts.
- Lift the hail guard from the lower retaining bracket and set aside.

Microchannel (MCHE) Coils

NOTICE:

Coil Damage!

Failure to follow instructions below could result in coil damage.
DO NOT use any detergents with microchannel condenser coils. Use pressurized water or air ONLY, with pressure no greater than 600psi.

For additional information regarding the proper microchannel coil cleaning procedure, refer to service bulletin RT-SVB83-EN.*

Due to the soft material and thin walls of the MCHE coils, the traditional field maintenance method recommended for Round Tube Plate Fin (RTPF) coils does not apply to microchannel coils.

Moreover, chemical cleaners are a risk factor to MCHE due to the material of the coil. The manufacturer does not recommend the use of chemical cleaners to clean microchannel coils. Using chemical cleaners could lead to warranty claims being further evaluated for validity and failure analysis.

The recommended cleaning method for microchannel condenser coils is pressurized water or air with a non-pinpoint nozzle and an ECU of at least 180 with pressure no greater than 600 psi. To minimize the risk of coil damage, approach the cleaning of the coil with the pressure washer aimed perpendicular to the face of the coil during cleaning.

Note: *For more details on Microchannel coil cleaning, please refer to bulletin RT-SVB83*-EN.*

Round Tube Plate Fin (RTPF) Coils

To clean refrigerant coils, use a soft brush and a sprayer (either a garden pump-up type or a high-pressure sprayer). A high-quality detergent is also required; suggested brands include "SPREX A.C.", "OAKITE 161", "OAKITE 166" and "COILOX". If the detergent selected is strongly alkaline (ph value exceeds 8.5), add an inhibitor.

⚠WARNING

Hazardous Chemicals!

Failure to follow all safety instructions below could result in death or serious injury. Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin occurs. Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices.

1. Remove enough panels from the unit to gain access to the coil.

2. Protect all electrical devices such as motors and controllers from any over spray.
3. Straighten any bent coil fins with a fin comb.

⚠WARNING

Hazardous Pressures!

Failure to follow safety precautions below could result in coil bursting, which could result in death or serious injury. Coils contain refrigerant under pressure. When cleaning coils, maintain coil cleaning solution temperature under 150°F to avoid excessive pressure in the coil.

4. Mix the detergent with water according to the manufacturer's instructions. If desired, heat the solution BUT DO NOT EXCEED 150°F maximum to improve its cleansing capability.
5. Pour the cleaning solution into the sprayer. If a high-pressure sprayer is used:
   a. do not allow sprayer pressure to exceed 600 psi.
   b. the minimum nozzle spray angle is 15 degrees.
   c. maintain a minimum clearance of 6" between the sprayer nozzle and the coil.
   d. spray the solution perpendicular (at 90 degrees) to the coil face.
6. Spray the leaving-airflow side of the coil first; then spray the opposite side of the coil. Allow the cleaning solution to stand on the coil for five minutes.
7. Rinse both sides of the coil with cool, clean water.
8. Inspect both sides of the coil; if it still appears to be dirty, repeat Step 6 and Step 7.
9. Reinstall all of the components and panels removed in Step 1 and any protective covers installed in Step 2.

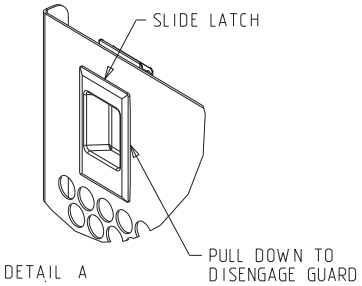
Note: *For units equipped with hail guards follow reinstallation procedure listed below.*

Hail Guard Reinstallation

10. To reinstall the hail guard, locate the bottom of the hail guard in the lower bracket and secure it to the upper unit bracket with the attached fasteners.

Note: *Secure hail guard latches.*

Figure 70. Hail guard



11. Restore the unit to its operational status and check system operation.

Annual Maintenance

- Clean and repaint any corroded surface.

Final Process

For future reference, you may find it helpful to record the unit data requested in the blanks provided.

Complete Model Number: _____

Unit Serial Number: _____

Wiring Diagram Numbers (from unit control panel): _____

Connections: _____

Schematics: _____

Table 9. Sample maintenance log

	Refrigerant Circuit #1						
Date	**Current Ambient Temp. F/C**	**Compr. Oil Level**	**Suct. Press. Psig/ kPa**	**Disch. Press. Psig/ kPa**	**Liquid Press. Psig/ kPa**	**Super -heat F/C**	**Sub-cool. F/C**
		- ok - low					
		- ok - low					
		- ok - low					
		- ok\ - low					
		- ok - low					

Note: *Check and record the data requested above each month during the cooling season with the unit running.*

Troubleshooting

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.
Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

ReliaTel™ Control

The RTRM has the ability to provide the service personnel with some unit diagnostics and system status information.

Before turning the main power disconnect switch "Off", follow the steps below to check the ReliaTel Refrigeration Module (RTRM). All diagnostics & system status information stored in the RTRM will be lost when the main power is turned "Off".

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

To prevent injury or death from electrocution, it is the responsibility of the technician to recognize this hazard and use extreme care when performing service procedures with the electrical power energized.

1. Verify LED on face of the phase monitor is green. If LED is red, correct supply power fault.
2. Verify that the Liteport LED on the RTRM is burning continuously. If the LED is lit, go to Step 3.
3. If the LED is not lit, verify that 24 VAC is presence between J1-1 and J1-2. If 24 VAC is present, proceed to Step 4. If 24 VAC is not present, check the unit main power supply, check transformer (TNS1). Proceed to Step 4 if necessary.
4. Utilizing "Method 1" or "Method 2" in the "System Status Diagnostic" section, check the following:
   - System status
   - Heating status
   - Cooling status

   If a system failure is indicated, proceed to Step 5. If no failures are indicated, proceed to Step 6.
5. If a system failure is indicated, recheck Step 2 and Step 3. If the LED is not lit in Step 2, and 24 VAC is present in Step 3, the RTRM has failed. Replace the RTRM.
6. If no failures are indicated, use one of the TEST mode procedures described in the "Unit Startup" section to start the unit. This procedure will allow you to check all of the RTRM outputs, and all of the external controls (relays, contactors, etc.) that the RTRM outputs energize, for each respective mode. Proceed to Step 7.
7. Step the system through all of the available modes, and verify operation of all outputs, controls, and modes. If a problem in operation is noted in any mode, you may leave the system in that mode for up to one hour while troubleshooting. Refer to the sequence of operations for each mode, to assist in verifying proper operation. Make the necessary repairs and proceed to Step 8 and Step 9.
8. If no abnormal operating conditions appear in the test mode, exit the test mode by turning the power "Off" at the main power disconnect switch.
9. Refer to the individual component test procedures if other microelectronic components are suspect.

System Status Checkout Procedure

"System Status" is checked by using one of the following two methods:

Method 1

If the Zone Sensor Module (ZSM) is equipped with a remote panel with LED status indication, you can check the unit within the space. If the ZSM does not have LED's, use Method 2. BAYSENS110*, BAYSENS109*, BAYSENS119*, BAYSENS023A all have the remote panel indication feature. The LED descriptions are listed below.

Zone Sensor LED 1 (System)

"On" during normal operation.

"Off" if a system failure occurs or the LED fails.

"Flashing" indicates test mode.

Zone Sensor LED 2 (Heat)

"On" when the heat cycle is operating.

"Off" when the heat cycle terminates or the LED fails.

"Flashing" indicates a heating failure.

Zone Sensor LED 3 (Cool)

"On" when the cooling cycle is operating.

"Off" when the cooling cycle terminates or the LED fails.

"Flashing" indicates a cooling failure.

Zone Sensor LED 4 (Service)

"On" indicates a clogged filter.

"Off" during normal operation.

"Flashing" indicates an evaporator fan or condensate overflow switch failure.

Below is the complete listing of failure indication causes.

System failure

Check the voltage between terminals 6 and 9 on J6, it should read approximately 32 VDC. If no voltage is present, a system failure has occurred. Refer to Step 4 in the previous section for the recommended troubleshooting procedure.

Heating Failure

Verify Heat Failure by Ignition Module (IGN) LED indicator:

OFF: No Power or Failure

ON: Normal

Slow Flash: Normal, Heat Call

Fast Flash: Error Code:

1 Flash: Communication Failure

2 Flashes: System Lockout

3 Flashes: Pressure Switch Fail

4 Flashes: TC01 or TC02 Open

5 Flashes: Flame w/o Gas Valve

6 Flashes: Flame Rollout Open

Cooling Failure

- Cooling and heating set point (slide pot) on the zone sensor has failed. Refer to the "Zone Sensor Test Procedure" section.
- Zone temperature thermistor ZTEMP on ZTS failed. Refer to the "Zone Sensor Test Procedure" section.
- CC1 or CC2 24 VAC control circuit has opened, check CC1 & CC2 coils, and any of the controls below that apply to the unit (HPC1, HPC2).
- LPC1 has opened during the 3 minute minimum "on time" during 4 consecutive compressor starts, check LPC1 or LPC2 by testing voltage between the J1-1 & J3-2 terminals on the RTRM and ground. If 24 VAC is present, the LPC's has not tripped. If no voltage is present, LPC's has tripped.

Service Failure

- If the supply fan proving switch has closed, the unit will not operate (when connected to RTOM), check the fan motor, belts, and proving switch.
- Clogged filter switch has closed, check the filters.
- If the condensate overflow switch is closed, the unit will not operate. Make sure the float switch is not in a tripped condition, and check for an "open" between wires connecting to RTOM J6-1, J6-2 (ReliaTel™ controls).

Simultaneous Heat and Cool Failure

- Emergency Stop is activated

Method 2

The second method for determining system status is done by checking voltage readings at the RTRM (J6). The system indication descriptions and the approximate voltages are listed below.

System Failure

- Measure the voltage between terminals J6-9 & J6-6.
- Normal Operation = approximately 32 VDC
- System Failure = less than 1 VDC, approximately 0.75 VDC
- Test Mode = voltage alternates between 32 VDC & 0.75 VDC

Heat Failure

- Measure the voltage between terminals J6-7 & J6-6.
- Heat Operating = approximately 32 VDC
- Heat Off = less than 1 VDC, approximately 0.75 VDC
- Heating Failure = voltage alternates between 32 VDC & 0.75 VDC

Cool Failure

- Measure the voltage between terminals J6-8 & J6-6.
- Cool Operating = approximately 32 VDC
- Cool Off = less than 1 VDC, approximately 0.75 VDC
- Cooling Failure = voltage alternates between 32 VDC & 0.75 VDC

Service Failure

- Measure the voltage between terminals J6-10 & J6-6.
- Clogged Filter = Approximately 32 VDC.
- Normal = Less than 1 VDC, approximately 0.75 VDC Fan Failure = voltage alternates between 32 VDC & 0.75 VDC.

To use LED's for quick status information at the unit, purchase a BAYSENS110* ZSM and connect wires with alligator clamps to terminals 6 through 10. Connected each respective terminal wire (6 through 10) from the Zone Sensor to the unit J6 terminals 6 through 10.

Note: *If the system is equipped with a programmable zone sensor, BAYSENS119* the LED indicators will not function while the BAYSENS110* is connected.*

Resetting Cooling and Ignition Lockouts

Cooling Failures and Ignition Lockouts are reset in an identical manner. Method 1 explains resetting the system from the space; Method 2 explains resetting the system at the unit.

Note: *Before resetting Cooling Failures and Ignition Lockouts check the Failure Status Diagnostics by the methods previously explained. Diagnostics will be lost when the power to the unit is disconnected.*

Method 1

To reset the system from the space, turn the "Mode" selection switch at the zone sensor to the "Off" position. After approximately 30 seconds, turn the "Mode" selection switch to the desired mode, i.e. Heat, Cool or Auto.

Method 2

To reset the system at the unit, cycle the unit power by turning the disconnect switch "Off" and then "On".

Lockouts can be cleared through the building management system. Refer to the building management system instructions for more information.

Zone Temperature Sensor (ZTS) Service Indicator

The ZSM SERVICE LED is a generic indicator, that will signal the closing of a Normally Open switch at any time, providing the Indoor Motor (IDM) is operating. This indicator is usually used to indicate a clogged filter, or an air side fan failure.

The RTRM will ignore the closing of this Normally Open switch for 2 (±1) minutes. This helps prevent nuisance SERVICE LED indications. The exception is the LED will flash 40 seconds after the fan is turned "On" if the Fan Proving Switch is not made.

Clogged Filter Switch

This LED will remain lit the entire time that the Normally Open switch is closed. The LED will be turned off immediately after resetting the switch (to the Normally Open position), or any time that the IDM is turned "Off".

If the switch remains closed, and the IDM is turned "On", the SERVICE LED will be turned "On" again after the 2 (±1) minute ignore delay.

This LED being turned "On", will have no other affect on unit operation. It is an indicator only.

Fan Failure Switch

When the "Fan Failure" switch is wired to the RTOM, the LED will remain flashing the entire time the fan proving switch is closed, indicating a fan failure, and it will shut the unit operations down.

Condensate Overflow Switch

When the "Condensate Overflow Switch" is closed, a drain pan overflow condition is indicated and it will shut unit operations down.

Zone Temperature Sensor (ZTS) Tests

Note: *These procedures are not for programmable or digital models and are conducted with the Zone Sensor Module electrically removed from the system.*

Test 1 - Zone Temperature Thermistor (ZTEMP)

This component is tested by measuring the resistance between terminals 1 and 2 on the Zone Temperature Sensor. Below are some typical indoor temperatures, and corresponding resistive values.

Test 2 - Cooling Set Point (CSP) and Heating Set Point (HSP)

Table 10. Cooling setpoint and heating setpoint

Zone Temperature		Nominal ZTEMP Resistance
50°F	10.0°C	19.9 K-Ohms
55°F	12.8°C	17.47 K-Ohms
60°F	15.6°C	15.3 K-Ohms
65°F	18.3°C	13.49 K-Ohms
70°F	21.1°C	11.9 K-Ohms
75°F	23.9°C	10.50 K-Ohms
80°F	26.7°C	9.3 K-Ohms
85°F	29.4°C	8.25 K-Ohms
90°F	32.2°C	7.3 K-Ohms

The resistance of these potentiometers are measured between the following ZSM terminals. Refer to the chart above for approximate resistances at the given setpoints.

Cool SP = Terminals 2 and 3

Range = 100 to 900 Ohms approximate

Heat SP = Terminals 2 and 5

Range = 100 to 900 Ohms approximate

Test 3 - System Mode and Fan Selection

The combined resistance of the Mode selection switch and the Fan selection switch can be measured between terminals 2 and 4 on the Zone Sensor. The possible switch combinations are listed below with their corresponding resistance values.

Test 4 - LED Indicator Test, (SYS ON, HEAT, COOL & SERVICE)

Method 1

Testing the LED using a meter with diode test function. Test both forward and reverse bias. Forward bias should measure a voltage drop of 1.5 to 2.5 volts, depending on your meter. Reverse bias will show an Over Load, or open circuit indication if LED is functional.

Method 2

Testing the LED with an analog Ohmmeter. Connect Ohmmeter across LED in one direction, then reverse the leads for the opposite direction. The LED should have at least 100 times more resistance in reverse direction, as compared with the forward direction. If high resistance in both directions, LED is open. If low in both directions, LED is shorted.

Method 3

To test LED's with ZSM connected to unit, test voltages at LED terminals on ZSM. A measurement of 32 VDC, across an unlit LED, means the LED has failed.

Relative Humidity Sensor Test

This component is measured by measuring the mA output signal on the Relative Humidity Sensor. Verify accuracy of the sensor annually. If the output reading is 0 mA, first verify that power is applied to the sensor. A reading of 4 mA corresponds to 0% RH and 20 mA corresponds to 100% RH.

% RH	mA
30	8.8
40	10.4
50	12.0
60	13.6
70	15.2
80	16.8

Note: *Measurements should be made from LED common (ZSM terminal 6 to respective LED terminal). Refer to the Zone Sensor Module (ZSM) Terminal Identification table at the beginning of this section.*

Programmable & Digital Zone Sensor Test

Testing serial communication voltage

1. Verify 24 VAC is present between terminals J6-14 & J6-11.
2. Disconnect wires from J6-11 and J6-12. Measure the voltage between J6-11 and J6-12, should be about 32 VDC.
3. Reconnect wires to terminals J6-11 and J6-12. Measure voltage again between J6-11 and J6-12, voltage should flash high and low every 0.5 seconds. The voltage on the low end will measure about 19 VDC, while the voltage on the high end will measure from approximately 24 to 38 VDC.
4. Verify all modes of operation, by running the unit through all of the steps in the "Test Modes" section discussed in "Unit Startup".
5. After verifying proper unit operation, exit the test mode. Turn the fan on continuously at the ZSM, by pressing the button with the fan symbol. If the fan comes on and runs continuously, the ZSM is good. If you are not able to turn the fan on, the ZSM is defective.

ReliaTel™ Refrigeration Module (RTRM) Default Chart

If the RTCI loses input from the building management system, the RTRM will control in the default mode after approximately 15 minutes. If the RTRM loses the Heating and Cooling setpoint input, the RTRM will control in the default mode instantaneously. The temperature sensing thermistor in the Zone Sensor Module is the only component required for the "Default Mode" to operate.

Unit Operation without a Zone Sensor

This procedure is for temporary operation only. The economizer and condenser fan cycling functions are disabled.

⚠WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

1. Open and Lock the unit disconnect switch.
2. Remove the Outside Air Sensor (OAS) from the condenser section of unit.
3. Use two (2) wire nuts, to individually cap the wires.
4. Locate the RTRM (J6). Connect two (2) wires to terminals J6-1 and 2.
5. Connect the sensor (OAS) using two wire nuts to the two (2) field supplied wires that were connected to terminals 1 and 2 on J6.

Table 11. Fault detection and diagnostic codes

	Primary Fault Codes								Information Code		
Failures	**Mixed Air Temp Sensor Fail**	**Outdoor Temp Sensor Fail**	**Economizer Actuator Fault**	**RTEM Comm Fail**	**Pressure Dead band Fail (If Used)**	**Temp Sensor Fail (If Used)**	**Airflow Sensor Fail (If Used)**	**Space Press Dead band Fail (If Used)**	**Unit Fails to Economize**	**Unit Economizing When It Should Not**	**Damper Position % Indicated**
Damper stuck at Minimum			X		X(a)		X(a)*	X(a)	X		X
Damper Stuck Open			X		X(a)		X(a)	X(a)		X	X
Mixed Sensor Failure	X										X
Supply Air Sensor Failure						X					X
Outdoor Air Temperature Fail		X									X
Power loss to RTEM				X							
Failed or Power Loss to Actuator			X								X
Mechanical Failure of Actuator							X				

(a) If goes out of range.

Table 12. Low leak economizer sensor values

Sensor Values Data					
Temp °F	**Resistance (K ohms)**	**Temp °F**	**Resistance (K ohms)**	**Temp °F**	**Resistance (K ohms)**
40	26.097	54	17.847	68	12.435
41	25.383	55	17.382	69	12.126
42	24.690	56	16.930	70	11.827
43	24.018	57	16.491	71	11.535
44	23.367	58	16.066	72	11.252
45	22.736	59	15.654	73	10.977
46	22.132	60	15.253	74	10.709
47	21.530	61	14.864	75	10.448
48	20.953	62	14.486	76	10.194
49	20.396	63	14.119	77	9.949
50	19.854	64	13.762	78	9.710
51	19.330	65	13.416	79	9.477
52	18.821	66	13.078	80	9.250
53	18.327	67	12.752	81	9.030

Unit Economizer Control (ECA) Troubleshooting

ReliaTel™ Control

Verify Economizer Status by Economizer Actuator (ECA) LED indicator:

- OFF: No power or failure
- ON: Normal, OK to economize
- Slow Flash: Normal, not OK to economize
- Fast Flash - 1/2 second on / 2 seconds off:
  - Error Code: Communications failure
- Pulse Flash:2 seconds on / 1/2 second off:
  - Error Code:
    - 1 Flash: Actuator Fault
    - 2 Flashes: CO_2 Sensor
    - 3 Flashes: RA Humidity Sensor

- 4 Flashes: RA Temp Sensor
- 5 Flashes: OA Quality Sensor
- 6 Flashes: OA Humidity Sensor
- 7 Flashes: OA Temp Sensor
- 8 Flashes: MA Temp Sensor
- 9 Flashes: RAM Fault
- 10 Flashes: ROM Fault
- 11 Flashes: EEPROM Fault

Heating Failure

Verify Heat Failure by Ignition Module (IGN) LED indicator:

- OFF: No Power or Failure
- ON: Normal
- Slow Flash: Normal, Heat Call
- Fast Flash: Error Code:

  1 Flash: No Communication

  2 Flashes: System Lockout

  3 Flashes: Pressure Switch Fail

  4 Flashes: TC01 or TC02 Open

  5 Flashes: Flame w/o Gas Valve

  6 Flashes: Flame Rollout Open

Cooling Failure

- Cooling and heating set point (slide pot) on the thermostat has failed.
- CC1 or CC2 24 VAC control circuit has opened, check CC1 & CC2 coils, and any of the controls below that apply to the unit (HPC1, HPC2, LPC1, LPC2, Frostat™).

Resetting Cooling and Ignition Lockouts

Cooling failures and ignition lockouts are reset in an identical manner. Method 1 explains resetting the system from the space; Method 2 explains resetting the system at the unit.

Method 1

To reset the system from the space, turn the “Mode” selection switch at the thermostat to the “Off” position. After approximately 30 seconds, turn the “Mode” selection switch to the desired mode, i.e. Heat, Cool or Auto.

Method 2

To reset the system at the unit, cycle the unit power by turning the disconnect switch “Off” and then “On”.

Compressor Inverter Drive

Refer to RT-SVD05*-EN (for VF-S15 inverters, refer to RT-SVD007*-EN) for compressor inverter drive troubleshooting information.

Unit Wiring Diagrams Numbers

Note: *Wiring diagrams can be accessed using e-Library by entering the diagram number in the literature order number search field or by contacting technical support.*

Table 13. Unit wiring diagram numbers

Schematic Type			Drawing Number	Description
Control	**ReliaTel™**	230,460,575V	1213-1929	Diagram Controls; YZC(072,090,102,120)F(3,4,W)
		230, 460V	4366-8324	Diagram Controls; YZC(036E, 048F, 060E4)
		230, 460V	1213-1655	Diagram Control; YZC060E3
Power	**ReliaTel™**	230V	1213-1924	Diagram Power; YZC(072,090,102,120)F3
		460V	1213-1925	Diagram Power; YZC(072,090,102,120)F4
		575V	1213-1927	Diagram Power; YZC(072,090,102,120)FW
		460V	4366-8316	Diagram Power; YZC(036E, 048F, 060E)4
		230V	4366-8318	Diagram Power; YZC(036E, 048F)3
		230V	1213-1654	Diagram Power; YZC060E3
Connection	**ReliaTel™**	230V	1213-2072	Diagram Connection; YZC(072,090,102,120)F3
		460, 575V	1213-2074	Diagram Connection; YZC(072,090,102,120)F4,W
		230V	4366-8508	Diagram Connection; YZC036E3
		460V	4366-8509	Diagram Connection; YZC036E4
		230V	4366-8510	Diagram Connection; YZC048F3
		230V	4366-8968	Diagram Connection; YZC048F3
		460V	4366-8511	Diagram Connection; YZC(048F4,060E4)

Limited Warranty

Combination Gas Electric Air Conditioner

YZC (Parts Only)

Models Less Than 20 Tons for Commercial Use*

This warranty is extended by Trane to the original purchaser and to any succeeding owner of the real property to which the Combination Gas Electric Air Conditioner is originally affixed, and applies to products purchased and retained for use within the U.S.A. and Canada. There is no warranty against corrosion, erosion or deterioration.

If any part of your Combination Gas Electric Air Conditioner fails because of a manufacturing defect within one year from the date of the original purchase, Warrantor will furnish without charge the required replacement part.

In addition, if the sealed motor-compressor fails because of a manufacturing defect within the second through fifth year from the date of original purchase, Warrantor will furnish without charge the required replacement compressor.

In addition, if the standard aluminized steel heat exchanger fails because of a manufacturing defect within five years from the date of startup, Warrantor will furnish without charge a replacement heat exchanger. Any local transportation, related service labor and diagnosis calls are not included.

In addition, if the optional, factory installed, stainless steel heat exchanger fails because of a manufacturing defect within ten years from the date of startup, Warrantor will furnish without charge a replacement heat exchanger. Any local transportation, related service labor and diagnosis calls are not included.

Warrantor's obligations and liabilities under this warranty are limited to furnishing F.O.B. Warrantor factory or warehouse at Warrantor designated shipping point, freight allowed to Buyer's city, replacement parts for Warrantor's products covered under this warranty. Warrantor shall not be obligated to pay for the cost of lost refrigerant. No liability shall attach to Warrantor until products have been paid for and then liability shall be limited solely to the purchase price of the equipment under warranty shown to be defective.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, AND IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Trane

2701 Wilma Rudolph Blvd.

Clarksville, TN 37040-1008

Attention: Manager, Product Service

GW-606-4800

* This warranty is for commercial usage of said equipment and not applicable when the equipment is used for a residential application. Commercial use is any application where the end purchaser uses the product for other than personal, family or household purposes.

**A 5 year limited warranty is provided for the optional "Low Leak" economizer when combined with the additional FDD (Fault Detection & Diagnostics) option.

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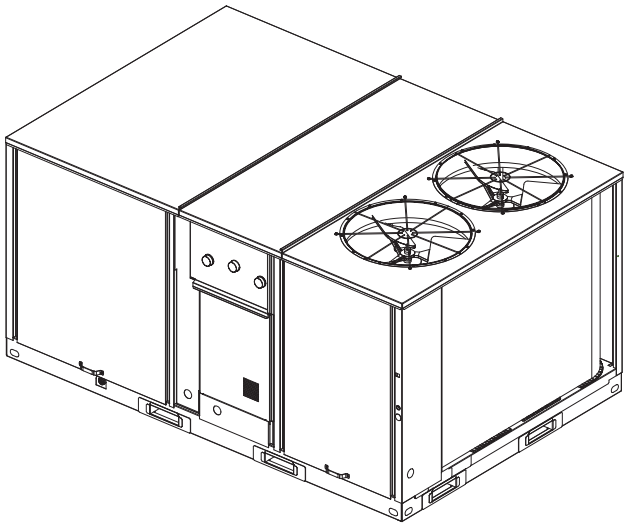
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RT-SVX46E-EN 13 Jan 2017
Supersedes RT-SVX46D-EN (06 May 2016)

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Ingersoll Rand

Installation, Operation, and Maintenance

Packaged Rooftop Air Conditioners
Voyager™ with eFlex™ Technology
Cooling and Gas/Electric
12.5 to 17.5 Tons, 60Hz



Model Numbers: YZD150-210
YZH150-210

⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

July 2019 **RT-SVX48E-EN**

Ingersoll Rand

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

NOTICE Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS/SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

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⚠WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Ingersoll Rand personnel must follow Ingersoll Rand Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. All policies can be found on the BOS site. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Ingersoll Rand personnel should always follow local regulations.**

NOTICE

Water Damage!

Failure to follow instructions could result in equipment and property damage. Non-factory penetrations through the base of this unit are not allowed. Any penetration in the base of the unit may affect the water tight integrity of the unit and lead to water leaks into the conditioned space.

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Factory Training

Factory Training is available through Trane University™ to help you learn more about the operation and maintenance of your equipment. To learn about available training opportunities contact Trane University™.

Online: www.trane.com/traneuniversity

Phone: 855-803-3563

Email: traneuniversity@trane.com

Revision History

Updated Model Number Description, Factory-Mounted Unit Options, and Maintenance sections.

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Model Number Descriptions

All products are identified by a multiple character model number that precisely identifies a particular type of unit. An explanation of the alphanumeric identification code is provided. Its use will enable the owner/operator, installing contractors, and service engineers to define the operation, specific components, and other options for any specific unit.

When ordering replacement parts or requesting service, be sure to refer to the specific model number and serial number printed on the unit nameplate.

Digit 1 — Unit Type

Y = Packaged Gas/Electric

Digit 2 — Efficiency

Z = eFlex™

Digit 3 — Airflow Configuration

D = Downflow
H = Horizontal

Digit 4, 5, 6 — Nominal Gross Cooling Capacity (MBh)

150 = 12½ Tons
180 = 15 Tons
210 = 17½ Tons

Digit 7 — Major Design Sequence

F = Microchannel Type Condenser Coils

Digit 8 — Voltage Selection

3 = 208-230/60/3
4 = 460/60/3

Digit 9 — Unit Controls

R = ReliaTel

Digit 10 — Heating Capacity

H = Gas Heat - High
L = Gas Heat - Low
V = Gas Heat - SS Ht Ex - Modulating
X = Gas Heat - SS Ht Ex - Low
Z = Gas Heat - SS Ht Ex - High

Digit 11 — Minor Design Sequence

Digit 12, 13 — Service Sequence

Digit 14 — Fresh Air Selection

0 = No Fresh Air
D = Econ Dry Bulb w/ Barometric Relief[1]
F = Econ Reference Enthalpy w/ Barometric Relief[1]
H = Econ Comparative Enthalpy w/ Barometric Relief[1]
K = Low Leak Econ w/ Barometric Relief[1]
M = Low Leak Econ Reference Enthalpy w/ Barometric Relief[1]
P = Low Leak Econ Comparative Enthalpy w/ Barometric Relief[1]

Digit 15 — Supply Fan/Drive Type/Motor

6 = Single Zone Variable Air Volume Standard Motor
8 = Single Zone Variable Air Volume Oversized Motor
A = Single Zone Variable Air Volume Standard Motor w/ Shaft Grounding Ring
C = Single Zone Variable Air Volume Oversized Motor w/ Shaft Grounding Ring
E = Multiple Zone Variable Air Volume Supply Air Temperature Control - Standard Motor
F = Multiple Zone Variable Air Volume Supply Air Temperature Control - Oversized Motor
G = Multiple Zone Variable Air Volume Supply Air Temperature Control - Standard Motor w/ Shaft Grounding Ring
H = Multiple Zone Variable Air Volume Supply Air Temperature Control - Oversized Motor w/ Shaft Grounding Ring

Digit 16 — Hinged Service Access / Filters

0 = Standard Panels/Standard Filters[12]
A = Hinged Access/Standard Filters[12]
B = Standard Panels/MERV 8 Filters[3]
C = Hinged Access/MERV 8 Filters[3]
D = Standard Panels/MERV 13 Filters[3]
E = Hinged Access/MERV 13 Filters[3]

Digit 17 — Condenser Coil Protection

0 = Standard Coil
1 = Standard Coil With Hail Guard
4 = CompleteCoat™ Condenser Coil
5 = CompleteCoat™ Condenser Coil with Hail Guard

Digit 18 — Through The Base Provisions

0 = No Through The Base Provisions
A = Through The Base Electric[6]
B = Through The Base Gas
C = Through The Base Electric/Gas[6]
D = Through The Base Access

Digit 19 — Disconnect Switch/ Circuit Breaker[5]

0 = No Disconnect/circuit break
1 = Unit Mounted Non-Fused Disconnect Switch
2 = Unit Mounted Circuit Breaker

Digit 20 — Convenience Outlet Option

0 = Without Convenience Outlet
A = Unpowered Convenience Outlet[2]
B = Powered Convenience Outlet[2]

Digit 21 — Communications Options

0 = Without Communications Options
1 = Trane Communications Interface
2 = Lontalk Communications Interface[3]
6 = Building Automation Control Network Communications Interface
7 = Air-Fi™ Wireless Communications[14]

Digit 22 — Refrigeration System Option

0 = Standard Refrigeration System[11]

Digit 23 — Refrigeration Controls

0 = Standard Refrigeration Controls[10]

Digit 24 — Smoke Detector[4]

0 = Without Smoke Detector
A = Return Air Smoke Detector
B = Supply Air Smoke Detector
C = Return/Supply Air Smoke Detector

Digit 25 — System Monitoring Controls

0 = Standard Monitoring System[9]
1 = Clogged Filter Switch
2 = Fan Failure Switch
4 = Clogged Filter Switch and Fan Failure Switch
A = Condensate Drain Pan Overflow Switch
B = Clogged Filter Switch and Condensate Drain Pan Overflow Switch
C = Fan Failure Switch and Condensate Drain Pan Overflow Switch
E = Clogged Filter Switch, Fan Failure Switch and Condensate Drain Pan Overflow Switch

Digit 26 - System Monitoring Controls

0 = No Monitoring Controls
A = Demand Control Ventilation (CO_2)[7]
B = FDD (Fault Detection and Diagnostics)
C = FDD (Fault Detection Diagnostics) and Demand Control Ventilation (CO_2)[7]

Digit 27 - Unit Hardware Enhancements

0 = No Enhancements
1 = Stainless Steel Drain Pan

Digit 28 - Short Circuit Current Rating

0 = Standard SCCR
A = 65kA SCCR Option[8]

Digit 29, 30 - Service Sequence

Digit 31 - Advanced Unit Controls

0 = Standard Unit Controls
1 = Human Interface[13]

Note: *Most Factory Installed Options available for Downflow Air Discharge units only. Please verify with ordering system for availability.*

Model Number Notes

1. Some field set up required.
2. Must be ordered with Through-the-Base Electrical option or Horizontal-Side Access and either Unit Mounted Disconnect or Circuit Breaker.
3. Available factory installed on downflow AND horizontal units. Verify with ordering system.
4. Option cannot be ordered in conjunction with field installed economizer on downflow units. Must be factory installed. The return air smoke detector may not fit up or work properly on the Voyager units when used in conjunction with 3rd party accessories (such as bolt on heat wheels, economizers, and power exhaust). Do not order the return air smoke detectors when using this type of accessory.
5. Unit mounted disconnect and circuit breakers are mutually exclusive of each other.
6. Through-the-base electrical option or Horizontal-Side Access must be ordered with either unit mounted disconnect or circuit breaker. When adding heat, you must order Trane Electric Heat.
7. Demand Control Ventilation Option includes wiring only. The $C0_2$ sensor is a field-installed only option.
8. Only available where MOP is above 60A.
9. Discharge Air Sensing Tube is standard.
10. Frostat™ and crankcase heaters are standard.
11. Thermal Expansion Valve (TXV) is standard.
12. Standard filters are not available with Low Leak Economizers.
13. Human Interface is standard with FDD (Fault Detection Diagnostics).
14. Must be used with BACnet™ open protocol.

General Information

Overview of Manual

Note: *One copy of this document ships inside the control panel of each unit and is customer property. It must be retained by the unit's maintenance personnel.*

This booklet describes proper installation, operation, and maintenance procedures for air cooled systems.

By carefully reviewing the information within this manual and following the instructions, the risk of improper operation and/or component damage will be minimized.

It is important that periodic maintenance be performed to help assure trouble free operation. A maintenance schedule is provided at the end of this manual.

Should equipment failure occur, contact a qualified service organization with qualified, experienced HVAC technicians to properly diagnose and repair this equipment.

Unit Description

Before shipment, each unit is leak tested, dehydrated, charged with refrigerant and compressor oil, and run tested for proper control operation.

For major design sequence F units, the condenser coils are microchannel type aluminum coils.

Direct-drive, vertical discharge condenser fans are provided with built-in thermal overload protection.

The ReliaTel™ Control Module is a microelectronic control system that is referred to as "Refrigeration Module" (RTRM). The acronym RTRM is used extensively throughout this document when referring to the control system network.

This module through Proportional/Integral control algorithms perform specific unit functions that governs unit operation in response to; zone temperature, supply air temperature, and/or humidity conditions depending on the application.

The stages of capacity control for these units are achieved by starting and stopping the compressors.

The RTRM is mounted in the control panel and is factory wired to the respective internal components. The RTRM receives and interprets information from other unit modules, sensors, remote panels, and customer binary contacts to satisfy the applicable request for cooling.

Economizer Control Actuator ReliaTel™ Control

The ECA monitors the mixed air temperature, return air temperature, minimum position setpoint (local or remote), power exhaust setpoint, CO_2 setpoint, CO_2, and ambient dry bulb/ enthalpy sensor or comparative humidity (return air humidity against ambient humidity) sensors, if selected, to control dampers to an accuracy of ±5 percent of stroke. The actuator is spring returned to the closed position any time that power is lost to the unit. It is capable of delivering up to 25 in·lb of torque and is powered by 24 Vac.

RTCI—ReliaTel™ Trane Communication Interface (Optional)

This module is used when the application calls for an ICS™ building management type control system. It allows the control and monitoring of the system through an ICS panel. The module can be ordered as a kit to be field installed. Follow the installation instruction that ships with each kit when field installation is necessary.

RLCI—ReliaTel™ LonTalk Communication Interface (Optional)

This module is used when the application calls for an ICS™ building management type control system that is LonTalk. It allows the control and monitoring of the system through an ICS panel. The module can be ordered from the factory or ordered as a kit to be field installed. Follow the installation instruction that ships with each kit when field installation is necessary.

RBCI—ReliaTel BACnet™ Communications Interface (Optional)

This module is used when the application calls for an open BACnet protocol. It allows the control and monitoring of the system through an ICS panel. The module can be ordered from the factory or as a kit to be field installed. Follow the installation instructions that ships with each kit when field installation is necessary.

RTOM—ReliaTel™ Options Module

The RTOM monitors the supply fan proving, clogged filter, supply air temperature, exhaust fan setpoint, supply air tempering, Frostat™ and smoke detector. Refer to system input devices and functions for operation.

WCI—Trane Air-Fi™ Wireless Communication Interface (Optional)

The Trane Air-Fi Communication Interface allows for wireless communication between system controls, unit controls, and wireless sensors for Trane control products that use BACnet protocol. The WCI replaces the need for communications wire in all system applications.

System Input Devices and Functions

The RTRM must have a zone sensor or thermostat input in order to operate the unit.

Note: *The unit function will be reduced when using a conventional thermostat.*

The flexibility of having several mode capabilities depends upon the type of zone sensor or thermostat selected to interface with the RTRM.

The descriptions of the following basic Input Devices used within the RTRM network are to acquaint the operator with their function as they interface with the various modules.

Refer to the unit's electrical schematic for the specific module connections. The following controls are available from the factory for field installation.

Supply Fan Failure Input (Optional)

The Fan Failure Switch (FFS) can be connected to sense indoor fan operation. If air flow through the unit is not proven by the differential pressure switch connected to the RTOM (factory set point 0.07" w.c.) within 40 seconds nominally, the RTRM will shut off all mechanical operations, lock the system out, send a diagnostic to ICS, and the SERVICE output will flash. The system will remain locked out until a reset is initiated either manually or through ICS.

Drain Pan Condensate Overflow Switch (Optional)

This input incorporates the Condensate Overflow Switch (COF) mounted on the drain pan and the ReliaTel Options Module (RTOM). When the condensate level reaches the trip point for 6 continuous seconds, the RTOM will shut down all unit function until the overflow condition has cleared. The unit will return to normal operation after 6 continuous seconds with the COF in a non-tripped condition. If the condensate level causes the unit to shutdown more than 2 times in a 3 day period, the unit will be locked-out of operation. A manual reset of the diagnostic system through the Zone Sensor or Building Automation System (BAS) will be required. Cycling unit power will also clear the fault."

Clogged Filter Switch (Optional)

The unit mounted clogged filter switch monitors the pressure differential across the return air filters. It is mounted in the filter section and is connected to the RTOM. A diagnostic SERVICE signal is sent to the remote panel if the pressure differential across the filters is at least 0.5" w.c.

The contacts will automatically open when the pressure differential across the filters decreases to approximately 0.4" w.c.

The clogged filter output is energized when the supply fan is operating and the clogged filter switch has been closed for at least 2 minutes. The system will continue to operate regardless of the status of the filter switch.

Please note that on units equipped with factory installed MERV 13 filters, a clogged filter switch with different pressure settings will be installed. This switch will close when the differential pressure is approximately 0.8" w.c. and open when the differential falls to 0.7" w.c.

Compressor Disable (CPR1/2)

This input incorporates the low pressure control (LPC) of each refrigeration circuit and can be activated by opening a field supplied contact installed on the LTB.

If this circuit is open before the compressor is started, the compressor will not be allowed to operate. Anytime this circuit is opened for 1 continuous second during compressor operation, the compressor for that circuit is immediately turned "Off". The compressor will not be allowed to restart for a minimum of 3 minutes should the contacts close.

If four consecutive open conditions occur during the same call for compressor operation, the compressor for that circuit will be locked out, a diagnostic communicated to the remote panel (if installed), and a manual reset will be required to restart the compressor. If the call for the compressor is removed before the fault count reaches 4, the fault count will be reset.

Phase Monitor

The Phase Monitor is a three-phase line monitor module that protects against phase loss, and phase reversal. To prevent motor failure, phase to phase imbalance should be less than 2% imbalance. It is intended to protect compressors from reverse rotation. It has an operating input voltage range of 190–600 Vac, and LED indicators for ON and FAULT. There are no field adjustments and the module will automatically reset from a fault condition.

Low Pressure Control ReliaTel Control

When the LPC is opened for 1 continuous second, the compressor for that circuit is turned off immediately. The compressor will not be allowed to restart for a minimum of 3 minutes.

If 4 consecutive open conditions occur during the same call for compressor operation, the compressor will be locked out, a diagnostic communicated to ICS™ if applicable, and a manual reset will be required to restart the compressor. If the call for the compressor is removed before the fault count reaches 4, the fault count will be reset.

Discharge Line Thermostat ReliaTel Control

The high pressure controls and discharge line thermostats are wired in series between the compressor outputs on the RTRM and the compressor contactor coils. If the high pressure control switch or discharge line thermostat open, the RTRM senses a lack of current while calling for cooling and locks the compressor out. This is an auto reset lockout. If the circuit is open three consecutive times when the contactor coil should be on, the RTRM sets a manual lockout for that compressor.

Power Exhaust Control (Optional)

The power exhaust fan is started whenever the position of the economizer dampers meets or exceeds the power exhaust setpoint when the indoor fan is on.

The setpoint panel is located in the return air section and is factory set at 25 percent.

Evaporator Frost Control

This input incorporates the Frostat™ control (FOS) mounted in the indoor coil and can be activated by closing a field supplied contact installed in parallel with the FOS.

If this circuit is closed before the compressor is started, the compressor will not be allowed to operate. Anytime this circuit is closed for 5 continuous seconds during compressor operation, the compressor for that circuit is immediately turned "Off". The compressor will not be allowed to restart for a minimum of 3 minutes should the FOS close.

Compressor/Inverter Protection

The ReliaTel control receives input from the inverter drive for any errors encountered by the drive (refer to RT-SVD05A-EN for error code details). If an error is encountered before the compressor has run for 3 minutes, ReliaTel begins counting errors. The drive will automatically reset when the error condition clears and ReliaTel will try to start the compressor again, if a call for cooling remains and 3 minutes have passed since the compressor last ran.

If ReliaTel counts 4 such errors within 30 minutes, the system will go to manual lock out mode. Refer to RT-SVD05A-EN for potential causes.

Sensors

Note: *Zone sensor required for units configured for Single Zone VAV indoor fan system control to enable Single Zone VAV functionality.*

Zone Sensor Module (ZSM) (BAYSENS106*)

This electronic sensor features three system switch settings (Heat, Cool, and Off) and two fan settings (On and Auto). It is a manual changeover control with single setpoint. (Cooling Setpoint Only.)

Zone Sensor Module (ZSM) (BAYSENS108*)

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto). It is a manual or auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Zone Sensor (BAYSENS110*)

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto) with four system status LEDs. It is a manual or auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Programmable Zone Sensor (BAYSENS119*)

Programmable Night Setback: Auto or manual changeover with seven-day programming. Keyboard selection of Heat, Cool, Fan, Auto, or On. All programmable sensors have System On, Heat, Cool, Service LED/indicators as standard. Night Setback Sensors have one (1) Occupied, one (1) Un-occupied, and one (1) Override program per day.

Remote Zone Sensor (BAYSENS073*)

This electronic sensor features remote zone sensing and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

Remote Zone Sensor (BAYSENS074*)

This electronic sensor features single setpoint capability and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

Remote Zone Sensor (BAYSENS016*)

This bullet type temperature sensor can be used for outside air (ambient) sensing, return air temperature sensing, supply air temperature sensing, and remote temperature sensing (uncovered). Wiring procedures vary according to the particular application and equipment involved. Refer to the unit's wiring diagrams for proper connections.

Remote Zone Sensor (BAYSENS077*)

This electronic sensor can be used with BAYSENS119* Remote Panels. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to the specific Remote Panel for wiring details.

Wireless Zone Sensor (BAYSENS050)

This electronic sensor features five system settings (Auto, Off, Cool, Heat, and Emergency Heat) and with On and Auto fan settings. It is a manual or auto changeover control with dual setpoint capability. Other features include a timed override function, lockable system settings, and Fahrenheit or Celsius temperature display. Included with the wireless zone sensor will be a receiver that is to be mounted inside the unit, a mounting bracket, and a wire harness.

High Temperature Sensor (BAYFRST003*)

This sensor connects to the RTRM Emergency Stop Input on the LTB and provides high limit "shutdown" of the unit. The sensor is used to detect high temperatures due to fire in the air conditioning or ventilation ducts. The sensor is designed to mount directly to the sheet metal duct. Each kit contains two sensors. The return air duct sensor (X1310004001) is set to open at 135°F.

The supply air duct sensor (X1310004002) is set to open at 240°F. The control can be reset after the temperature has been lowered approximately 25°F below the cutout setpoint.

Smoke Detector Sensor (Optional)

This sensor is only applicable on units equipped with a RTOM. It provides high limit "shutdown" of the unit and requires a manual reset. The sensor is used to detect smoke due to fire in the air conditioning or ventilation ducts.

Notes:

- *The supply and return air smoke detectors are designed to shut off the unit if smoke is sensed in the supply air stream or return air stream. This function is performed by sampling the airflow entering the unit at the return air opening. Follow the instructions provided below to assure that the airflow through the unit is sufficient for adequate sampling. Failure to follow these instructions will prevent the smoke detectors from performing it's design function.*
- *Airflow through the unit is affected by the amount of dirt and debris accumulated on the indoor coil and filters. To insure that airflow through the unit is adequate for proper sampling by the return air smoke detector, complete adherence to the maintenance procedures, including recommended intervals between filter changes, and coil cleaning is required.*
- *Periodic checks and maintenance procedures must be performed on the smoke detector to insure that it will function properly. For detailed instructions concerning these checks and procedures, refer to the appropriate section(s) of the smoke detector Installation and Maintenance Instructions provided with the literature package for this unit.*

In order for the supply air smoke detector or return air smoke detector to properly sense smoke in the supply air stream or return air stream, the air velocity entering the smoke detector unit must be in accordance with manufacturers recommended airflow limits.

Equipment covered in this manual will develop an airflow velocity that falls within these limits over the entire airflow range specified in the evaporator fan performance tables.

Wall Mounted Relative Humidity Sensor (BAYSENS036*)

Field installed, wall mounted humidity sensor is used to control activation of the enhanced dehumidification feature.

Humidity set points can be selected for relative humidity levels between 40 percent and 60 percent by adjusting the DEHUMID setting on the ReliaTel Options Module; see "RTOM—ReliaTel™ Options Module," p. 7.

Duct Mounted Relative Humidity Sensor (BAYSENS037*)

Field installed, duct mounted humidity sensor is used to control activation of the enhanced dehumidification option.

Humidity set points can be selected for relative humidity levels between 40 percent and 60 percent by adjusting the DEHUMID setting on the ReliaTel Options Module; see "RTOM—ReliaTel™ Options Module," p. 7.

Unit Inspection

As soon as the unit arrives at the job site:

- Verify that the nameplate data matches the data on the sales order and bill of lading (including electrical data).
- Verify that the power supply complies with the unit nameplate specifications.
- Visually inspect the exterior of the unit, including the roof, for signs of shipping damage.
- Visually inspect the internal components for shipping damage as soon as possible after delivery and before it is stored. Do not walk on the sheet metal base pans.
- If concealed damage is discovered, notify the carrier's terminal of damage immediately by phone and by mail. Concealed damage must be reported within 15 days.
  - Request an immediate joint inspection of the damage by the carrier and the consignee.
  - Do not remove damaged material from the receiving location.
  - Take photos of the damage, if possible. The owner must provide reasonable evidence that the damage did not occur after delivery.
- Notify the appropriate sales representative before installing or repairing a damaged unit.

Precautionary Measures

⚠WARNING

Fiberglass Wool!

Product contains fiberglass wool. Disturbing the insulation in this product during installation, maintenance or repair will expose you to airborne particles of glass wool fibers and ceramic fibers known to the state of California to cause cancer through inhalation. You MUST wear all necessary Personal Protective Equipment (PPE) including gloves, eye protection, a NIOSH approved dust/mist respirator, long sleeves and pants when working with products containing fiberglass wool. Exposition to glass wool fibers without all necessary PPE equipment could result in cancer, respiratory, skin or eye irritation, which could result in death or serious injury.

- Avoid breathing fiberglass dust.
- Use a NIOSH approved dust/mist respirator.
- Avoid contact with the skin or eyes. Wear long-sleeved, loose-fitting clothing, gloves, and eye protection.
- Wash clothes separately from other clothing: rinse washer thoroughly.
- Operations such as sawing, blowing, tear-out, and spraying may generate fiber concentrations requiring additional respiratory protection. Use the appropriate NIOSH approved respiration in these situations.

First Aid Measures

- Eye Contact - Flush eyes with water to remove dust. If symptoms persist, seek medical attention.
- Skin Contact - Wash affected areas gently with soap and warm water after handling.

Storage

Take precautions to prevent condensate from forming inside the unit's electrical compartments and motors if:

- The unit is stored before it is installed; or,
- The unit is set on the roof curb, and temporary heat is provided in the building. Isolate all side panel service entrances and base pan openings (e.g., conduit holes, S/A and R/ A openings, and flue openings) from the ambient air until the unit is ready for start-up.

Note: *Do not use the unit's heater for temporary heat without first completing the start-up procedure detailed under "Start Up," p. 34.*

The manufacturer will not assume any responsibility for equipment damage resulting from condensate accumulation on the unit's electrical and/or mechanical components.

Unit Clearances

Figure 1, p. 12 illustrates the minimum operating and service clearances for either a single or multiple unit installation. These clearances are the minimum distances necessary to assure adequate serviceability, cataloged unit capacity, and peak operating efficiency.

Providing less than the recommended clearances may result in condenser coil starvation, "short-circuiting" of exhaust and economizer airflows, or recirculation of hot condenser air.

Unit Dimensions

Figure 1. Typical installation clearance for single and multiple unit applications

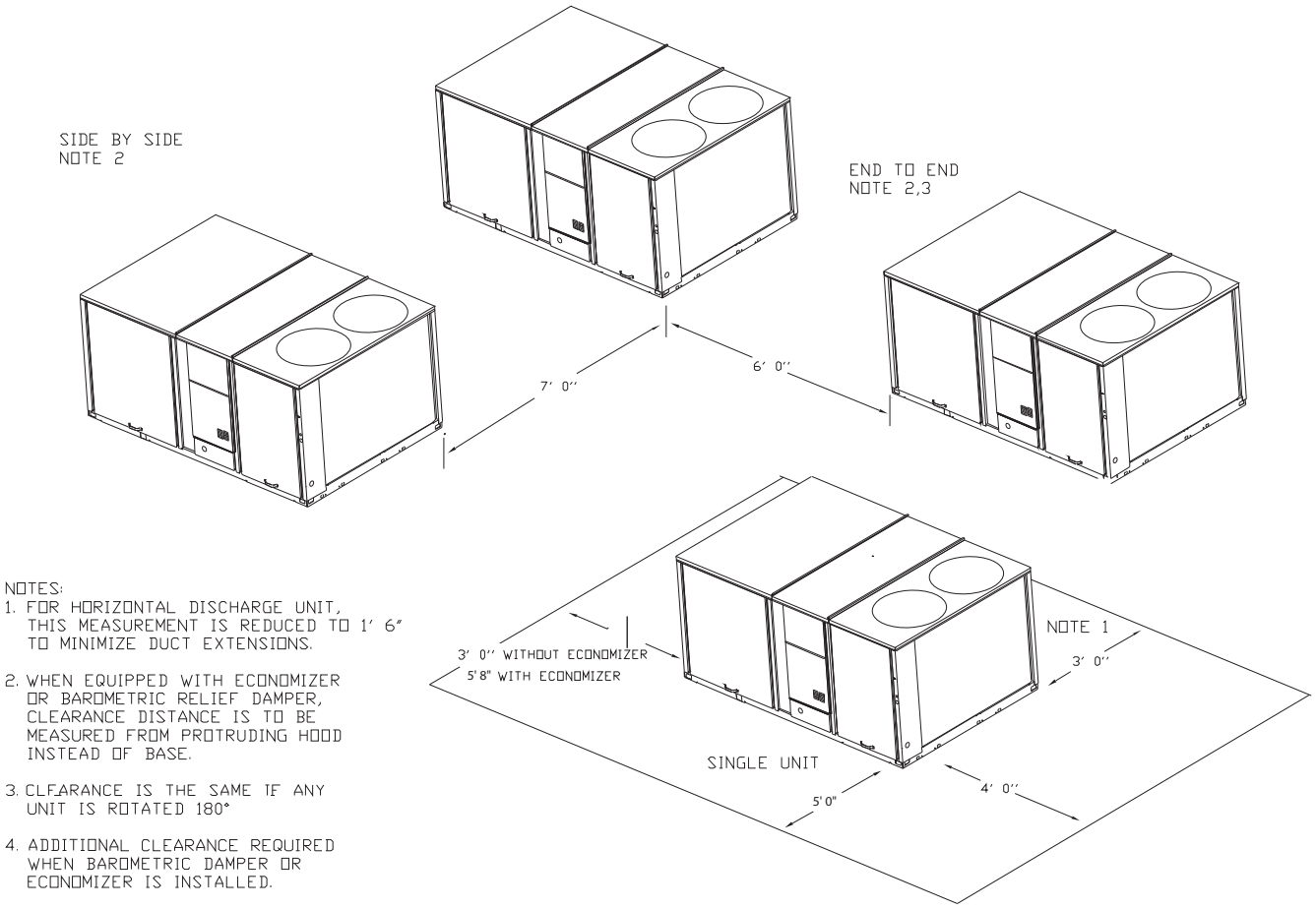
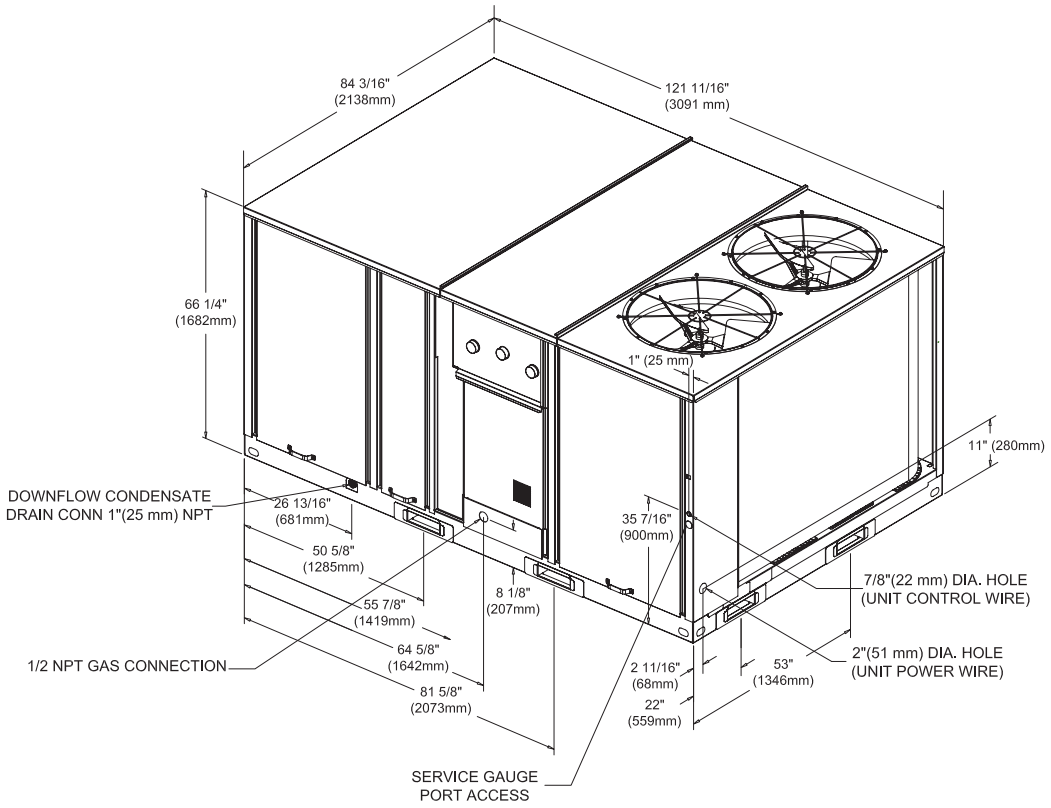
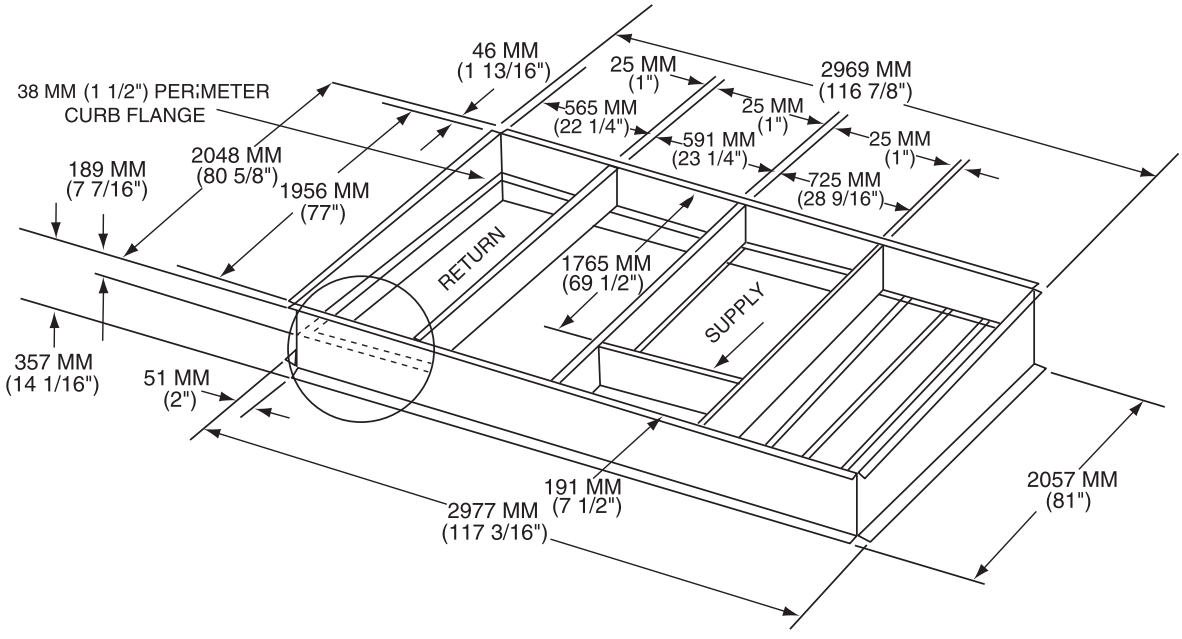


Figure 2. Unit dimensional data 12½-17½ tons ultra high efficiency units



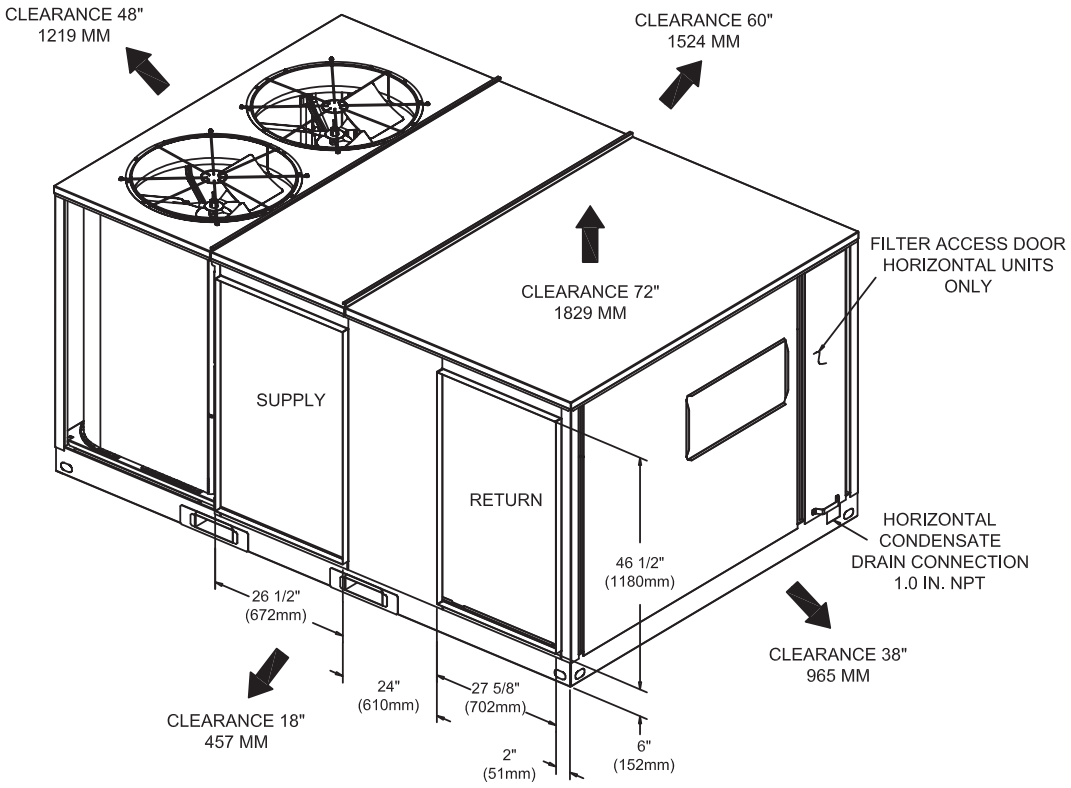
Note: *½ NPT Gas Connection*

Figure 3. Unit dimensional data 12½–17½ tons ultra high efficiency units



Unit Dimensions

Figure 4. Horizontal duct dimensional data 12½–17½ tons ultra high efficiency units

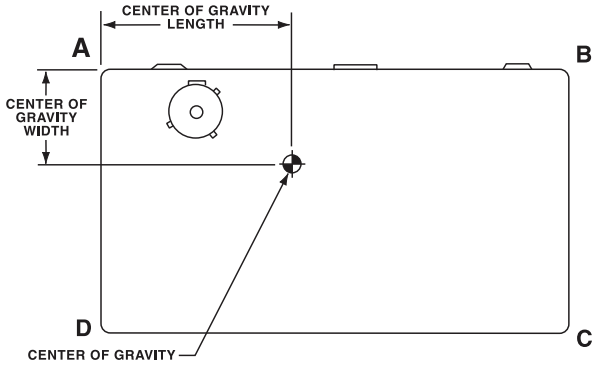


Unit Weights

Table 1. Maximum unit weights, corner weights (Lbs) and center of gravity dimensions (in).

Unit Model No.	Tons	Maximum Weights (lb)		Corner Weights				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
YZ*150	12.5	2680	2237	708	612	420	497	56"	35"
YZ*180	15	2686	2243	710	613	421	498	56"	34"
YZ*210	17.5	2766	2323	744	624	434	518	55"	35"

Figure 5. Corner weights



Rigging

⚠WARNING

Heavy Objects!

Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements could cause equipment or property damage. Failure to follow instructions above or properly lift unit could result in unit dropping and possibly crushing operator/ technician which could result in death or serious injury.

⚠WARNING

Improper Unit Lift!

Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level. Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury and possible equipment or property-only damage.

Refer to Figure 6 and Table 1 for typical unit operating weights rigging before proceeding.

1. Remove the shipping crate from around the unit. Do not remove the crating from the top of the unit.
2. Rig the unit as shown in Figure 6. Attach adequate strength lifting slings to all four lifting brackets in the unit base rail. Do not use cables, chains, or slings except as shown.
3. Install a lifting bar, as shown in Figure 6, to protect the unit and to facilitate a uniform lift. The minimum distance between the lifting hook and the top of the unit should be 7 feet.

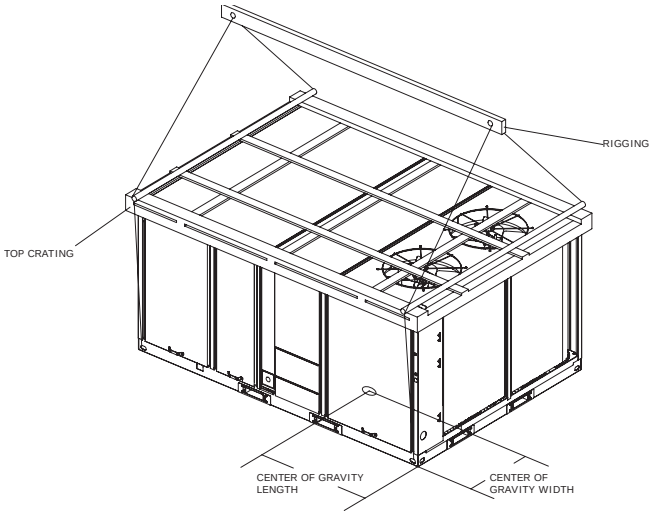
NOTICE

Unit Damage!

Unit damage will occur if fork lifting is attempted once the pallet has been removed.

4. Removal of the base pallet must be completed before unit can be set. Prior to lifting the unit, remove the 6 fork pockets from the base rails and 4 wood screws from the lifting lug corners. The unit will then separate from the pallet when lifted.
5. Test-lift the unit to ensure it is properly rigged and balanced, make any necessary rigging adjustments.
6. Lift the unit and position it into place.
7. Downflow units; align the base rail of the unit with the curb rail while lowering the unit onto the curb. Make sure that the gasket on the curb is not damaged while positioning the unit.

Figure 6. Rigging and center of gravity data



Installation

Foundation

⚠WARNING

Risk of Roof Collapsing!

Confirm with a structural engineer that the roof structure is strong enough to support the combined weight of the roofcurb and the unit. Refer to "Unit Weights," p. 15 for typical unit and curb weights. Failure to ensure proper structural roof support could cause the roof to collapse, which could result in death or serious injury and property damage.

Horizontal Units

Notes:

- *For units with optional Condensate Overflow Switch (COF), the switch will not work properly if unit is not level or slightly sloped toward switch.*
- *To assure proper condensate flow during operation the unit and the curb must be level.*
- *Any non-factory penetrations of the base pan in the field violates the water integrity of the base pan and becomes the responsibility of the person making the penetration.*

If the unit is installed at ground level, elevate it above the snow line. Provide concrete footings at each support location with a "full perimeter" support structure or a slab foundation for support. Refer to Table 1, p. 15 for the unit's operating and point loading weights when constructing a footing foundation.

If anchoring is required, anchor the unit to the slab using hold down bolts or isolators. Isolators should be installed to minimize the transmission of vibrations into the building.

For rooftop applications, if anchoring is required, anchor the unit to the roof with hold-down bolts or isolators.

Check with a roofing contractor for proper waterproofing procedures.

Ductwork

Elbows with turning vanes or splitters are recommended to minimize air noise due to turbulence and to reduce static pressure.

When attaching the ductwork to the unit, provide a water-tight flexible connector at the unit to prevent operating sounds from transmitting through the ductwork.

All outdoor ductwork between the unit and the structure should be weather proofed after installation is completed.

Note: *For sound consideration, cut only the holes in the roof deck for the ductwork penetrations. Do not cut out the entire roof deck within the curb perimeter.*

If a Curb Accessory Kit is not used:

a. The ductwork can be attached directly to the factory-provided flanges around the unit's supply and return air openings. Be sure to use flexible duct connections at the unit.

b. For "built-up" curbs supplied by others, gaskets must be installed around the curb perimeter flange and the supply and return air opening flanges.

General Unit Requirements

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

The checklist listed below is a summary of the steps required to successfully install a commercial unit. This checklist is intended to acquaint the installing personnel with what is required in the installation process. It does not replace the detailed instructions called out in the applicable sections of this manual.

- Check the unit for shipping damage and material shortage; file a freight claim and notify appropriate sales representative.
- Verify correct model, options and voltage from nameplate.
- Verify that the installation location of the unit will provide the required clearance for proper operation.
- Assemble and install the roof curb (if applicable). Refer to the latest edition of the curb installers guide that ships with each curb kit.
- Fabricate and install ductwork; secure ductwork to curb.
- Rigging the unit.
- Set the unit onto the curb; check for levelness.
- Ensure unit-to-curb seal is tight and without buckles or cracks.
- Install and connect a condensate drain line to the evaporator drain connection.

Factory Installed Economizer

- Ensure the standard economizer has been pulled out into the operating position. Refer to the economizer Installation Instructions for proper setup.

Note: *Low Leak Economizers do not pull out. Refer to Low Leak Economizers Installation Instructions for proper setup.*

- Install all access panels.

Main Electrical Power Requirements

- Verify that the power supply complies with the unit nameplate specifications.
- Inspect all control panel components; tighten any loose connections.
- Connect properly sized and protected power supply wiring to a field-supplied/ installed disconnect switch and to the main power terminal block (HTB1) in the unit control panel.
- Install proper grounding wires to an earth ground.

Note: *All field-installed wiring must comply with NEC and applicable local codes.*

Electric Heat Requirements

- Verify that the power supply complies with the electric heater specifications on the unit and heater nameplate.
- Inspect the heater junction box and control panel; tighten any loose connections.
- Check electric heat circuits for continuity.
- Low Voltage Wiring (AC and DC) Requirements
- Install the zone thermostat, with or without switching subbase.
- Connect properly sized control wiring to the proper termination points between the zone thermostat and the unit control panel.

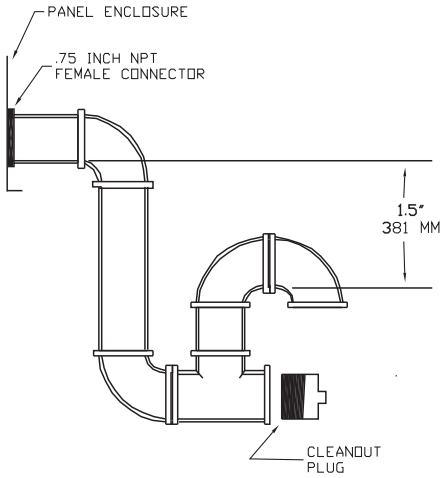
Condensate Drain Configuration

An evaporator condensate drain connection is provided on each unit. Refer to "Unit Dimensions," p. 12 for the appropriate drain location.

A condensate trap must be installed at the unit due to the drain connection being on the "negative pressure" side of the fan. Install the P-Trap using the guidelines in Figure 7.

A condensate drain line must be connected to the P-Trap. Pitch the drain lines at least ½-inch for every 10 feet of horizontal run to assure proper condensate flow. Do not allow the horizontal run to sag causing a possible double-trap condition which could result in condensate backup due to "air lock".

Figure 7. Condensate trap installation



Filter Installation

Each unit ships with 2-inch filters installed. The quantity of filters is determined by unit size. Access to the filters is obtained by removing the indoor fan access panel. If included, pull on filter removal tool to remove filters.

Refer to the unit Service Facts (shipped with each unit) for filter requirements.

Note: *Do not operate the unit without filters.*

Field Installed Power Wiring

An overall dimensional layout for the standard field installed wiring entrance into the unit is illustrated in "Unit Dimensions," p. 12. To insure that the unit's supply power wiring is properly sized and installed, follow the guidelines outlined below.

Note: *All field installed wiring must conform to NEC guidelines as well as state and Local codes.*

Verify that the power supply available is compatible with the unit's nameplate ratings. The available supply power must be within 10% of the rated voltage stamped on the nameplate and less than 2% phase to phase. See "Voltage Imbalance," p. 23. Use only copper conductors to connect the power supply to the unit.

NOTICE

Use Copper Conductors Only!

Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.

Note: *If the unit is not equipped with an optional factory installed nonfused disconnect switch or circuit breaker, a field supplied disconnect switch must be installed at or near the unit in accordance with the National Electrical Code (NEC latest edition).*

Main Unit Power

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

Standard Wiring

The electrical service must be protected from over current and short circuit conditions in accordance with NEC requirements.

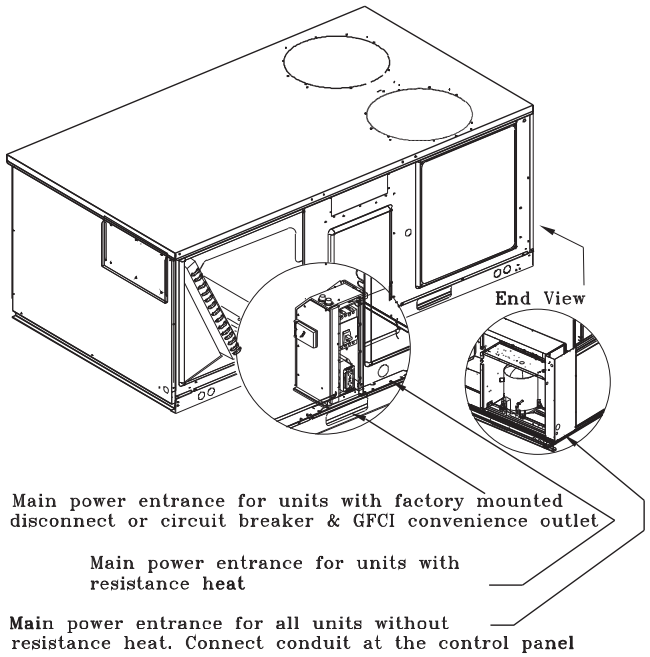
Protection devices must be sized according to the electrical data on the nameplate.

- If the unit is not equipped with an optional factory installed nonfused disconnect switch or circuit breaker, a field supplied disconnect switch must be installed at or near the unit in accordance with the National Electrical Code (NEC latest edition).
- Location of the applicable electrical service entrance is illustrated in "Unit Dimensions," p. 12. Complete the unit's power wiring connections onto either; the main terminal block HTB1 inside the unit control panel, the factory mounted nonfused disconnect switch (UCD) or circuit breaker (UCB), or the electric heat terminal block. Refer to the customer connection diagram that shipped with the unit for specific termination points.
- Provide proper grounding for the unit in accordance with local and national codes.

Optional TBUE Wiring (Through the Base Electrical Option)

- Location of the applicable electrical service is illustrated below. Refer to the customer connection diagram that is shipped with the unit for specific termination points. The termination points, depending on the customer option selected would be a factory mounted nonfused disconnect switch (UDC) or circuit breaker (UCB).
- Provide proper grounding for the unit in accordance with local and national codes.

Figure 8. Through the base electrical option



Field Installed Control Wiring

An overall layout of the various control options available with the required number of conductors for each control device is illustrated in Figure 12, p. 20.

Note: *All field wiring must conform to NEC guidelines as well as state and local codes.*

Control Power Transformer

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

The 24-volt control power transformers are to be used only with the accessories called out in this manual. Transformers rated greater than 50 Vac are equipped with internal circuit breakers. If a circuit breaker trips, turn "Off" all power to the unit before attempting to reset it.

The transformer is located in the control panel. The circuit breaker is located on the left side of the transformer and can be reset by pressing in on the black reset button.

Controls Using 24VAC

NOTICE

Use Copper Conductors Only!

Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.

Before installing any connecting wiring, refer to ""Unit Dimensions," p. 12 for the electrical access locations provided on the unit and Table 2, p. 19 for AC conductor sizing guidelines, and;

1. Use copper conductors unless otherwise specified.
2. Ensure that the AC control wiring between the controls and the unit's termination point does not exceed three (3) ohms/conductor for the length of the run.

   Note: *Resistance in excess of 3 ohms per conductor may cause component failure due to insufficient AC voltage supply.*

   Note: *Be sure to check all loads and conductors for grounds, shorts, and mis-wiring.*
3. Do not run the AC low voltage wiring in the same conduit with the high voltage power wiring.

Table 2. 24V AC conductors with ReliaTel™

Distance from Unit to Control	Recommended Wire Size
000 - 460 feet	18 gauge
000 - 140 m	.75 mm2
461 - 732 feet	16 gauge
141 - 223 m	1.3 mm2
733 - 1000 feet	14 gauge
224 - 305 m	2.0 mm2

Controls using DC Analog Input/Outputs (Standard Low Voltage Multiconductor Wire)

Before installing any connecting wiring between the unit and components utilizing a DC analog input\output signal, refer to "Unit Dimensions," p. 12 for the electrical access locations provided on the unit.

1. Table 3 lists the conductor sizing guidelines that must be followed when interconnecting the DC binary output devices and the system components utilizing a DC analog input\output signal to the unit.

Note: *Resistance in excess of 2.5 ohms per conductor can cause deviations in the accuracy of the controls.*

2. Ensure that the wiring between controls and the unit's termination point does not exceed two and a half (2.5) ohms/conductor for the length of the run.
3. Do not run the electrical wires transporting DC signals in or around conduit housing high voltage wires

Table 3. Zone sensor module wiring

Distance from Unit to Control	Recommended Wire Size
0–150 feet (0–45.7 m)	22 gauge (0.33 mm^2)
151–240 feet (46–73.1 m)	20 gauge (0.50 mm^2)
241–385 feet (73.5–117.3 m)	18 gauge (0.75 mm^2)
386–610 feet (117.7–185.9 m)	16 gauge (1.3 mm^2)
611–970 feet (186.2–295.7 m)	14 gauge (2.0 mm^2)

Figure 9. ReliaTel™ options module

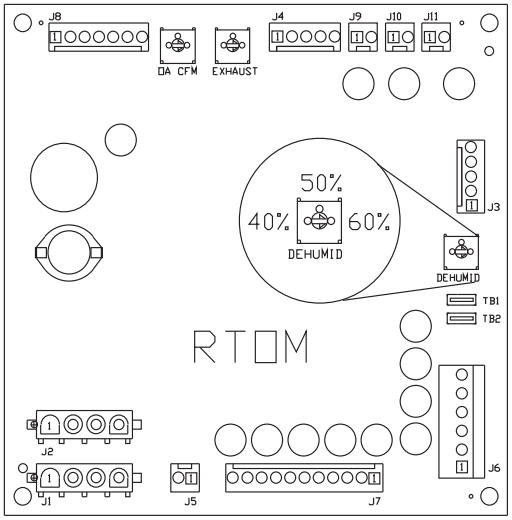


Figure 10. ReliaTel relative humidity sensor (Enhanced Dehumidification operation)

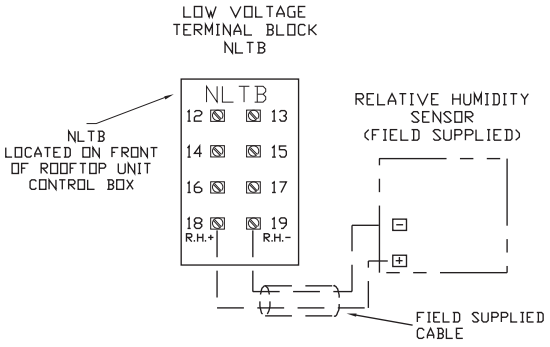


Figure 11. ReliaTel humidistat (Enhanced Dehumidification operation)

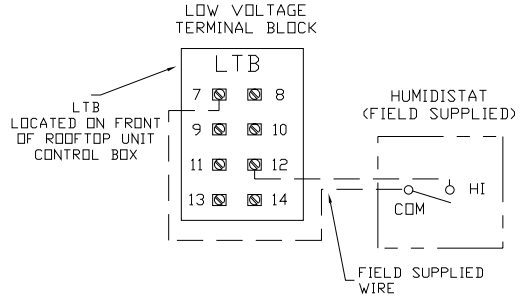
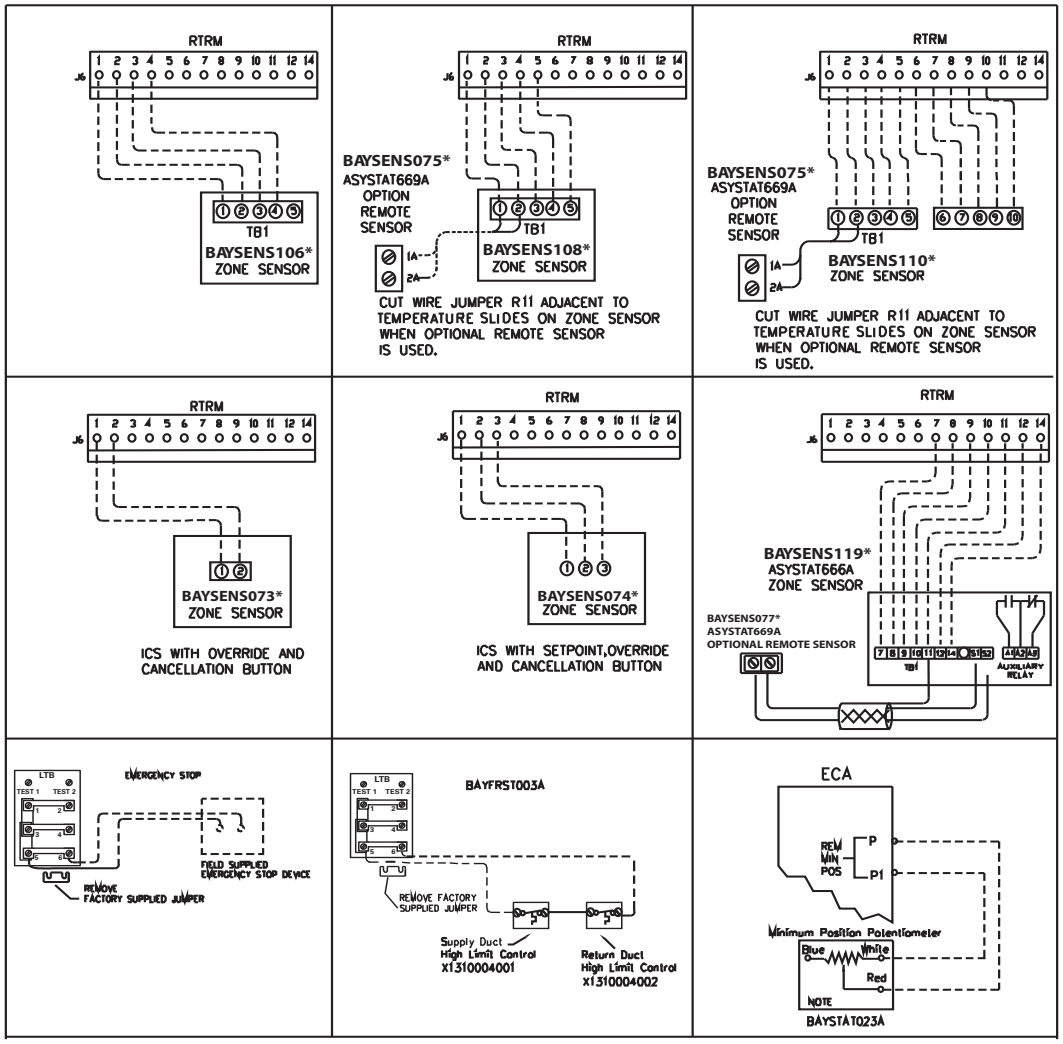
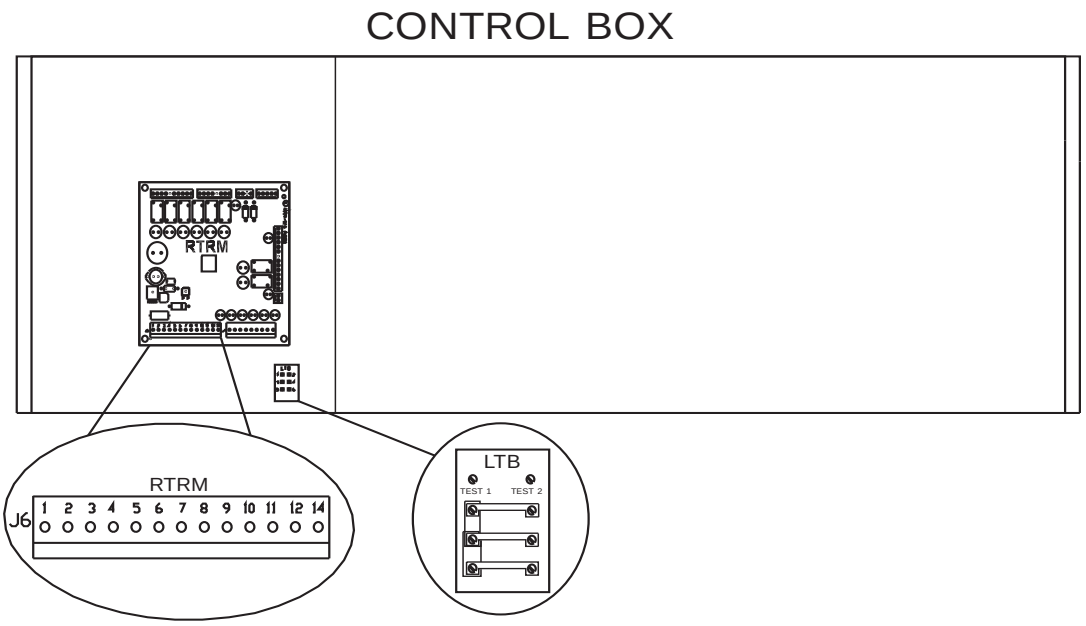


Figure 12. Typical field wiring diagrams for optional controls (ReliaTel only)





Space Temperature Averaging

Space temperature averaging is accomplished by wiring a number of remote sensors in a series/parallel circuit.

Using the BAYSENS016* or BAYSENS077*, at least four sensors are required to accomplish space temperature averaging.

Example #1 illustrates two series circuits with two sensors in each circuit wired in parallel. The square of any number of remote sensors required. Example #2 illustrates three sensors squared in a series/parallel circuit. Example #3 illustrates the circuit required for this senor. Table 4 lists the temperature versus resistance coefficient for all sensing.

Table 4. Temperature vs. resistance

Degrees		Nominal Resistance (K-Ohms)
°F	°C	
-20	-28.9	170.1
-15	-26.1	143.5
-10	-23.3	121.4
-5	-20.6	103.0
0	-17.8	87.56
5	-15.0	74.65
10	-12.2	63.80
15	-9.4	54.66
20	-6.7	46.94
25	-3.8	40.40
30	-1.1	34.85
35	1.7	30.18
40	4.4	26.22
45	7.2	22.85
50	10.0	19.96
55	12.8	17.47
60	15.6	15.33
65	18.3	13.49
70	21.1	11.89
75	23.9	10.50
80	26.7	9.297
85	29.4	8.247
90	32.2	7.330
95	35.0	6.528
100	37.8	5.824

Figure 13. Space temperature averaging examples

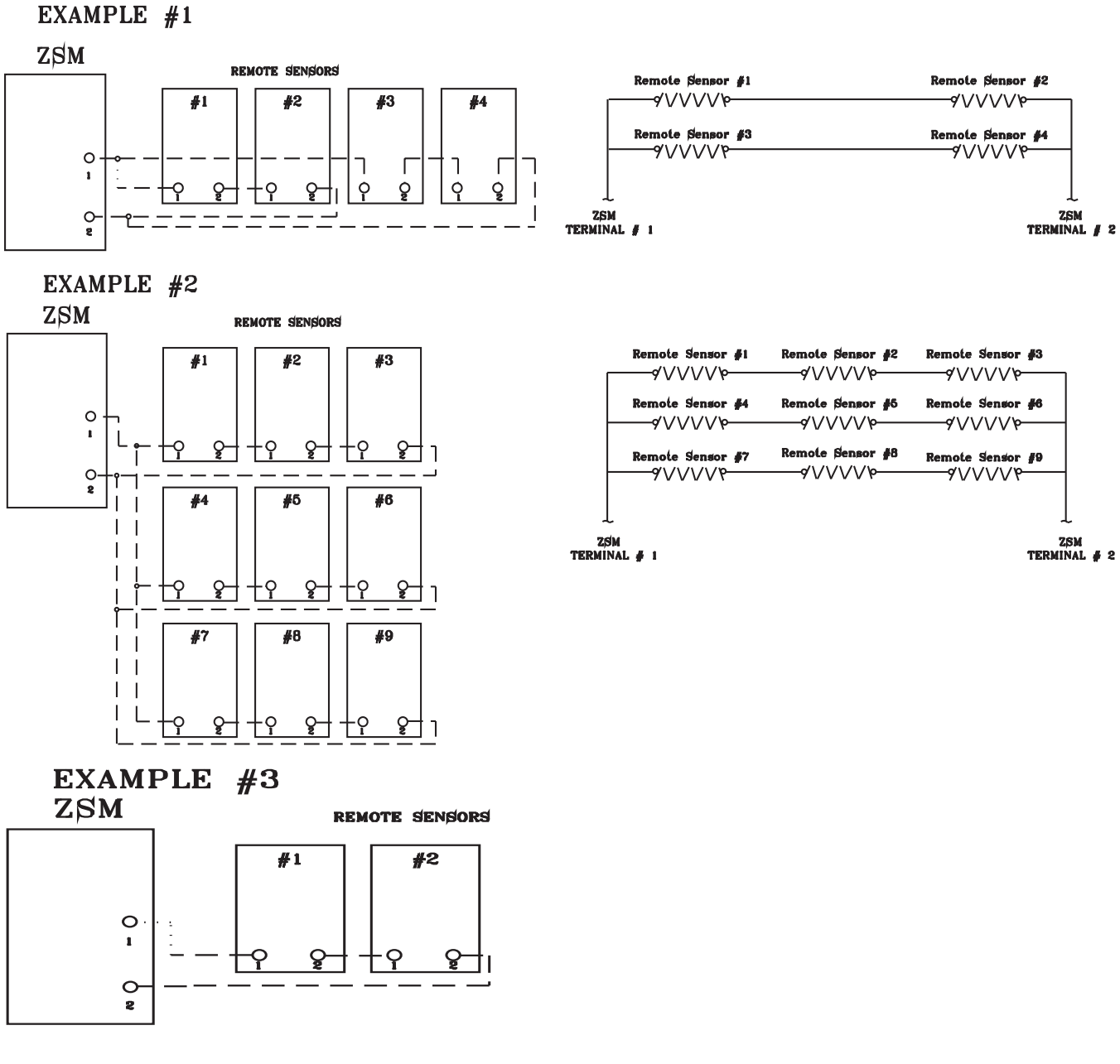


Table 5. Gas heater operating data

Heating Input Rate—Btu/h	135,000	250,000
Minimum Supply Gas Pressure Natural/ LP	3.5" w.c./ 8.0" w.c.	
Manifold Gas Pressure[a]	-0.2" w.c	
Combustion Blower Suction Pressure (1st Stage)	-2.1 to -3.1" w.c.	-0.8 to -1.2" w.c.
(With Gas Valve Closed) (2nd Stage)	N/A -2.1 to	-3.1" w.c.
Minimum Flame Sensing Current [b]	5.0 Microamps D.C.	
Normal Sensing Current Range	8.0 to 16.0 Microamps D.C.	
Flue Gas Temperature Rise Above Ambient	400°F to 500°F	350°F to 475°F
Flue Gas Content - %CO_2	8.3 to 9.5	8.0 to 9.0
Natural LP	9.5 to 10.5	
Minimum Supply Air Temperature Across Heat Exchanger	40°F	

(a) Staged gas heat units have a negative pressure gas valve. Never adjust the staged gas pressure valve to a positive pressure.
(b) A voltage reading across pens (V+) & (V-) is equatable to the flame sensing current. One volt equals one micro amp.

Table 6. Piping

Length of Pipe (ft)	Iron Pipe Size (IPS) Inches				
	½" Pipe	¾" Pipe	1" Pipe	1¼" Pipe	1½" Pipe
15	76	176	345	750	1220
30	52	120	241	535	850
45	43	99	199	435	700
60	38	86	173	380	610
75		77	155	345	545

Note: Capacity of Pipe of Different Diameters and Lengths in Cu. Ft. Per Hr. with Pressure Drop of 0.3" and Specific Gravity of 0.60

Table 7. Specific gravity multipliers

Specific Gravity	Multipliers
0.50	1.10
0.55	1.04
0.60	1.00
0.65	0.96

Figure 14. Schematic diagram for field gas piping to units

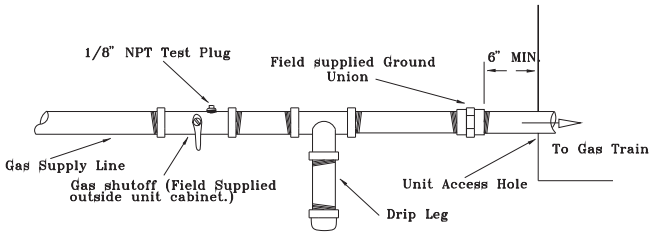
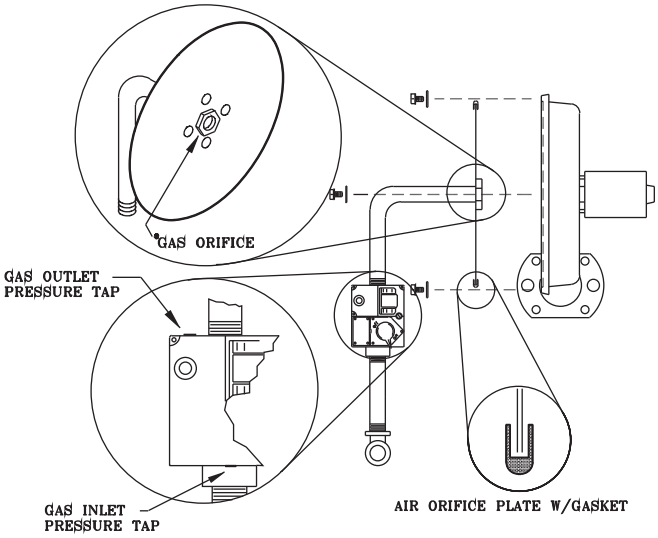


Figure 15. Typical unit gas train configuration



Use the following checklist in conjunction with the general checklist ("General Unit Requirements," p. 16) to ensure that the unit is properly installed and ready for operation.

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

- Check all electrical connections for tightness and "point of termination" accuracy.
- Verify that the condenser airflow will be unobstructed.
- Verify that the condenser fan and indoor blower turn freely without rubbing and are properly tightened on the shafts.
- Check the supply fan belts for proper tension and the fan bearings for sufficient lubrication. If the belts require adjustment, or if the bearings need lubricating, refer to the maintenance section of this manual for instructions.
- Verify that a condensate trap is installed and the piping is properly sized and pitched.
- Verify that the correct size and number of filters are in place.
- Inspect the interior of the unit for tools and debris and install all panels in preparation for starting the unit.

Voltage Imbalance

Three phase electrical power to the unit must meet stringent requirements for the unit to operate properly. Measure each leg (phase-to-phase) of the power supply.

Each reading must fall within the utilization range stamped on the unit nameplate. If any of the readings do not fall within the proper tolerances, notify the power company to correct this situation before operating the unit.

Excessive three phase voltage imbalance between phases will cause motors to overheat and eventually fail.

The maximum allowable voltage imbalance is 2 percent. Measure and record the voltage between phases 1, 2, and 3 and calculate the amount of imbalance as follows:

% Voltage Imbalance =

$$\frac{100 \text{ X AV - VD}}{\text{AV}}$$ where;

AV (Average Voltage) =

$$\frac{\text{Volt 1 + Volt 2 + Volt 3}}{3}$$

- V1, V2, V3 = Line Voltage Readings
- VD = Line Voltage reading that deviates the farthest from the average voltage.

Example: If the voltage readings of the supply power measured 221, 230, and 227, the average volts would be:

$$\frac{221 + 230 + 227}{3} = 226 \text{ Avg.}$$

- VD (reading farthest from average) = 221
- The percentage of Imbalance equals:

$$\frac{100 \text{ X } 226 - 221}{226} = 2.2\%$$

The 2.2 percent imbalance in this example exceeds the maximum allowable imbalance of 2.0 percent. This much imbalance between phases can equal as much as a 20 percent current imbalance with a resulting increase in motor winding temperatures that will decrease motor life.

If the voltage imbalance is over 2 percent, notify the proper agencies to correct the voltage problem before operating this equipment.

Electrical Phasing (Three Phase Motors)

The compressor motor(s) and the supply fan motor are internally connected for the proper rotation when the incoming power supply is phased as A, B, C.

Proper electrical supply phasing can be quickly determined and corrected before starting the unit by using an instrument such as an Associated Research Model 45 Phase Sequence Indicator and following the steps below:

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

- Turn the field supplied disconnect switch that provides power to the main power terminal block or to the "Line" side of the optional factory mounted disconnect switch to the "Off" position.
- Connect the phase sequence indicator leads to the terminal block or to the "Line" side of the optional factory mounted disconnect switch as follows;

  Black (phase A) to L1

  Red (phase B) to L2

  Yellow (phase C) to L3
- Close the field supplied main power disconnect switch or circuit protector switch that provides the supply power to the unit.

⚠WARNING

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

- Observe the ABC and CBA phase indicator lights on the face of the sequencer. The ABC indicator light will glow if the phase is ABC. If the CBA indicator light glows, open the disconnect switch or circuit protection switch and reverse any two power wires.
- Restore the main electrical power and recheck the phasing. If the phasing is correct, open the disconnect switch or circuit protection switch and remove the phase sequence indicator.

Compressor Crankcase Heaters

NOTICE

Compressors Failure!

Unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started. This will protect the compressors from premature failure.

Each compressor is equipped with a crankcase heater. The proper operation of the crankcase heater is important to

maintain an elevated compressor oil temperature during the "Off" cycle to reduce oil foaming during compressor starts. Oil foaming occurs when refrigerant condenses in the compressor and mixes with the oil. In lower ambient conditions, refrigerant migration to the compressor could increase.

When the compressor starts, the sudden reduction in crankcase pressure causes the liquid refrigerant to boil rapidly causing the oil to foam. This condition could damage compressor bearings due to reduced lubrication and could cause compressor mechanical failures.

Before starting the unit in the "Cooling" mode, set the system switch to the "Off" position and turn the main power disconnect to the "On" position and allow the crankcase heater to operate a minimum of 8 hours.

Before closing the main power disconnect switch, insure that the "System"selection switch is in the "Off" position and the "Fan" selection switch is in the "Auto" position.

Close the main power disconnect switch and the unit mounted disconnect switch, if applicable.

ReliaTel™ Controls

Upon power initialization, the RTRM performs self-diagnostic checks to insure that all internal controls are functional. It also checks the configuration parameters against the components connected to the system.

The Liteport LED located on the RTRM module is turned "On" within one second of power-up if internal operation is okay.

Use one of the following "Test" procedure to bypass some time delays and to start the unit at the control panel.

Each step of unit operation can be activated individually by temporarily shorting across the "Test" terminals for two to three seconds. The Liteport LED located on the RTRM module will blink when the test mode has been initiated.

The unit can be left in any "Test" step for up to one hour before it will automatically terminate, or it can be terminated by opening the main power disconnect switch. Once the test mode has been terminated, the Liteport LED will glow continuously and the unit will revert to the "System" control.

Modulating Gas Heat 2.5:1 Turndown (Optional)

The set-up required for equipment ordered with modulating gas heat varies based on the control system utilized. Zone sensors, LonTalk, and Comm3/4 do not require additional set-up.

24 volt control systems (thermostats) require setting the desired leaving air temperature. The heat exchanger will modulate to maintain this temperature. Use the following procedure for set-up:

1. Locate the RTOM
2. Locate the "Discharge Air SP" or "OA CFM SP"
3. Adjust the variable resistor to match the desired leaving temperature
    a. Range = 50°F–150°F
        i. Clockwise—Increase Temperature
        ii. Counterclockwise—Decrease Temperature

Factory-Mounted Unit Options

Circuit Breaker (UCB) and Unit Disconnect (UDC)

⚠WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06-EN*

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

Important: *All phases of this installation must comply with NATIONAL, STATE, and LOCAL CODES. In addition to local codes, the installation must comply with National Electric Code - ANSI/NFPA NO. 70 LATEST REVISION.*

1. Field connections are made by first removing all access panels on the front of the unit. Unscrew the assembly around the outside of the disconnect switch or circuit breaker. This assembly is located between the evaporator and heat section of the unit (Figure 16, p. 26).

   For downflow configurations, the hole in the base section is for both high and low voltage power wiring on down flow units. Horizontal units will route through the front plate located directly under the circuit breaker or disconnect panel. The hole is sized for 1½" conduit. Horizontal units will use the front plate located directly under the circuit breaker panel.

2. If the conduit required for your application is larger, remove the termination plate and connect to the larger hole using field supplied reducing washers.

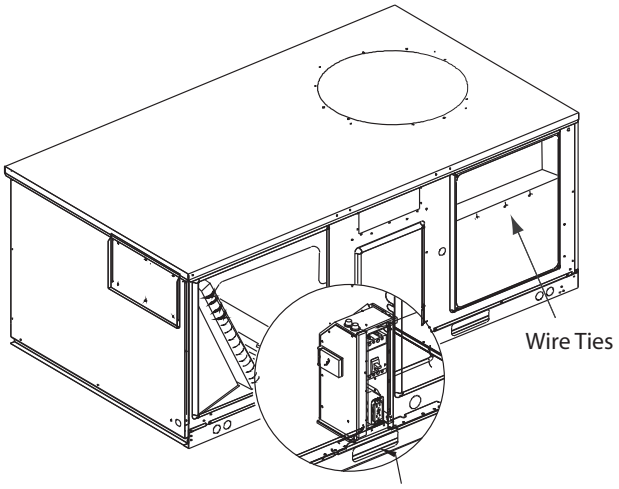
3. Route the power wires and ground conductor through conduit and into the bottom of the factory installed disconnect switch or circuit breaker. Connect the power conductors to the lugs provided. Connect the ground wire to the unit ground lug.

   Note: *Wire size for the length of run should be determined using the circuit ampacity found on the unit nameplate and the N.E.C.*

4. Route low voltage (class II), control wiring through hole in base of unit but not through high voltage conduit. Feed control wiring through bushing provided on side panel and into the flexible conduit provided in the heat section of the unit (Figure 16). Route wires through loose wire ties provided in unit as in Figure 16.

5. Tighten the wire ties. Secure the excess wire bundle under the wire ties in the outdoor section. Do not leave excess wire in the electrical enclosure. Use the unit wiring diagram to make the low voltage connections.

Figure 16. Main power entrance for units with factory mounted disconnect or circuit breaker



Main power entrance for units with factory mounted disconnect or circuit breaker

Powered and Unpowered Convenience Outlets

⚠WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06-EN*

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

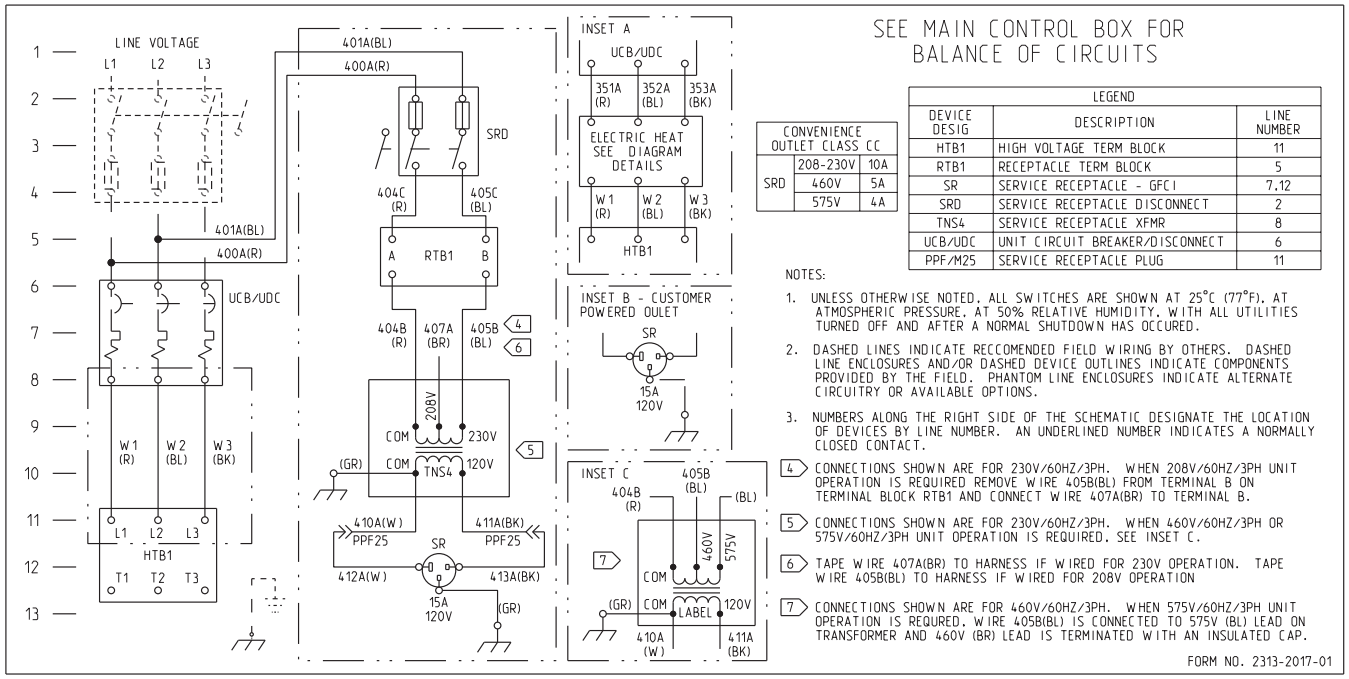
Convenience Outlet Powered Option (COPO)

When the powered convenience outlet option is installed, the unit will include a dedicated transformer located in the evaporator section of the unit. Additionally, a service receptacle disconnect switch will be provided on the side wall of the evaporator section. The service receptacle switch is shipped in the OFF position.

The powered outlet comes completely wired from the factory except for 208 volt applications.

1. For 208 volt applications, disconnect and tape the blue 230 volt wire.
2. Then connect the brown 208 volt wire.

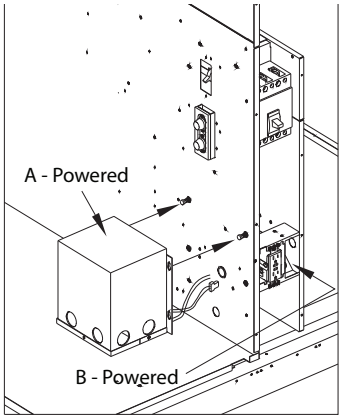
Figure 17. Wiring schematic 12½ through 17½ ton options



Convenience Outlet Unpowered Option (COUP)

1. When the unpowered convenience outlet option is installed, remove the receptacle.
2. The field wiring should be routed through the hole in the base for downflow applications or front panel for horizontal applications then through holes provided in the "J" box (bottom for EMT and top for flexible conduit).
3. Connect the three (3) wires to terminals inside outlet box.

Figure 18. Power options



Return Air Smoke Detector

Pre-Requisite

Note: *The following field installation instructions apply to downflow only. Horizontal return air smoke detectors require no field installation.*

When a unit is ordered with a downflow economizer and a return air smoke detector as factory installed options, the return air smoke detector cannot be completely installed because the economizer, when it is in the shipping position, is occupying the space where the return air smoke detector is to be installed.

The partial assembly and set-up required for each factory installed economizer must be completed up to the point where the barometric relief hood is to be installed into the unit. Prior to this operation, go to Step 5 of this instruction and perform the operations described there. After this is completed, the economizer installation is to be completed in its entirety as outlined in the installation guide.

Smoke Detector Installation

Notes:

- *The shipping screw that holds the barometric relief damper must be removed before proceeding with the smoke detector installation.*
- *With a Low Leak Economizer the smoke detector will be fully installed before leaving the factory.*

After completion of the economizer installation, proceed with the installation of the return air smoke detector as follows:

⚠WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06-EN*

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

1. Remove the smoke detector assembly from its shipping position in the indoor fan compartment. This assembly is attached with three screws to the indoor fan board near the top of the unit.
2. Remove and discard the shipping bracket from the smoke detector assembly. This is the angled piece of sheet metal that secured the smoke detector assembly to the interior parts of the unit during shipment.
3. Place the end of the smoke detector 16 inch metal exhaust tube provided into the bottom hole in the back of the smoke detector. Line up the tab in the exhaust tube with one of the slots in the detector and insert the tube until the tube can be rotated. Rotate the tube 45 degrees to lock it in place.

Figure 19. Brackets

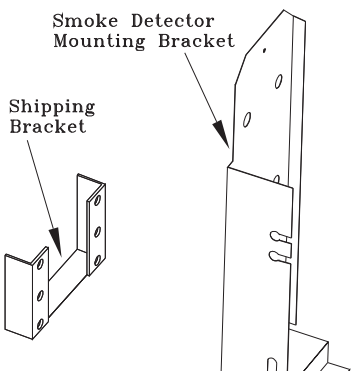
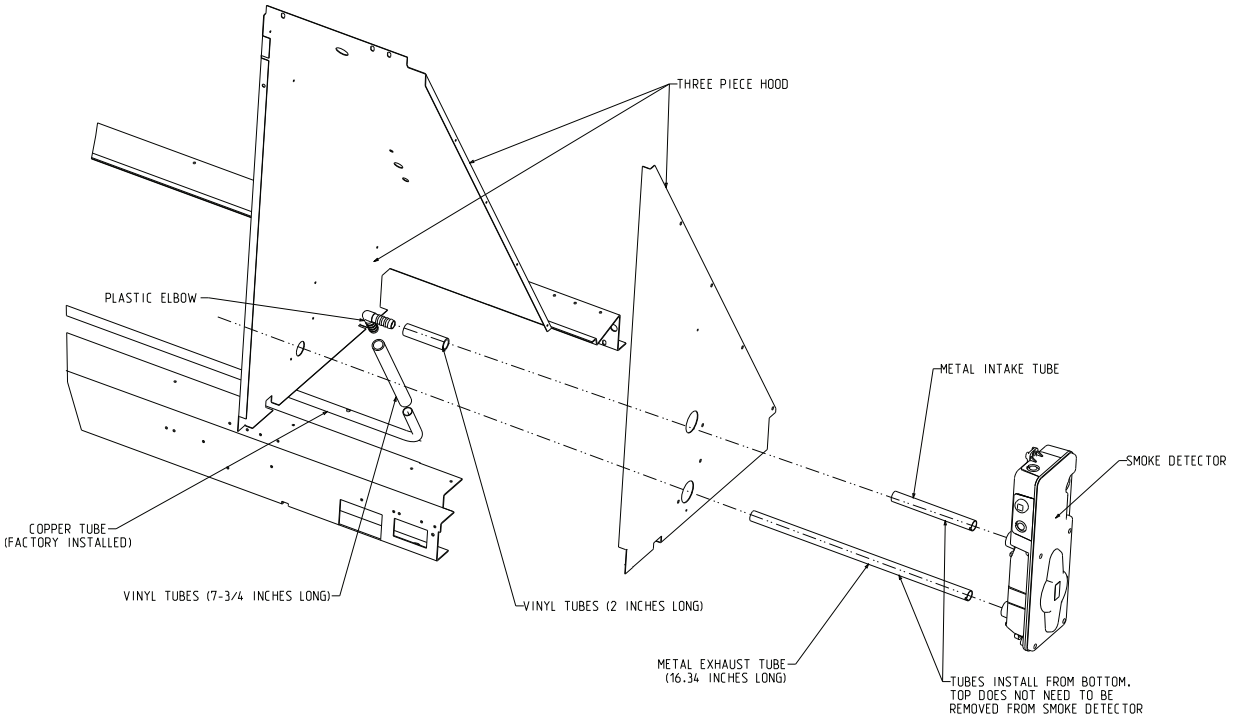


Figure 20. Return air smoke detector for downflow units



4. Slide one 2" piece of the vinyl tubing provided onto the short smoke detector inlet tube which protrudes out of the back side of the smoke detector. Push this piece of vinyl tubing onto the inlet tube until it contacts the end of the plastic extension on the backside of the smoke detector.
5. Slide the long piece of vinyl tubing provided onto one leg of the plastic barbed elbow provided. Slide the other end of this piece of vinyl tubing with the elbow attached approximately 1" onto the end of the copper sampling tube installed in the unit's return air opening. Position the leg of elbow without the vinyl tubing such that it points toward the front side of the unit (directly out of the unit toward the filter access panel).
6. Mount the smoke detector assembly into the unit. Align the smoke detector (exhaust tube down) with the holes in the outer panel of the barometric relief hood and position the smoke detector flush on the panel.

Note: *On all units there is a hole with a plastic snap bushing located on the inner vertical side of the barometric relief hood that the long exhaust tube must pass through. Be sure that the exhaust tube is aligned with this hole before positioning the smoke detector flush on the outer panel of the barometric relief hood.*

7. Secure the smoke detector to the hood with two #10-16 x 3/4' sheet metal screws provided.

Note: *In order to perform the last part of this operation, it will be necessary to remove the barometric relief filter, open the barometric relief damper, and reach inside through the barometric relief outlet to access and connect the copper exhaust elbow to the smoke detector exhaust tube.*

8. Connect the leg of the plastic elbow without the vinyl tubing attached that was installed in Step 5 to the smoke detector inlet tube pushing it onto the piece of vinyl tubing attached to the inlet tube.
9. Refer to Figure 21, p. 30 for wire connections of return air smoke detector to the unit wiring harness.
10. This completes the installation of the return air smoke detector. If the unit's air filter(s) and/or barometric relief filter were removed to ease installation of the smoke detector, they need to be replaced at this time.

Airflow and Sampling

Refer to the instructions provided below regarding unit airflow to assure that the return air smoke detector will function properly.

Important: *The return air smoke detector is designed to shut off the unit if smoke is sensed in the return air stream. This function is performed by sampling the airflow entering the unit at the return air opening. Observe the following instructions to assure the airflow through the unit is sufficient for adequate sampling. Failure to follow these instructions will prevent the smoke detector from performing its design function.*

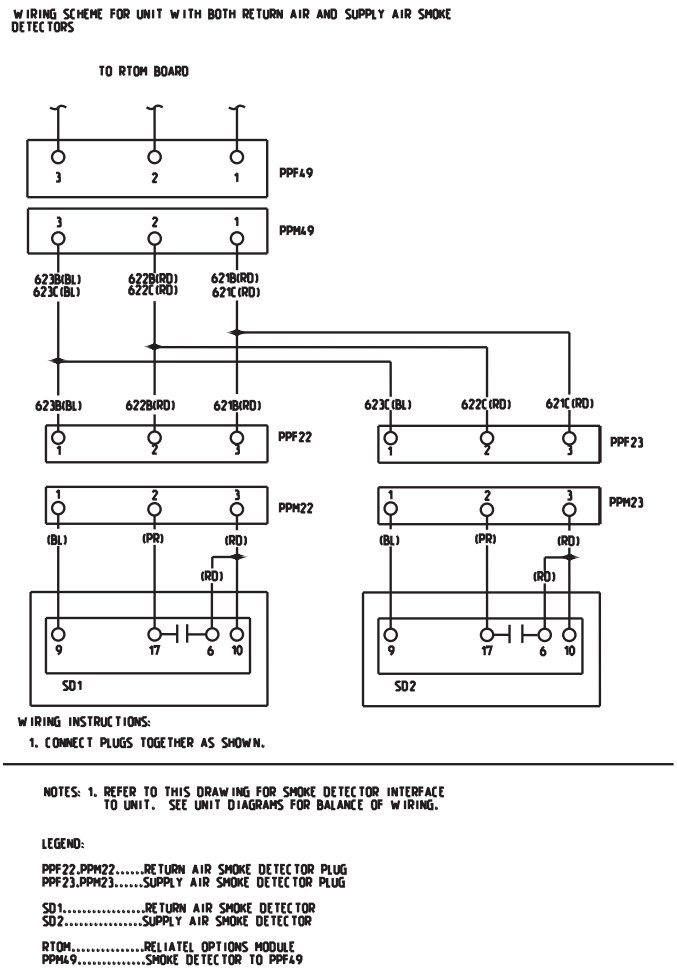
In order for the return air smoke detector to properly sense smoke in the return air stream, the air velocity entering the unit must be in accordance with manufacturers recommended airflow limits. Most models of equipment covered by this instruction will develop an airflow velocity that falls within these limits over the entire airflow range specified in the evaporator fan performance tables.

Notes:

- *Airflow through the unit is affected by the amount of dirt and debris accumulated on the indoor coil and filters. To insure that airflow through the unit is adequate for proper sampling by the return air smoke detector, complete adherence to the maintenance procedures, including recommended intervals between filter changes and coil cleaning, is required.*
- *Periodic checks and maintenance procedures must be performed on the smoke detector to insure that it will function properly. For detailed instructions concerning these checks and procedures, refer to the appropriate section(s) of the smoke detector Installation and Maintenance Instructions provided with the literature package for this unit.*

Important: *Refer to the service literature provided for testing and other information about the smoke detector or if problems are encountered.*

Figure 21. Smoke detector wiring scheme



Air-Fi™ Wireless Communication Interface (WCI)

When installed, the Trane Air-Fi Wireless Communication Interface is located in the evaporator section, near the return air ductwork. The exact mounting location is dependent on the airflow configuration, cabinet size, and fresh air selection. Refer to Figure 22 through Figure 24.

Refer to BAS-SVX40*-EN for instructions and troubleshooting procedures.

Figure 22. WCI mounting location - YZD150-210

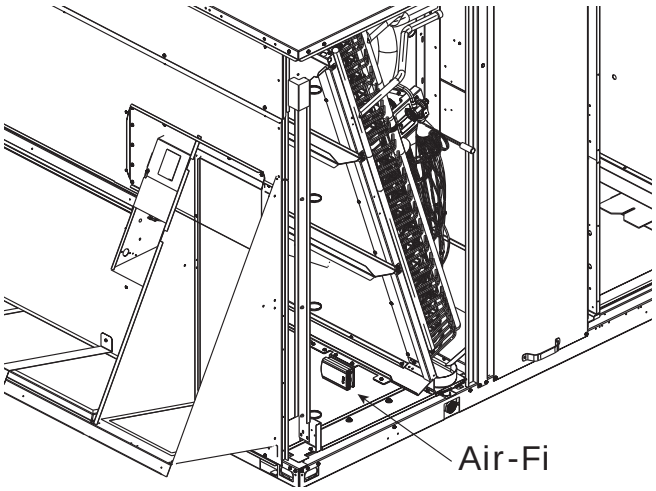


Figure 23. WCI mounting location - YZH150-210

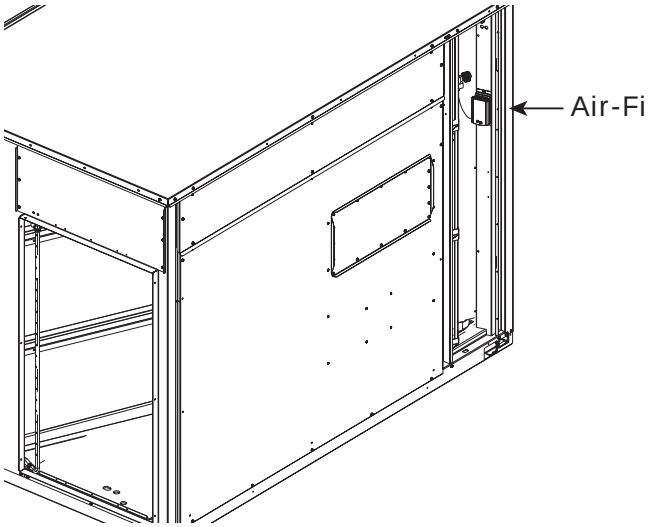
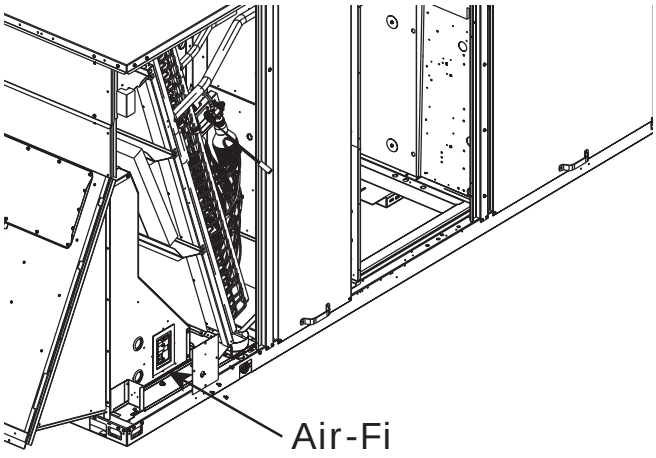


Figure 24. WCI mounting location - YZD150-210 - with low leak economizer



Through the Base Gas Utility Option

This section contains the instructions for making field connections to the Through the Base Gas Utility Option. For gas piping, supply, and manifold pressure information see the unit installation, operation, and maintenance guide.

Field Installed Connections

⚠WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06-EN*

⚠WARNING

Proper Field Wiring and Grounding Required!

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

Important: *All phases of this installation must comply with NATIONAL, STATE, and LOCAL CODES. In absence of local codes, the installation must conform with American National Standard-Z223.1a- National Fuel Gas Code Latest Revision.*

1. Field connections are made by first removing the access panel for the heat section on the front of the unit, Figure 26.
2. The gas piping assembly ships inside this section and includes the shut-off valve, a pressure tap for testing, and the necessary unions for field connection. For through the base access, remove the factory-provided cap from the base pan opening. See Figure 25.
3. Route field piping through this hole to the dimension shown in Table 8.

⚠WARNING

Outlet Pressure Check Required!

This unit uses a negative pressure gas valve. At start-up, the outlet pressure should be checked and adjusted if required to a negative -0.2 inches of water column. Never adjust the regulator to a positive pressure. Failure to follow instructions could result in death or serious injury or equipment damage.

4. Place the assembly through the cabinet opening as shown in Figure 26 and make the union connection to the field piping and to the gas train. Refer to the unit IOM for checkout procedures.

Table 8. Piping hole dimension

Model	Dimension
YZ*210	1 3/16"

Figure 25. Through the base opening

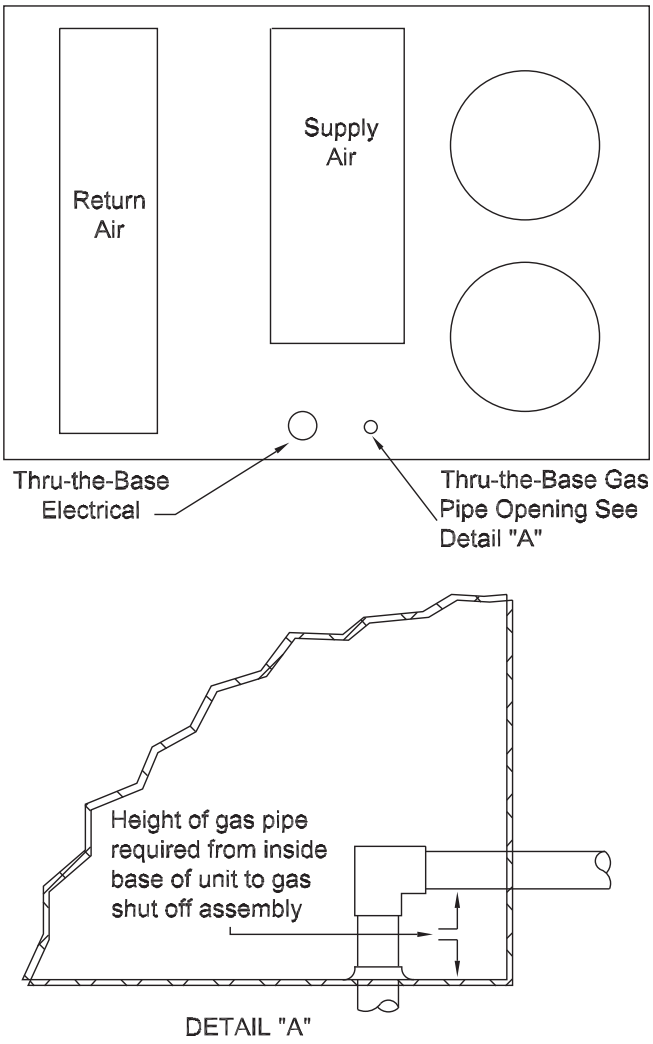
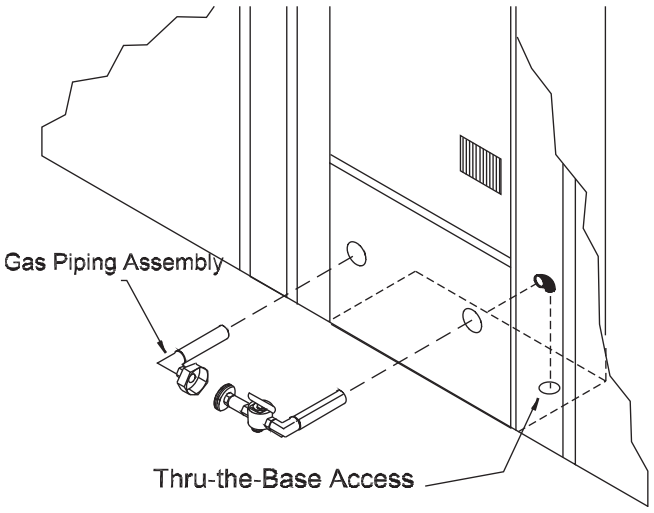


Figure 26. Gas piping



Pre Start

Test Modes

There are three methods in which the "Test" mode can be cycled at LTB-Test 1 and LTB-Test 2.

1. Step Test Mode—This method initiates the different components of the unit, one at a time, by temporarily shorting across the two test terminals for five seconds. For the initial start-up of the unit, this method allows the technician to cycle a component "On" and have up to one hour to complete the check.
2. Resistance Test Mode—This method can be used for start-up providing a decade box for variable resistance outputs is available. This method initiates the different components of the unit, one at a time, when a specific resistance value is placed across the two test terminals. The unit will remain in the specific test mode for approximately one hour even though the resistance is left on the test terminals.
3. Auto Test Mode—This method is not recommended for start-up due to the short timing between individual component steps. This method initiates the different components of the unit, one at a time, when a jumper is installed across the test terminals. The unit will start the first test step and change to the next step every 30 seconds. At the end of the test mode, control of the unit will automatically revert to the applied "System" control method.

For unit test steps, test modes, and step resistance values to cycle the various components, refer to Table 9.

Table 9. Service test guide for component operation

Test Step	Mode	Supply Fan% Output[a] [b]	VSPD Compressor Capacity Output[c] [d]	Fixed Compressor 1	Fixed Compressor 2	Outdoor Fan PWM Output
1	Fan On	0%/25%	0%	OFF	OFF	0%
2	Econ	0%/25%	0%	OFF	OFF	0%
3	Cool 1	67%/75%	50%	OFF	OFF	(e)
4	Cool 2	100%	100%	ON	OFF	(e)
5	Cool 3	100%	100%	ON	ON	(e)
6	Heat 1	100%	0%	OFF	OFF	0%
7	Heat 2	100%	0%	OFF	OFF	0%

(a) The Supply Fan % Output is in reference to the user selected maximum unit fan speed. Unit will operate at 100% fan speed during heating.
(b) First % shown is the control signal percentage. Second % is the actual fan speed percentage.
(c) The Supply Fan and Compressor Outputs shall follow all Startup and Shutdown requirements prior to moving through Test Mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
(d) All Compressor % Outputs are in reference to the 100% capacity point per unit tonnage.
(e) Condenser Fan operation will be controlled based on the active OAT and compressor speed as during normal operation.

Verifying Proper Air Flow (Units with Belt Drive Indoor Fan)

Much of the systems performance and reliability is closely associated with, and dependent upon having the proper airflow supplied both to the space that is being conditioned and across the evaporator coil.
The indoor fan speed is changed by opening or closing the adjustable motor sheave.
Before starting the SERVICE TEST, set the minimum position setpoint for the economizer to 0% using the setpoint potentiometer located on the Economizer Control (RTEM), if applicable.

ReliaTel Control

Using the Service Test Guide in Table 9, momentarily jump across the Test 1 and Test 2 terminals on LTB1 one time to start the Minimum Ventilation Test.
Once the supply fan has started, check for proper rotation. The direction of rotation is indicated by an arrow on the fan housing. With the fan operating properly, determine the total system airflow (cfm):

1. Measure the actual rpm.
2. Measure the total external static pressure.
3. Using the fan performance tables in the unit Service Facts, plot the actual rpm and the bhp to obtain the operating cfm.
4. If the required cfm is too low, (external static pressure is high causing motor horsepower output to be below table value):
   a. Relieve supply and/or return duct static.
   b. Change indoor fan speed and repeat Step 1 and Step 2.
5. To increase fan rpm, loosen the pulley adjustment set screw and turn sheave clockwise.
6. To decrease fan rpm, loosen the pulley adjustment set screw and turn sheave counterclockwise.
7. If the required cfm is too high (external static pressure is low causing motor horsepower output to be above table value), change indoor fan speed and repeat Step 1 and Step 2.
8. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or continue to step through the service test steps.

Start Up

Economizer Start-Up

Using the Service Test Guide in Table 9, p. 33, momentarily jump across the Test 1 and Test 2 terminals on LTB1 one-time to start the Minimum Ventilation Test.

1. Set the minimum position setpoint for the economizer to the required percentage of minimum ventilation using the setpoint potentiometer located on the Economizer Control (ECA).

   The economizer will drive to its minimum position setpoint, exhaust fans (if applicable) may start at random, and the supply fan will start when the SERVICE TEST is initiated.

   The Exhaust Fan will start anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. Exhaust fan setpoint pot, R40 - EXH FAN, located on the RTOM module.
2. Verify that the dampers stroked to the minimum position.
3. Momentarily jump across the Test 1 and Test 2 terminals on LTB one additional time if continuing from previous component start-up or until the desired start-up component Test is started.
4. Verify that the dampers stroked to the full open position.
5. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or proceed to the next component start-up procedure. Remove electro mechanical test mode connections (if applicable).

Compressor Start-Up

1. Attach a set of service gauges onto the suction and discharge gauge ports for each circuit. Refer to the refrigerant circuit illustration in the Service Facts.

   Using the Service Test Guide in Table 9, p. 33, continue the Service Test start-up procedure for each compressor circuit.

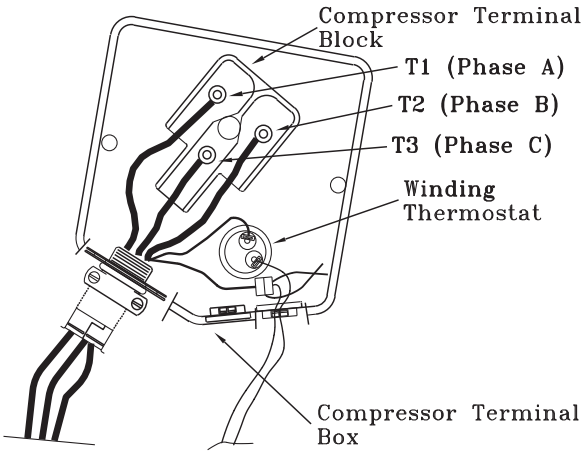
   Momentarily jump across the Test 1 and Test 2 terminals on LTB1 one additional time if continuing from previous component start-up or until the desired startup component Test is started.

   Scroll Compressors

   a. Once each compressor has started, verify that the rotation is correct. If wired correctly the suction pressure should drop and the discharge pressure should rise. If a scroll compressor is rotating backwards, it will not pump and a loud rattling sound can be observed.

   b. If the electrical phasing is correct, before condemning a compressor, interchange any two leads (at the compressor Terminal block) to check the internal phasing. Refer to the following illustration for the compressor terminal/phase identification. Do not allow the compressor to operate backwards for more than 5 seconds. Operation for a period of time longer than this will result in compressor damage. Copeland (Alliance) will experience failure also. If the compressor runs backward for an extended period, the motor winding can overheat and cause the motor winding thermostat to open.

Figure 27. Compressor terminal box



Note: *The Copeland, SSA and SPA scroll compressors for R-410A units use Trane OIL00094. The correct Oil for Trane CSHD is Trane OIL00079 or OIL00080. Compressor types are listed in Table 10. The appropriate oil charge is listed in Table 11.*

Table 10. Compressor types

Tonnage	C1 (Tandem Set)	C2
YZ*150	ZPT88K5E	VRJ028T
YZ*180	ZPT98K5E	VRJ035T
YZ*210	ZPT114K5E	VRJ035T

Table 11. Oil recharge amount (fl. oz.)

	POE		PVE32
Model	C1A	C1B	C2
YZ*150	38	38	30
YZ*180	38	38	39
YZ*210	38	38	39

2. After the compressor and condenser fan have started and operated for approximately 30 minutes, observe the operating pressures. Compare the operating pressures to the operating pressure curve in the Service Facts.

3. Check system subcooling. Follow the instruction listed on the subcooling charging curve in the Service Facts.
4. Repeat Step 1 through Step 3 for each refrigerant circuit.
5. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or proceed to the next component start-up procedure. Remove electro mechanical test mode connections (if applicable).

Dip Switch Settings

Verify that the dip switch settings match the unit model as indicted in Figure 28 and Figure 29.

Figure 28. 12.5T ultra high efficiency unit

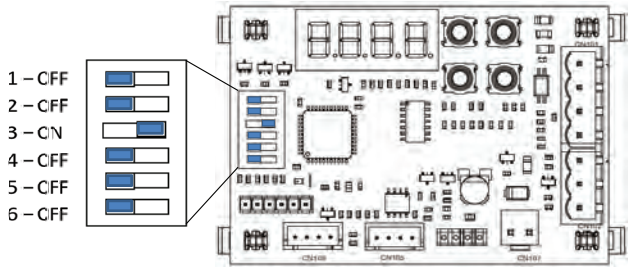
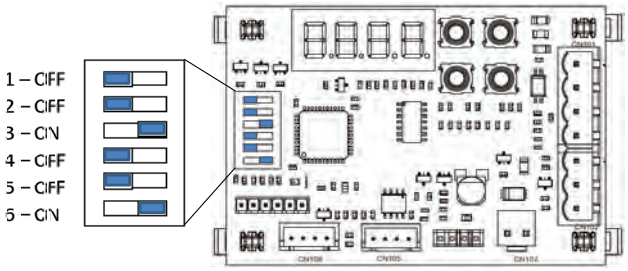


Figure 29. 15T and 17.5T ultra high efficiency units



Heating Start-Up

Open the main disconnect switch to shut the unit off and to reset the RTRM.

Follow the Test Guide in Table 9, p. 33 to start the unit in the heating mode. ReliaTel Control Momentarily jump across the Test 1 and Test 2 terminals on LTB1 one additional time if continuing from previous component start-up or until the desired start-up component Test is started.

Note: *At initial start-up modulating gas heat exchangers can produce a resonance that will subside after the break-in period.*

Final System Set Up

After completing all of the pre-start and start-up procedures outlined in the previous sections (i.e., operating the unit in each of its modes through all available stages of cooling and heating), perform these final checks before leaving the unit:

- Program the Night Setback (NSB) panel (if applicable) for proper unoccupied operation. Refer to the programming instructions for the specific panel.
- Verify that the Remote panel "System" selection switch, "Fan" selection switch, and "Zone Temperature" settings for automatic operation are correct.
- Inspect the unit for misplaced tools, hardware, and debris.
- Verify that all exterior panels including the control panel doors and condenser grilles are secured in place.
- Close the main disconnect switch or circuit protector switch that provides the supply power to the unit's terminal block or the unit mounted disconnect switch.

Sequence of Operation

ReliaTel Controls

- The master module is the ReliaTel Refrigeration Module (RTRM).
- The RTRM provides compressor anti-short cycle timing functions through minimum "Off" and "On" timing to increase reliability, performance and to maximize unit efficiency.
- Upon power initialization, the RTRM performs self-diagnostic checks to insure that all internal controls are functioning. It checks the configuration parameters against the components connected to the system.
- The LED located on the RTRM module is turned "On" within one second after power-up if all internal operations are okay.
- The RTRM in conjunction with the Variable Speed Module (VSM) will provide capability to control of a modulating eFlex™ compressor, and two multispeed outdoor motors (ODM).
- The ReliaTel Options Module (RTOM) is utilized in conjunction with the RTRM for control of a variable speed indoor motor (IDM) and optional accessories.
- All units employ a Phase Monitor to ensure proper power supply connection of phases for compressor operation. If the monitor senses incorrect phase connection (phase reversal), a loss of phase, or large voltage imbalance between phases, all unit operation will be prevented until the condition is corrected. The Phase Monitor has green (Ok) and red (Phase Fault) status LEDs on the face of the monitor. All units are functional tested to ensure correct factory wiring. A red status LED is an indication of a serious problem that can only be resolved by isolating and repairing the Supply Power fault.

ReliaTel Control Cooling without an Economizer

When the system switch is set to the "Cool" position and the zone temperature rises above the cooling setpoint controlband, the RTRM energizes the modulating eFlex compressor starting with the minimum compressor motor speed and runs through a start-up sequence for that compressor, provided the low pressure control (LPC4), high pressure control (HPC3), and the discharge line thermostat (DLT3) are closed. When the eFlex compressor and the outdoor fan motor are energized, they adjust motor speeds in order to maintain the zone temperature (Single Zone VAV) to within +/-0.5°F or Supply Air Temperature (Multi Zone VAV) to within ±1°F of the sensor setpoint at the sensed location. If the modulating compressor at its maximum capacity cannot satisfy the cooling requirement, the RTRM energizes the first fixed speed compressor, provided the low pressure control (LPC1), the high pressure control (HPC1), and the discharge line thermostat (DLT1) are closed, while simultaneously reducing the modulating compressor motor speed to allow a smooth transition in system capacity. When the fixed speed compressor is energized, the ReliaTel control starts to maintain the zone temperature (Single Zone VAV) to within +/-0.5°F or Supply Air Temperature (Multi Zone VAV) to within ±1°F of the sensor setpoint at the sensed location by modulating the eFlex compressor speed and both ODM. If the first two compressors cannot satisfy the load, the second fixed speed compressor is energized in addition to the first fixed speed compressor, provided the low pressure control (LPC1), the high pressure control (HPC2), and the discharge line thermostat (DLT2) are closed. Simultaneously, the modulating compressor speed is reduced for a smooth transition to the higher system capacity. When the third compressor is energized, the ReliaTel control starts to maintain the zone temperature (Single Zone VAV) to within +/-0.5°F or Supply Air Temperature (Multi Zone VAV) to within +/-1°F of the sensor setpoint at the sensed location by modulating the eFlex compressor motor speed and both ODM.

ReliaTel Control Evaporator Fan Operation

With the indoor fan in "Auto" mode, the RTRM energizes the indoor fan motor for approximately 1 second after energizing the modulating compressor in the cooling mode. In the heating mode, the RTRM energizes the indoor fan motor approximately 45 seconds after gas ignition (gas heat unit) or 1 second before energizing electric heat (electric heat unit). With the indoor fan in "On" mode, the RTRM keeps the indoor fan energized for continuous fan motor operation. When the unit is equipped with the optional clogged filter switch, wired to the ReliaTel Options Module (RTOM), the RTRM produces an analog signal output if the clogged filter switch closes for two minutes after a request for fan operation. When the system is connected to a remote panel, the "SERVICE" LED will be turned on when this failure occurs.

Drain Pan Condensate Overflow Switch (Optional)

This input incorporates the Condensate Overflow Switch (COF) mounted on the drain pan and the ReliaTel Options Module (RTOM). When the condensate level reaches the trip point for 6 continuous seconds, the RTOM will shut down all unit function until the overflow condition has cleared. The unit will return to normal operation after 6 continuous seconds with the COF in a non-tripped condition. If the condensate level causes the unit to shutdown more than 2 times in a 3 day period, the unit will be locked-out of operation. A manual reset of the diagnostic system through the Zone Sensor or Building Automation System will be required. Cycling unit power will also clear the fault.

Low Ambient Operation

During low ambient operation, outside air temperature below 40°F, the RTRM will cycle the compressors and outdoor fan motors "Off" for approximately 3 minutes after every 10 minutes of accumulated compressor run time. The indoor fan motor will continue to operate during this evaporator defrost cycle and the compressors and outdoor fans will return to normal operation once the defrost cycle has terminated and the compressor "Off" time delay has been satisfied.

ReliaTel Control Cooling with an Economizer

The economizer is utilized to control the zone temperature providing the outside air conditions are suitable. Outside air is drawn into the unit through modulating dampers. When cooling is required and economizing is possible, the RTRM sends the cooling request to the unit economizer actuator to open the economizer damper.

The RTRM tries to cool the zone utilizing the economizer to slightly below the zone temperature setpoint. If the mixed air sensor (MAS) senses that the mixed air temperature is below 53°F, the damper modulates toward the closed position.

If the zone temperature continues to rise above the zone temperature setpoint controlband and the economizer damper is fully open, the RTRM energizes the modulating eFlex compressor. If the zone temperature continues to rise above the zone temperature setpoint controlband and the economizer damper is fully open, the RTRM instructs the compressor inverter drive to increase the compressor speed to allow more compressor capacity.

If the eFlex compressor is running at its maximum capacity and the zone temperature continues to rise above the zone temperature setpoint controlband and the economizer damper is fully open, the RTRM energizes the first fixed speed compressor, while simultaneously instructing the compressor inverter drive to decrease the eFlex compressor capacity to allow a smooth system capacity transition. If the zone temperature continues to rise above the zone temperature setpoint controlband and the economizer damper is fully open, the RTRM instructs the compressor inverter drive to increase the eFlex compressor speed to allow more compressor capacity.

If the eFlex compressor is running at its maximum capacity and the zone temperature continues to rise above the zone temperature setpoint controlband and the economizer damper is fully open, the RTRM energizes the second fixed speed compressor, while simultaneously decreasing the eFlex compressor speed to allow a smooth transition of system cooling capacity.

All compressor capacity transitions are accompanied by corresponding IDM and ODM speed adjustments to allow optimal unit cooling performance. The ECA continues to modulate the economizer damper open/closed to keep the mixed air temperature that is calculated by the RTRM.

If economizing is not possible, the ECA drives the damper to the minimum position setpoint when the indoor fan relay is energized and allows mechanical cooling operation. When the unit is equipped with the optional fan failure switch, wired to the RTOM, the RTRM will stop all cooling functions and produce an analog output if the fan failure switch does not open within 40 seconds after a request for fan operation. When the system is connected to a remote panel, the "SERVICE" LED will flash when this failure occurs.

Economizer Set-Up

Adjusting the minimum position potentiometer located on the unit economizer actuator (ECA) sets the required amount of ventilation air.

Two of the three methods for determining the suitability of the outside air can be selected utilizing the enthalpy potentiometer on the ECA, as described below:

1. Ambient Temperature-Controlling the economizing cycle by sensing the outside air dry bulb temperature. Table 12 lists the selectable dry bulb values by potentiometer setting.
2. Reference Enthalpy-Controlling the economizer cycle by sensing the outdoor air humidity. Table 12 lists the selectable enthalpy values by potentiometer setting. If the outside air enthalpy value is less than the selected value, the economizer is allowed to operate.
3. Comparative Enthalpy-By utilizing a humidity sensor and a temperature sensor in both the return air stream and the outdoor air stream, the unit control processor (RTRM) will be able to establish which conditions are best suited for maintaining the zone temperature, i.e. indoor conditions or outdoor conditions.

The potentiometer located on the ECA is non-functional when both the temperature and humidity sensors are installed.

Table 12. Potentiometer settings

Potentiometer Setting	Enthalpy	Dry Bulb
A	27 Btu/lb (63 kJ/kg)	73°F (22.8°C)
B	25 Btu/lb (58 kJ/kg)	70°F (21.1°C)
C[(a)]	23 Btu/lb (53 kJ/kg)	67°F (19.4°C)
D	22 Btu/lb (51 kJ/kg)	63°F (17.2°C)
E	19 Btu/lb (44 kJ/kg)	55°F (12.8°C)

(a) Factory setting

ReliaTel Control Heating Operation for Gas Units

When the system switch is set to the "Heat" position and the zone temperature falls below the heating setpoint controlband, a heat cycle is initiated when the RTRM communicates ignition information to the Ignition module.

Modulating Gas Heat 2.5:1 Turndown

In a modulating heat unit, when a call for heat is received, the burner will light at full fire (100%). After the burner is lit, the unit controls will monitor the discharge air temperature and modulate the input rate down to match the load.

Ignition Control Module

Two-Stage (IGN) runs self-check (including verification that the gas valve is de-energized). IGN checks the high-limit switches (TC01 and TC02) for normally closed contacts. With power supplied to the ignition module, the hot surface ignition probe is Preheated. The gas valve is energized for a few seconds for trial for ignition, to ignite the burner. Once the burner is ignited, the hot surface ignition probe is de-energized by the ignition module and functions as the flame sensing device. If the burner fails to ignite, the ignition module will attempt two retries before locking out. The green LED will indicate a lockout by two fast flashes. An ignition lockout can be reset by:

1. Opening for 3 seconds and closing the main power disconnect switch.
2. By switching the "Mode" switch on the zone sensor to "OFF" and then to the desired position.
3. Allowing the ignition control module to reset automatically after one hour. Refer to Table 13 for the LED diagnostic definitions.

When the fan selection switch is set to the "Auto" position, the RTRM energizes the indoor fan relay coil approximately 30 seconds after initiating the heating cycle to start the indoor fan motor. The automatic reset high limit, located in the bottom right corner of the burner compartment, protects against abnormally high leaving air temperatures. The automatic reset fan fail limit, located in the upper middle section of the indoor fan board, protects against abnormally high heat buildup which could occur because of extended cycling of the high limit or if the indoor fan motor fails to operate. Should TCO2 open, the RTRM will energize the indoor fan relay in an attempt to start the fan motor. The RTRM signals that a heat failure has occurred by flashing the "Heat" LED on the zone sensor. There is a green LED located in the Ignition Control Module. Table 13 lists the diagnostics and the status of the LED during the various operating states.

Ignition Control Module Diagnostics

At any time the control is powered, a green LED indicator light shall be lit using the following signal:

Table 13. Ignition module diagnostics

Steady OFF:	No Power/Failure/Internal Failure
Steady ON:	Normal
Slow Flash Rate:	Normal, call for heat (¾ second on, ¼ second off).
Fast Flash Rate:	Used for error indication only (¼ second off, ¾ second on).

Table 13. Ignition module diagnostics

Error Code Fast Flash Rate:	
1 Flash	Communication Issue between Refrigeration Module and 3SH control.
2 Flashes	System Lockout: Failed to detect or sustain flame.
3 Flashes	Not implemented.
4 Flashes	High Limit switch protection device open.
5 Flashes	Flame sensed and gas valve not energized or flame sensed and no call for heat.
6 Flashes	Not implemented.

Note: The pause between groups of fast flashes is approximately two seconds. Additionally, the LED indicator light shall flash for one second at power-up.

Enhanced Dehumidification

Note: *Enhanced Dehumidification is not be supported on Multiple Zone VAV.*

Enhanced Dehumidification is available on all units equipped with a Space Humidity sensor. Once the Space Humidity value exceeds the Dehumidification Setpoint and dehumidification is enabled the unit will transition to the Enhanced Dehumidification mode. If the unit is actively cooling, the ReliaTel control will latch the current compressor operation and reduce the current indoor airflow. If the unit is not actively cooling when the Enhanced Dehumidification mode is activated, the unit will energize a single fixed speed compressor and the modulating eFlex compressor will ramp to a fixed speed while engaging the IDM and both ODM at the appropriate airflow for that condition. If during active enhanced dehumidification the Space Humidity falls below the Dehumidification Setpoint – 2%, Dehumidification will be terminated and the unit will transition back to normal Cooling or Heating control.

Single Zone Variable Air Volume (Single Zone VAV) Control

For normal Cooling operation, available cooling capacity will be modulated in order to meet the calculated discharge air setpoint between the user selected upper and lower limits. If the current active cooling capacity is controlling the discharge air within the deadband no additional Cooling capacity change will be requested. As the Discharge Air Temperature rises above the deadband the control will request additional capacity as required (additional compressor operation or economizer). As the Discharge Air Temperature falls below the deadband the algorithm will request a reduction in active capacity.

Cooling Operation

If the control determines that there is a need for compressor operation in order to meet the discharge air requirements, once supply fan proving has been made, the unit will begin to modulate compressors. As the zone cooling demand continues to increase, if additional capacity is required, the supply fan output will be modulated above minimum speed in order to meet the zone requirements.

Note: *The supply fan speed will remain at the activated compressors' associated minimum value until the control requires additional capacity to meet the zone demand.*

As the cooling load in the zone decreases the control will reduce the speed of the fan down to minimum per compressor operation and control the compressor outputs accordingly. As the compressors begin to de-energize, the Supply Fan speed will fall back to the Cooling Capacity's associated minimum fan speed but not below. As the load in the zone continues to drop, cooling capacity will be reduced in order to maintain the calculated discharge air setpoint.

Economizer Cooling

During normal Economizer Cooling, the fan speed will operate at its minimum. However, if the economizer is able to meet the demand alone, due to desirable ambient conditions, the supply fan speed will be allowed to increase above the minimum prior to utilizing mechanical cooling. Note that Economizer Enable/Disable decisions will be made based on the previous sections; however, the economizer control point will now be variable based on the zone cooling demand.

Demand Controlled Ventilation

Units configured for SZVAV and Demand Controlled Ventilation (CO_2 sensor value available) require a new control scheme comprised of 2 existing schemes that have been traditionally mutually exclusive; DCV and OA CFM Compensation. Units configured with DCV will invoke the new Demand Controlled Ventilation scheme which allows variable Bldg. Design and DCV Minimum Positions and OA Damper Position Target setpoints based on the supply fan speed and space CO_2 requirements.

Economizer Damper Position Set-Up with DCV

This new scheme will require the setting of 5 OA Damper position setpoints; 3 more than on non-SZ VAV. These new setpoints are located on the RTVM module:

1. Design Min Position @ Minimum Fan Speed Command (RTVM R130)
2. Design Min Position @ Middle Fan Speed Command (RTVM R136)
3. Design Min Position @ Full Fan Speed Command (RTEM Design Min Position)
4. DCV Min Position @ Minimum Fan Speed Command (RTVM R41)
5. DCV Min position @ Full Fan Speed Command (RTEM DCV Min Position)

As the supply fan speed command varies between minimum and maximum, the Building Design and DCV Minimum Position Targets will be calculated between the user selected setpoints based on the instantaneous supply fan speed. The Bldg. Design and DCV Minimum Position Targets will be used to calculate the Active OA Damper Minimum Position Target, as on traditional units, based on the Space CO2 relative to the active Design and DCV CO2 setpoints.

By default, the Design Minimum Position schedule will be a linear line through all user selectable Design Minimum Position setpoints. The user will have the ability to set the Design Minimum Position at Middle fan speed command to a point that would be lower than the calculated linear line between the Design Minimum Position setpoints at 0% and 100% fan speed command in order to compensate for the non-linear outside airflow through the fan and damper modulation range. However, if the Design Minimum Position at Middle fan speed command is set to a point that would be higher than the calculated linear line between the Design Minimum Position setpoints at Minimum and Full fan speed command, the minimum position will be limited to the point that would make the Design Minimum Position schedule linear.

Provisions have been made in Service Test Mode to allow for proper damper minimum position setup:

1. To set the Design and DCV Minimum Position setpoints at Minimum Fan Speed, set the unit to operate at Step 1 (Fan ON) or Step 2 (Economizer Open) and make the proper adjustments.
2. To set the Design Minimum Position setpoint at Middle Fan Speed, set the unit to operate at Step 3 (Cool 1) and make the proper adjustment.
3. To set the Design and DCV Minimum Position setpoints at Full Fan Speed, set the unit to operate at Step 4 (Cool 2) and make the proper adjustments.

Economizer Damper Position Set-Up without DCV

For units not configured with DCV (no CO_2 sensor value available), additional minimum position setpoints to increase outdoor airflow accuracy will be supported. The operation will be similar to OA CFM Compensation on Traditional VAV units with the addition of a Design Minimum Position setpoint at Middle Fan Speed Command. The following setpoint potentiometers will be used on the RTEM:

1. Design Min at Minimum Fan Speed Command (RTEM DCV Min)
2. Design Min at Middle Fan Speed Command (RTEM DCV Setpoint LL)
3. Design Min at Full Fan Speed Command (RTEM Design Min)

The controller will calculate the active OA Damper Minimum position between the user-selected setpoints based on the supply fan speed command. By Default, the Design Minimum Position schedule will be a linear line through all user selectable Design Minimum Position setpoints. As with Demand Controlled Ventilation, if the Design Minimum Position at Middle fan speed command is set to a point that would be higher than the calculated linear line between the Design Minimum Position setpoints at Minimum and Maximum fan speed command, the minimum position will be limited to the point that would make the Design Minimum Position schedule linear.

Provisions have been made in Service Test Mode to allow for proper damper minimum position setup:

1. To set the Design Minimum Position setpoint at Minimum Fan Speed, set the unit to operate at Step 1 (Fan ON) or Step 2 (Economizer Open) and make the proper adjustment.
2. To set the Design Minimum Position setpoint at Middle Fan Speed, set the unit to operate at Step 3 (Cool 1) and make the proper adjustment.
3. To set the Design Minimum Position setpoint at Full Fan Speed, set the unit to operate at Step 4 (Cool 2) and make the proper adjustment.

Heating Operation

Heating operation on units configured with Single Zone VAV control will utilize two separate control methodologies based on heating configurations. For all "Staged" Heating types, the unit will utilize 100% full airflow during all active heating periods like traditional Constant Volume units. For Modulating Gas heat units, the unit will have the ability to control the discharge air temperature to the calculated discharge air heating setpoint in order to maintain the Zone Temperature to the Zone Heating setpoint.

Staged Heating Operation

For units configured with Staged Heat once the control determines that there is an active heating capacity request, the unit will energize the Supply Fan and ramp up to full speed. The control methodology during Active Heating on units configured with Staged Heat types will be identical to traditional Constant Volume units; heating stages will be energized/de-energized to meet the Zone Heating demand.

Note: *All heat staging sequences will be identical to Constant Volume unit staging sequences.*

Modulating Heat Operation with SZVAV Heating

Units configured with Modulating Gas Heat will utilize true Single Zone VAV control in the same manner as during Active Cooling.

Heating Sequence

Once the unit control determines that there is a space heating demand, the unit will transition into zone heating. Once the Discharge Air Temperature falls below the calculated discharge air temperature setpoint, the unit will initiate the Modulating Heat output request and control the supply fan at minimum speed. At this point, the Modulating Heat output will be controlled to maintain the discharge air temperature requirements and the supply fan speed will be controlled between 63%-100% to meet the zone heating requirements.

As the heating load in the zone decreases the fan speed will decrease down to minimum (63%) and control the modulating heat output as necessary to meet the discharge air heating requirements. As the load in the zone continues to drop the fan speed will be maintained at this minimum airflow and the modulating heat output will be controlled accordingly.

Low Ambient Operation

The indoor fan motor (IDM) will operate at 100% fan speed during this evaporator defrost cycle (EDC) and the compressor and outdoor fan will return to normal operation once the defrost cycle has terminated and the compressor "Off" time delay has been satisfied.

Clogged Filter Option

The unit mounted clogged filter switch monitors the pressure differential across the return air filters. It is mounted in the indoor section and is connected to the RTOM. The clogged filter switch is normally open and will automatically close when the pressure differential across the filters falls below the clogged filter setpoint. The RTOM will generate a SERVICE diagnostic that will be sent to the zone sensor or remote panel when the clogged filter switch has been closed for at least 2 minutes during supply fan operation. The system will continue to operate regardless of the status of the clogged filter switch.

Ventilation Override

Note: *Applying 24 volts to one of the three Ventilation Override inputs manually activates ventilation override. One input is provided to request the Pressurize Mode, the second input the Purge Mode, and the third input the Exhaust Mode.*

When the Pressurize Mode is selected, activating Ventilation Override will cause the supply fan to run, the economizer to open to 100%, the exhaust fan to turn (remain) off, or the VFD to run at full speed, and the VAV boxes to fully open.

When Purge is selected, activating Ventilation Override will cause the supply fan to run, the economizer to open to 100%, the exhaust fan to run, or the VFD to run at full speed, and the VAV boxes to fully open.

When Exhaust is selected, activating Ventilation Override will cause the supply fan to turn off, the economizer to close to 0%, the exhaust fan to run (exhaust damper at 100% if configured for Statitrac), or the VFD to stop, and the VAV boxes to operate normally.

If more than one mode is requested at the same time, the Pressurize request will have priority followed by Purge. When any Ventilation Override Mode is active, all heating and cooling is turned off. For the case where the unit is required to turn off, the Emergency Stop input is used. The ICS can also initiate any ventilation override mode. Table 14 lists the sequence of events within the system for each ventilation mode. Refer to the unit wiring diagram for contact switching and wiring.

Note: *Fresh air tracking will not work with VOM.*

Table 14. Ventilation override sequence

Affected Function	Mode and Priority		
	Pressurize	**Purge**	**Exhaust[a]**
	1	2	3
Heat/Cool	off	off	off
VFD	full speed	full speed	full speed
Supply Fan	on	on	off
Exhaust Fan	off	on[b]	on
Economizer	open	open	closed
VAV Boxes	forced open	forced open	normal operation

(a) Exhaust mode 3 is not available with the tracking power exhaust option.
(b) For units configured with the Statitrac option, the Exhaust Damper will open during Ventilation Override modes that request the exhaust fan to operate.

Emergency Stop

When this binary input is opened, all outputs are immediately turned off and the system will not be allowed to restart until the binary input is closed for approximately 5 seconds minimum. The shutdown is communicated to Tracer™ if applicable and the Heat and Cool LED outputs (RTRM J6-7 and J6-8) will blink at a nominal rate of 1 blink per second.

Phase Monitor

The Phase Monitor is a 3 phase line monitor module that protects against phase loss, phase reversal and phase unbalance. It is intended to protect compressors from reverse rotation. It has an operating input voltage range of 190-600 VAC, and LED indicators for ON and FAULT. There are no field adjustments and the module will automatically reset from a fault condition.

Low Pressure Control

This input incorporates the low pressure cutout of each refrigeration circuit and can be activated by opening a field supplied contact.

If this circuit is open before a compressor(s) is started, the compressor(s) in that circuit will not be allowed to operate.

Anytime this circuit is opened for 5 continuous seconds, the compressor(s) in that circuit are turned off immediately. The compressor(s) will not be allowed to restart for a minimum of 3 minutes.

If four consecutive open conditions occur during the first three minutes of operation, the compressor(s) in that circuit will be locked out, a diagnostic communicated to Tracer, and a manual reset will be required to restart the compressor(s).

High Pressure Cutout and Temperature Discharge Limit

The high pressure controls and temperature discharge limit are wired in series between the compressor outputs on the RTRM and the compressor contactors. If the high pressure safety or temperature discharge limit opens, the compressor(s) on the affected circuit is locked out. If the compressor output circuit is opened four consecutive times during compressor operation, the RTRM will generate a manual reset lockout.

Coil Frost Protection

The Frostat™ control monitors the evaporator coil temperature to prevent the evaporator from freezing due to low operating temperatures whenever there is a demand for cooling. When a closed circuit has occurred for 5 seconds minimum, the RTRM turns off all of the cooling outputs. The Supply Fan will be held “On” until the Frostat has been opened for 5 continuous seconds or for 60 seconds after the last compressor was shut “Off”, whichever is the longest. The compressor shutdown is communicated to Tracer, if applicable. There is no local diagnostic for this condition.

Failure and Override Modes

Certain failure and overriding conditions require special handling of the Supply Fan Speed on units configured with Single Zone VAV. See below for a list of these conditions:

- Supply Fan Proving Failure - If a Supply Fan Proving failure is detected, the Supply Fan will be de-energized

after 40s of run time and the Fan Speed output will go to 0 Vdc (0%).

- Ventilation Override Mode - If a VOM goes active in which the Supply Fan is commanded ON (Purge, Pressurize, etc.), the Supply Fan will be energized and the Fan Speed output will ramp to 100%.
- Zone Temperature Sensor Failure - If the Active Zone Temperature input goes out of range, the unit will discontinue all Heating, Cooling, and Dehumidification operation.
- Supply Air Temperature Sensor Failure - If the Supply Air Temperature input goes out of range, the unit will revert back to Full Airflow, Traditional CV control. The unit will call out a Supply Air Temperature Sensor Failure Alarm, the RTRM System LED will flash the 2-blink error code, and the Zone Sensor Heat (Modulating Heat Only) and Cool LEDs will flash.
- Frostat Failure - If a Frostat failure occurs, all active Heating, Cooling, and Dehumidification will be de-energized immediately and the Supply Fan will ramp up to 100%.
- Heat Failure (High Temp. Limit Trip) - If a unit configured with Gas Heat has a High Temp. Limit trip, the Supply Fan will be requested to remain ON and the Fan Speed output will ramp to full speed.

Variable Air Volume Applications (Traditional VAV)

Supply Air Temperature Control - Occupied Cooling and Heating

The RTRM is designed to maintain a selectable supply air temperature of 40°F to 90°F with a +/- 3.5°F deadband.

Note: *To reduce the risk of coil freezing, it is not recommended to set the supply air temperature below 50°F.*

In cooling, if supply air temperature is more than 3.5 degrees warmer than the selected temperature, a stage of cooling will be turned "On" (if available). Then if the supply air temperature is more than 3.5 degrees cooler than the selected temperature, a stage of cooling will be turned "Off". At very low airflows the unit may cycle stages "On" and "Off" to maintain an average discharge air temperature outside the 7 degree deadband.

If the unit has modulating heat, the unit can be made to do discharge heating with VAV control. This is done by placing a contact closure across the "Changeover Input" on the RTAM. During this mode, the unit will heat to the Supply Air Heating Setpoint +/- 3.5°F. During low load or low airflow conditions the actual temperature swing of the discharge air will likely be greater.

The RTRM utilizes a proportional and integral control scheme with the integration occurring when the supply air temperature is outside the deadband. As long as the supply air temperature is within the setpoint deadband, the system is considered to be satisfied and no staging up or down will occur.

Supply Air Temperature Control with an Economizer

The economizer is utilized to control the supply air cooling at +1.5°F around the supply air temperature setpoint range of 40°F and 90°F providing the outside air conditions are suitable. While economizing, the mechanical cooling is disabled until the economizer dampers have been fully open for three minutes. If the economizer is disabled due to unsuitable conditions, the mechanical cooling will cycle as though the unit had no economizer.

VHR Relay Output

During unoccupied mode, daytime warm-up (DWU) and morning warm-up (MWU) the VFD will open to 100%. All VAV boxes must be opened through an ICS program or by the VHR wired to the VAV boxes. The RTRM will delay 100% fan operation approximately 6.5 minutes when switching from occupied cooling mode to a heating mode.

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Cooling

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and RTRM J6-12, both the economizer and the mechanical cooling will be disabled.

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Heating

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and J6-12 and DWU is enabled, the zone temperature will be controlled at 10°F below the Morning Warm-up setpoint, but not less than 50°F, by cycling one or two stages of either gas or electric heat, whichever is applicable.

Morning Warm-up (MWU) Control

Morning Warm-up is activated if the zone temperature is at least 1.5°F below the MWU setpoint whenever the system switches from Unoccupied to Occupied status. The MWU setpoint may be set from the unit mounted potentiometer or a remotely mounted potentiometer. The setpoint ranges are from 50°F to 90°F. When the zone temperature meets or exceeds the MWU setpoint, the unit will switch to the "Cooling" mode. The economizer will be held closed during the morning warm-up cycle.

Daytime Warm-up (DWU) Control

Daytime Warm-up is applicable during occupied status and when the zone temperature is below the initiation temperature. It can be activated or deactivated through

ICS or a night setback zone sensor. If ICS or a night setback zone sensor is not utilized, DWU can be activated by setting the DWU enable DIP switch (RTAM) to ON and supplying a valid morning warm-up setpoint. The unit is shipped with a Morning Warm-up setpoint configured and the Daytime Warm-up function is activated (switch on). Opening the DWU enable switch will disable this function. If the system control is local, the DWU initiation setpoint is 3°F below the Morning Warm-up setpoint. The termination setpoint is equal to the Morning Warm-up setpoint. If the system control is remote (Tracer™), the DWU setpoint is equal to the Tracer Occupied heating setpoint. The initiation and termination setpoints are selectable setpoints designated by Tracer. When the zone temperature meets or exceeds the termination setpoint while the unit is in an Occupied, "Auto" Mode or switched to the "Cooling" Mode, the unit will revert to the cooling operation. If an Occupied "Heating" Mode is selected, the unit will only function within the DWU perimeters until the system is switched from the "Heat" Mode or enters an Unoccupied status.

Note: *When a LCI is installed on a VAV unit, the MWU setpoint located on the RTAM board is ignored. The MWU and DWU setpoints come from the higher priority LCI-R DAC.*

Table 15. Variable air volume mode operation

System Mode		Fan "Auto"	Fan "On"
Heat	DWU Active DWU Off	DWU[2] Off[4]	DWU[2] VAV Heating[4]
Cool		VAV Cooling[1]	VAV Cooling[1]
Auto	DWU Active DWU Off	DWU or Cooling[1,2,3,4] VAV Cooling[1]	DWU or Cooling[1,2,3,4] VAV Cooling or Heating[1]
Off		Off[4]	Off[4]

Notes:
1. If Cooling is selected the supply fan will run continuously. If VAV Heating is activated the supply fan will run continuously.
2. If Daytime Warmup is Activated, the supply fan will run continuously.
3. Auto changeover between Cooling and Daytime Warmup depends upon the DWU initiate setpoint.
4. The fan will be Off any time the system selection switch is "Off".

Supply Duct Static Pressure Control

The supply duct static pressure is measured by a transducer with a 0.25 to 2.125 Vdc proportional output which corresponds to an adjustable supply duct static pressure of 0.3" w.c. to 2.5" w.c. respectively with a deadband adjustment range from 0.2" w.c. to 1.0" w.c. The setpoint is adjustable on the RTAM Static Pressure Setpoint potentiometer or through ICS.

Example:
Supply Duct Static setpoint = 2.0" w.c. (RTAM)
Deadband = 0.2" w.c. (RTAM)
Duct Static Control Range = 1.9" w.c. to 2.1" w.c.

Mechanical Cooling with an Economizer

The economizer is utilized to control the zone temperature when the outside air conditions are suitable. The method used to determine economizer effectiveness, depending on the available data, is described below in descending order of complexity.

Table 16. Economizer effectiveness

Method used to determine economizer effectiveness	Required
Comparative Enthalpy	OAT, OAH, RAT, RAH
Reference Enthalpy	OAT, OAH
Reference Dry Bulb	OAT
Unable to determine effectiveness	OAT data is invalid or unavailable

The most sophisticated method available is always used. Two of the three methods for determining the suitability of the outside air can be selected utilizing the potentiometer on the Economizer Actuator, as described below:

1. Ambient Temperature - controlling the economizing cycle by sensing the outside air dry bulb temperature. Table 17 lists the selectable dry bulb values by potentiometer setting.
2. Reference Enthalpy - controlling the economizer cycle by sensing the outdoor air humidity. Table 17 lists the selectable enthalpy values by potentiometer setting. If the outside air enthalpy value is less than the selected value, the economizer is allowed to operate.

Table 17. Economizer configuration

Selection	Dry Bulb	Enthalpy Value
A	73°F	27 BTU/LB Air
B	70°F	25 BTU/LB Air
C	67°F	23 BTU/LB Air
D	63°F	22 BTU/LB Air
E	55°F	19 BTU/LB Air

3. Comparative Enthalpy - By utilizing a humidity sensor and a temperature sensor in both the return air stream and the outdoor air stream, the economizer will be able to establish which conditions are best suited for maintaining the zone temperature, i.e., indoor conditions or outdoor conditions.

Off Mode

This mode is set at the zone sensor or by ICS. During this status, no heating, ventilation, or mechanical cooling is being performed. When switching the "System" selector to the "Off" mode from any other mode, any diagnostic data and diagnostic indication signal will be retained as long as the system remains in the "Off" status. Switching the "System" selector from the "Off" mode back to any other mode of operation will reset all diagnostics.

Heating Operation

Heating operation on units configured with Traditional Multi-Zone VAV control will utilize two separate control methodologies based on heating configurations. For all "Staged" Heating types, the unit will utilize 100% full airflow during all active heating periods like traditional Constant Volume units. If the unit has modulating heat, the unit can be made to do discharge heating with VAV control. This is done by placing by placing a contact closure across the "Changeover Input" on the RTAM. During this mode, the unit will heat to the Supply Air Heating Setpoint ± 3.5°F. During low load or low airflow conditions the actual temperature swing of the discharge air will likely be greater.

Zone Temperature - Unoccupied Heating

While a building is in an unoccupied period as designated by a remote panel with night setback or ICS, the necessary heating capacity will be controlled to maintain the zone temperature to within the unoccupied setpoint deadband. For traditional VAV systems, the VFD will operate at 100% during this mode. It will be necessary to drive VAV boxes to their maximum position through ICS programming or the factory provided VHR relay. For Modulating Gas Heat units, Full Airflow is not required but can be enabled by connecting the changeover mode input J5-1 and J5-2 on the RTAM module. For all Staged Heating types, the Supply Fan will be controlled at maximum fan speed during active heating operation as during Occupied periods.

Gas Heat Control

The ignition sequence and timing are provided by a separate heat control module. The RTRM only provides the heating outputs to initiate 1st and 2nd stages and control the combustion blower relay. Both stages of the furnace will start and operate for one minute and then cycle back if only one stage is required. Units with modulating heat capabilities will light on high fire for one minute and then modulate to the appropriate heating rate for the building load present.

Maintenance

Make sure all personnel are standing clear of the unit before proceeding. The system components will start when the power is applied.

Fan Belt Adjustment—Belt Drive Units

⚠WARNING

Rotating Components!

The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.

The fan belts must be inspected periodically to assure proper unit operation.

Replacement is necessary if the belts appear frayed or worn. Units with dual belts require a matched set of belts to ensure equal belt length.

When removing or installing the new belts, do not stretch them over the sheaves. Loosen the belts using the belt tension adjustment bolts on the motor mounting base.

Once the new belts are installed, using a Browning or Gates tension gauge (or equivalent) illustrated in Figure 30; adjust the belt tension as follows;

1. To determine the appropriate belt deflection;
   a. Measure the center-to-center shaft distance (in inches) between the fan and motor sheaves.
   b. Divide the distance measured in Step 1a by 64; the resulting value represents the amount of belt deflection that corresponds to the proper belt tension.
2. Set the large O-ring on the belt tension gauge at the deflection value determined in Step 1b.
3. Set the small O-ring at zero on the force scale of the gauge plunger.
4. Place the large end of the gauge at the center of the belt span; then depress the gauge plunger until the large O-ring is even with the top of the next belt or even with a straightedge placed across the fan and motor sheaves.

   Refer to Table 18.
5. Remove the belt tension gauge. The small O-ring now indicates a number other than zero on the plunger's force scale. This number represents the force (in pounds) required to give the needed deflection.
6. Compare the "force" scale reading (Step 5) with the appropriate "force" value listed in Table 18. If the "force" reading is outside the range, readjust the belt tension.

Note: *Actual belt deflection "force" must not exceed the maximum "force" value shown in Table 18.*

7. Recheck the belt tension at least twice during the first 2 to 3 days of operation. Belt tension may decrease until the new belts are "run in".

Figure 30. Belt tension gauge

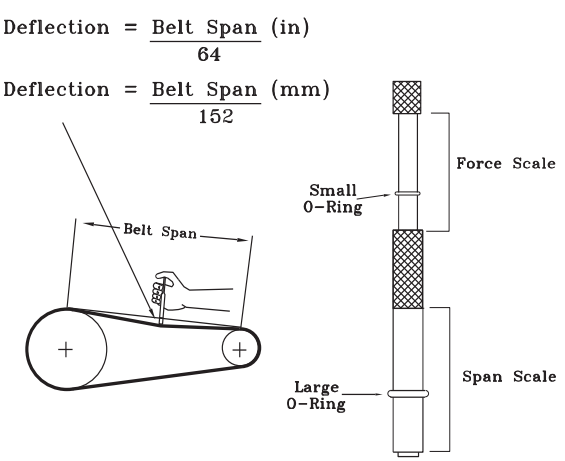


Table 18. Belt tension measurement and deflection ranges

Belts Cross Section	Small P.D Range (in.)	Deflection Force (lb)					
		Super Gripbelts (in.)		Gripnotch (in.)		Steel Cable Gripbelts (in.)	
		Min.	Max.	Min.	Max	Min.	Max.
A	3.0–3.6	3	4 1/2	3 7/8	5 1/2	3 1/4	4
	3.8–4.8	3 1/2	5	4 1/2	6 1/4	3 3/4	4 3/4
	5.0–7.0	4	5 1/2	5	6 7/8	4 1/4	5 1/4
B	3.4–4.2	4	5 1/2	5 3/4	8	4 1/2	5 1/2
	4.4–5.6	5 1/8	7 1/8	6 1/2	9 1/8	5 3/4	7 1/4
	5.8–8.8	6 3/8	8 3/4	7 3/8	10 1/8	7	8 3/4

Belts Cross Section	Small P.D Range (mm)	Deflection Force (kg)					
		Super Gripbelts (mm)		Gripnotch (mm)		Steel Cable Gripbelts (mm)	
		Min.	Max.	Min.	Max.	Min.	Max
A	13.3–16.0	13.3	20.0	17.2	24.5	14.5	17.8
	16.9–21.4	15.6	22.2	20.0	27.8	16.7	21.1
	22.0–31.1	17.8	24.5	22.2	30.6	18.9	23.4
B	15.1–18.7	17.8	24.5	25.6	35.6	20.0	24.5
	19.6–24.9	22.8	31.7	28.9	40.6	25.6	32.3
	25.8–39.1	28.4	38.9	32.8	45.0	31.1	38.9

Monthly Maintenance

Before completing the following checks, turn the unit OFF and lock the main power disconnect switch open.

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

Filters

Inspect the return air filters. Clean or replace them if necessary. Refer to the unit Service Facts for filter information.

Return Air Smoke Detector Maintenance

Airflow through the unit is affected by the amount of dirt and debris accumulated on the indoor coil and filters.

To insure that airflow through the unit is adequate for proper sampling by the return air smoke detector, complete adherence to the maintenance procedures, including recommended intervals between filter changes, and coil cleaning is required.

Periodic checks and maintenance procedures must be performed on the smoke detector to insure that it will function properly.

For detailed instructions concerning these checks and procedures, refer to the appropriate section(s) of the smoke detector Installation and Maintenance Instructions provided with the literature package for this unit.

Condensate Overflow Switch

During maintenance, the switch float (black ring) must be checked to ensure free movement up and down.

Cooling Season

- Check the unit's drain pans and condensate piping to ensure that there are no blockages.
- Inspect the evaporator and condenser coils for dirt, bent fins, etc. If the coils appear dirty, clean them according to the instructions described in "Condenser Coil Cleaning," p. 46.
- Manually rotate the condenser fan(s) to ensure free movement and check motor bearings for wear. Verify that all of the fan mounting hardware is tight.
- Inspect the F/A-R/A damper hinges and pins to ensure that all moving parts are securely mounted. Keep the blades clean as necessary.
- Verify that all damper linkages move freely; lubricate with white grease, if necessary.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Check the fan shaft bearings for wear. Replace the bearings as necessary.
- Check the supply fan belt. If the belt is frayed or worn, replace it. Refer to "Fan Belt Adjustment—Belt Drive Units," p. 45 for belt replacement and adjustments.
- Verify that all wire terminal connections are tight.
- Remove any corrosion present on the exterior surfaces of the unit and repaint these areas.
- Generally inspect the unit for unusual conditions (e.g., loose access panels, leaking piping connections, etc.).
- Make sure that all retaining screws are reinstalled in the unit access panels once these checks are complete.
- With the unit running, check and record the: ambient temperature; compressor suction and discharge pressures (each circuit); superheat (each circuit); Record this data on an "operator's maintenance log" like the one shown in Table 19, p. 47. If the operating pressures indicate a refrigerant shortage, measure the system superheat. For guidelines, refer to "Compressor Start-Up," p. 34.

Note: *Do NOT release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state and local laws.*

Heating Season

- Inspect the unit's air filters. If necessary, clean or replace them.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Inspect both the main unit control panel and heat section control box for loose electrical components and terminal connections, as well as damaged wire insulation. Make any necessary repairs.

Condenser Coil Cleaning

Regular coil maintenance, including annual cleaning, enhances the unit's operating efficiency by minimizing: compressor head pressure and amperage draw; evaporator water carryover; fan brake horsepower, due to increase static pressure losses; airflow reduction.

At least once each year, or more often if the unit is located in a "dirty" environment, clean the condenser coils using the instructions outlined below. Be sure to follow these instructions as closely as possible to avoid damaging the coils.

Microchannel (MCHE) Coils

NOTICE

Coil Damage!

DO NOT use any detergents with microchannel condenser coils. Use pressurized water or air ONLY, with pressure no greater than 600psi. Failure to do so could result in coil damage.

For additional information regarding the proper microchannel coil cleaning / repair procedures, refer to RTSVB83-EN.*

Due to the soft material and thin walls of the MCHE coils, the traditional field maintenance method recommended for Round Tube Plate Fin (RTPF) coils does not apply to microchannel coils.

Moreover, chemical cleaners are a risk factor to MCHE due to the material of the coil. The manufacturer does not recommend the use of chemical cleaners to clean microchannel coils. Using chemical cleaners could lead to warranty claims being further evaluated for validity and failure analysis.

The recommended cleaning method for microchannel condenser coils is pressurized water or air with a non-pinpoint nozzle and an ECU of at least 180 with pressure no greater than 600 psi. To minimize the risk of coil damage, approach the cleaning of the coil with the pressure washer aimed perpendicular to the face of the coil during cleaning. Optimum clearance between the sprayer nozzle and the microchannel coil is 1″–3″.

Final Process

For future reference, you may find it helpful to record the unit data requested below in the blanks provided.

(1) Complete Unit Model Number:

_____

(2) Unit Serial Number:

_____

(3) Wiring Diagram Numbers (from unit control panel)

— schematic(s)

_____

_____

— connection(s)

_____

_____

_

Table 19. Sample maintenance log

Date	Current Ambient Temp F/C	Refrigerant Circuit #1							Refrigerant Circuit #2					
		Compr. 1 Oil Level	Compr. 2 Oil Level	Suct. Press. Psig/kPa	Disch. Press Psig/kPa	Liquid Press Psig/kPa	Super-heat F/C	Sub-cool F/C	Compr. 1 Oil Level	Suct. Press. Psig/kPa	Disch. Press Psig/kPa	Liquid Press Psig/kPa	Super-heat F/C	Sub-cool F/C
		- ok - low							- ok - low					
		- ok - low							- ok - low					
		- ok - low							- ok - low					
		- ok - low							- ok - low					
		- ok - low							- ok - low					
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		- ok - low							- ok - low					
		- ok - low							- ok - low					
		- ok - low							- ok - low					

Troubleshooting

⚠WARNING

Hazardous Service Procedures!

The maintenance and troubleshooting procedures recommended in this section of the manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.

ReliaTel Control

The RTRM has the ability to provide the service personnel with some unit diagnostics and system status information.

Before turning the main power disconnect switch "Off", follow the steps below to check the ReliaTel™ Refrigeration Module (RTRM). All diagnostics and system status information stored in the RTRM will be lost when the main power is turned "Off".

To prevent injury or death from electrocution, it is the responsibility of the technician to recognize this hazard and use extreme care when performing service procedures with the electrical power energized.

1. Verify that the Liteport LED on the RTRM is burning continuously. If the LED is lit, go to Step 3.
2. If the LED is not lit, verify that 24 Vac is presence between J1-1 and J1-2. If 24 Vac is present, proceed to Step 3.

   If 24 Vac is not present, check the unit main power supply, check transformer (TNS1). Proceed to Step 3 if necessary.
3. Utilizing "Method 1" or "Method 2" in the "System Status Checkout Procedure, check the following:

   System status

   Heating status

   Cooling status

   If a System failure is indicated, proceed to Step 4. If no failures are indicated, proceed to Step 5.
4. If a System failure is indicated, recheck Step 1 and Step 2. If the LED is not lit in Step 1, and 24 Vac is present in Step 2, the RTRM has failed. Replace the RTRM.
5. If no failures are indicated, use one of the TEST mode procedures described in "Start Up," p. 34 to start the unit. This procedure will allow you to check all of the RTRM outputs, and all of the external controls (relays, contactors, etc.) that the RTRM outputs energize, for each respective mode. Proceed to Step 6.
6. Step the system through all of the available modes, and verify operation of all outputs, controls, and modes. If a problem in operation is noted in any mode, you may leave the system in that mode for up to one hour while troubleshooting. Refer to the sequence of operations for each mode, to assist in verifying proper operation. Make the necessary repairs and proceed to Step 7 and Step 8.
7. If no abnormal operating conditions appear in the test mode, exit the test mode by turning the power "Off" at the main power disconnect switch.
8. Refer to the individual component test procedures if other microelectronic components are suspect.

System Status Checkout Procedure

"System Status" is checked by using one of the following two methods:

Method 1

If the Zone Sensor Module (ZSM) is equipped with a remote panel with LED status indication, you can check the unit within the space. If the ZSM does not have LEDs, use "Method 2," p. 49.

BAYSENS110* and BAYSENS119* have the remote panel indication feature.

The LED descriptions are listed below.

- LED 1 (System)
  - "On" during normal operation.
  - "Off" if a system failure occurs or the LED fails.
  - "Flashing" indicates test mode.
- LED 2 (Heat)
  - "On" when the heat cycle is operating.
  - "Off" when the heat cycle terminates or the LED fails.
  - "Flashing" indicates a heating failure.
- LED 3 (Cool)
  - "On" when the cooling cycle is operating.
  - "Off" when the cooling cycle terminates or the LED fails.
  - "Flashing" indicates a cooling failure.
- LED 4 (Service)
  - "On" indicates a clogged filter.
  - "Off" during normal operation.

– "Flashing" indicates an evaporator fan failure or a Condenser Overflow Switch (COF) failure.

The following is the complete listing of indication causes:

System Failure

Check the voltage between terminals and 9 on J6, it should read approximately 32 Vdc. If no voltage is present, a System failure has occurred. Refer to Step 4 in the previous section for the recommended troubleshooting procedure.

Heating Failure

Verify Heat Failure by Ignition Module

(IGN) LED indicator:

OFF: No Power or Failure

ON: Normal

Slow Flash: Normal, Heat Call

Fast Flash: Error Code:

1 Flash: Communication Failure

2 Flashes: System Lockout

4 Flashes TC01 or TC02 Open

5 Flashes: Flame w/o Gas Valve

Cooling Failure

1. Cooling and heating set point (slide pot) on the zone sensor has failed. Refer to "Zone Temperature Sensor (ZTS) Test," p. 50.
2. Zone temperature thermistor ZTEMP on ZTS failed. Refer to "Zone Temperature Sensor (ZTS) Test," p. 50.
3. CC1 or CC2 24 Vac control circuit has opened, check CC1 and CC2 coils, and any of the controls below that apply to the unit (HPC1, HPC2).
4. LPC1 has opened during the three-minute minimum "on time" during consecutive compressor starts, check LPC1 by testing voltage between the J1-8 and J3-2 terminals on the RTRM and ground. If Vac is present, the LPCs has not tripped. If no voltage is present, LPCs has tripped.

Service Failure

1. If the supply fan proving switch has closed, the unit will not operate (when connected to RTOM), check the fan motor, belts, and proving switch.
2. If the clogged filter switch has closed, check the filters.

Simultaneous Heat and Cool Failure

- Emergency Stop is activated.

Method 2

The second method for determining system status is done by checking voltage readings at the RTRM (J6). The system indication descriptions and the approximate voltages are listed below.

System Failure

Measure the voltage between terminals J6-9 and J6-6.

- Normal Operation = approximately 32 Vdc
- System Failure = less than 1 Vdc, approximately 0.75 Vdc
- Test Mode = voltage alternates between 32 Vdc and 0.75 Vdc

Heat Failure

Measure the voltage between terminals J6-7 and J6-6.

- Heat Operating = approximately 32 Vdc
- Heat Off = less than 1 Vdc, approximately 0.75 Vdc
- Heating Failure = voltage alternates between 32 Vdc and 0.75 Vdc

Cool Failure

Measure the voltage between terminals J6-8 and J6-6.

- Cool Operating = approximately 32 Vdc
- Cool Off = less than 1 Vdc, approximately 0.75 Vdc
- Cooling Failure = voltage alternates between 32 Vdc and 0.75 Vdc

Service Failure

Measure the voltage between terminals J6-10 and J6-6.

- Clogged Filter = Approximately 32 Vdc.
- Normal = Less than 1 Vdc, approximately 0.75 Vdc
- Fan Failure = voltage alternates between 32 Vdc and 0.75 Vdc.

Note: *If the Condensate Overflow Switch is closed, the unit will not operate. Check to make sure the float position is not in a tripped condition and verify an "open" between wires connecting to RTOM J6-1, J6-2.*

To use LEDs for quick status information at the unit, purchase a BAYSENS110* ZSM and connect wires with alligator clamps to terminals 6 through 10. Connect each respective terminal wire (6 through 10) from the Zone Sensor to the unit J6 terminals 6 through 10.

Note: *If the system is equipped with a programmable zone sensor, (BAYSENS119*), the LED indicators will not function while the BAYSENS110* is connected.*

Resetting Cooling and Heating Lockouts

Cooling Failures and Heating Lockouts are reset in an identical manner.

'Method 1'explains resetting the system from the space; 'Method 2' explains resetting the system at the unit.

Note: *Before resetting Cooling Failures and Heating Lockouts check the Failure Status Diagnostics by*

the methods previously explained. Diagnostics will be lost when the power to the unit is disconnected.

Method 1

To reset the system from the space, turn the "Mode" selection switch at the zone sensor to the "Off" position. After approximately 30 seconds, turn the "Mode" selection switch to the desired mode, i.e. Heat, Cool or Auto.

Method 2

To reset the system at the unit, cycle the unit power by turning the disconnect switch "Off" and then "On".

Lockouts can be cleared through the building management system. Refer to the building management system instructions for more information.

Zone Temperature Sensor (ZTS) Service Indicator

The ZSM SERVICE LED is a generic indicator, that will signal the closing of a Normally Open switch at any time, providing the Indoor Motor (IDM) is operating.

This indicator is usually used to indicate a clogged filter, or an air side fan failure.

The RTRM will ignore the closing of this Normally Open switch for 2 (±1) minutes. This helps prevent nuisance SERVICE LED indications. The exception is the LED will flash 40 seconds after the fan is turned "On" if the Fan Proving Switch is not made.

Clogged Filter Switch

This LED will remain lit the entire time that the Normally Open switch is closed. The LED will be turned off immediately after resetting the switch (to the Normally Open position), or any time that the IDM is turned "Off".

If the switch remains closed, and the IDM is turned "On", the SERVICE LED will be turned "On" again after the 2 (±1) minute ignore delay.

This LED being turned "On", will have no other affect on unit operation. It is an indicator only.

Fan Failure Switch

When the "Fan Failure" switch is wired to the RTOM, the LED will remain flashing the entire time the fan proving switch is closed, indicating a fan failure, and it will shut the unit operations down.

Condensate Overflow Switch

When the condensate overflow switch is closed, a drain pan overflow condition is indicated and it will shut unit operations down.

Zone Temperature Sensor (ZTS) Test

Note: *These procedures are not for programmable or digital models and are conducted with the Zone Sensor Module electrically removed from the system.*

Test 1

Zone Temperature Thermistor (ZTEMP)

This component is tested by measuring the resistance between terminals 1 and 2 on the Zone Temperature Sensor. Below are some typical indoor temperatures, and corresponding resistive values.

Table 20. Temps and resistance values

Zone Temperature		Nominal ZTEMP Resistance (K-Ohms)	Nominal CSP or HSP Resistance (Ohms)
(°F)	(°C)		
50	10.0	19.9	889
55	12.8	17.47	812
60	15.6	15.3	695
65	18.3	13.49	597
70	21.1	11.9	500
75	23.9	10.50	403
80	26.7	9.3	305
85	29.4	8.25	208
90	32.2	7.3	110

Test 2

Cooling Set Point (CSP) and Heating Set Point (HSP) The resistance of these potentiometers are measured between the following ZSM terminals. Refer to Table 20 for approximate resistances at the given setpoints.

Cool SP = Terminals 2 and 3

Range = 100 to 900 Ohms approximate

Heat SP = Terminals 2 and 5

Range = 100 to 900 Ohms approximate

Test 3

System Mode and Fan Selection

The combined resistance of the Mode selection switch and the Fan selection switch can be measured between terminals 2 and 4 on the Zone Sensor. The possible switch combinations are listed Table 22, p. 51 with their corresponding resistance values.

Test 4

LED Indicator Test, (SYS ON, HEAT, COOL and SERVICE)

Method 1

Testing the LED using a meter with diode test function. Test both forward and reverse bias. Forward bias should measure a voltage drop of 1.5 to 2.5 volts, depending on your meter. Reverse bias will show an Over Load, or open circuit indication if LED is functional.

Method 2

Testing the LED with an analog Ohmmeter. Connect Ohmmeter across LED in one direction, then reverse the leads for the opposite direction. The LED should have at least 100 times more resistance in reverse direction, as compared with the forward direction. If high resistance in both directions, LED is open. If low in both directions, LED is shorted.

Method 3

To test LEDs with ZSM connected to unit, test voltages at LED terminals on ZSM. A measurement of 32 Vdc, across an unlit LED, means the LED has failed.

Table 21. Default operation for mechanical ZSM (CV only)

J6 Input/Connection	If no input/connection this happens
J6-7(a) - Heat indication	LED will not come on while heating LED will not flash during heat fail
J6-8(a) - Cool indication	LED will not come on while cooling LED will not flash during cool fail(a)
J6-9(a) - System indication (sys on)	LED will not come on while unit has power
J6-10(a) - Service indication	LED will not come on when CFS or FFS trips

(a) these connections are only on certain model ZSMs

Note: *Measurements should be made from LED common (ZSM terminal 6 to respective LED terminal). Refer to Table 21.*

Table 22. System mode and fan selection

Resistance Valves (K-Ohms)	Zone Sensor Unit/Fan Mode	Local Unit Mode	Local Fan Mode
2.32	Off/Auto	Off	Auto
4.87	Cool/Auto	Cool	Auto
7.68	Auto/Auto	Auto	Auto
10.77	Off/On	Off	On
13.32	Cool/On	Cool	On
16.13	Auto/On	Auto	On
19.48	Heat/Auto	Heat	Auto
27.93	Heat/On	Heat	On
35.0	Emergency Heat/Auto	Emergency Heat	Auto
43.45	Emergency Heat/On	Emergency Heat	On
Out of Range (Short)	INVALID/Short	Invalid (CV), Auto (VAV)	Invalid
Out of Range (Open)	INVALID/Open	Invalid (CV), Off (VAV)	Invalid

Programmable and Digital Zone Sensor Test

Testing Serial Communication Voltage

1. Verify 24 Vac is present between terminals J6-14 and J6-11.
2. Disconnect wires from J6-11 and J6-12. Measure the voltage between J6-11 and J6-12, should be about 32 Vdc.
3. Reconnect wires to terminals J6-11 and J6-12. Measure voltage again between J6-11 and J6-12, voltage should flash high and low every 0.5 seconds. The voltage on the low end will measure about 19 Vdc, while the voltage on the high end will measure from approximately 24 to 38 Vdc.
4. Verify all modes of operation, by running the unit through all of the steps in the "Test Modes" section discussed in "Start Up," p. 34".
5. After verifying proper unit operation, exit the test mode. Turn the fan on continuously at the ZSM, by pressing the button with the fan symbol. If the fan comes on and runs continuously, the ZSM is good. If you are not able to turn the fan on, the ZSM is defective.

ReliaTel Refrigeration Module (RTRM) Default Chart

If the RTCI loses input from the building management system, the RTRM will control in the default mode after approximately 15 minutes. If the RTRM loses the Heating and Cooling setpoint input, the RTRM will control in the default mode instantaneously.

The temperature sensing thermistor in the Zone Sensor Module is the only component required for the "Default Mode" to operate.

Unit Operation Without a Zone Sensor

This procedure is for temporary operation only. The economizer and condenser fan cycling functions are disabled.

1. Open and Lock the unit disconnect switch.
2. Remove the Outside Air Sensor (OAS) from the condenser section of unit.
3. Use two (2) wire nuts, to individually cap the wires.
4. Locate the RTRM (J6). Connect two (2) wires to terminals J6-1 and 2.

5. Connect the sensor (OAS) using two wire nuts to the two (2) field supplied wires that were connected to terminals 1 and 2 on J6.

Unit Economizer Control (RTEM) Troubleshooting ReliaTel Control

Verify Economizer Status by Economizer Actuator (RTEM) LED indicator:

- OFF: No Power or Failure
- ON: Normal, OK to Economize
- Slow Flash: Normal, Not OK to Economize
- Fast Flash - 1/4 Second On / 2 Seconds Off:
  - Error Code: Communications Failure
- Pulse Flash: 1/30 Second On / 1/4 Second Off: (2 Seconds between pulse sequences)

Error Code:

- 1 Flash: Actuator Fault
- 2 Flashes: CO_2 Sensor
- 3 Flashes: RA Humidity Sensor
- 4 Flashes: RA Temp Sensor
- 5 Flashes: OA Quality Sensor
- 6 Flashes: OA Humidity Sensor
- 7 Flashes: OA Temp Sensor
- 8 Flashes: MA Temp Sensor
- 9 Flashes: RAM Fault
- 10 Flashes: ROM Fault
- 11 Flashes: EEPROM Fault

Wiring Diagrams

Note: *Wiring diagrams can be accessed via e-Library by entering the diagram number in the literature order number search field or by contacting technical support.*

Table 23. Wiring diagrams for ultra high efficiency units

Schematic Type	Voltage	Diagram Number	Description
Power	208-460	2313-1544	YZ*150-210 60Hz, 2 Stage Gas Heat
		2313-1545	YZ*150-210 60Hz, Mod Gas Heat
Controls		1213-2199	YZ*150-210 60Hz, 2 Stage Gas Heat
		1213-2200	YZ*150-210 60Hz, Mod Gas Heat
Modules		1213-2201	YZ*150-210 Gas Heat
Component Layout		1213-2242	YZ*150-210 Gas Heat

Table 24. Wiring diagrams for ultra high efficiency units with High Short Circuit Rating (SCCR)

Schematic Type	Voltage	Diagram Number	Description
Power	208-460	2313-1524	YZ*150-210 60Hz, 2 Stage Gas Heat
		2313-1525	YZ*150-210 60Hz, Mod Gas Heat
Controls		1213-2199	YZ*150-210 60Hz, 2 Stage Gas Heat
		1213-2200	YZ*150-210 60Hz, Mod Gas Heat
Modules		1213-2201	YZ*150-210 Gas Heat
Component Layout		1213-2243	YZ*150-210 Gas Heat

Warranty

Central Air Conditioner

YZD, and YZH (Parts Only)

Models Less Than 20 Tons for Commercial Use*

This warranty is extended by Trane, to the original purchaser and to any succeeding owner of the real property to which the Air Conditioner is originally affixed, and applies to products purchased and retained for use within the U.S.A. and Canada. There is no warranty against corrosion, erosion or deterioration.

If any part of your Air Conditioner fails because of a manufacturing defect within one year from the date of the original purchase, Warrantor will furnish without charge the required replacement part.

If the heat exchanger fails because of a manufacturing defect within five years from the date of start-up, Warrantor will furnish without charge a replacement heat exchanger.

In addition, if the optional, factory installed, stainless steel heat exchanger fails because of a manufacturing defect within ten years from the date of start-up, Warrantor will furnish without charge a replacement heat exchanger. Any local transportation, related service labor and diagnosis calls are not included.

In addition, if the sealed motor-compressor fails because of a manufacturing defect within the second through fifth year from the date of original purchase, Warrantor will furnish without charge the required replacement compressor.

Warrantor's obligations and liabilities under this warranty are limited to furnishing F.O.B. Warrantor factory or warehouse replacement parts for Warrantor's products covered under this warranty.

Warrantor shall not be obligated to pay for the cost of lost refrigerant.

No liability shall attach to Warrantor until products have been paid for and then liability shall be limited solely to the purchase price of the equipment under warranty shown to be defective.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING BUT NOT SPECIFICALLY LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, AND IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Trane
2701 Wilma Rudolph Blvd.
Clarksville, TN 37040-1008
Attention: Manager, Product Service
GW-602-4800

* This warranty is for commercial usage of said equipment and not applicable when the equipment is used for a residential application. Commercial use is any application where the end purchaser uses the product for other than personal, family or household purposes.

*A 5 year limited warranty is provided for the optional Low Leak Economizer, when combined with the optional FDD (Fault Detection and Diagnostics) option.



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Carrier

United Technologies

Product Data

WeatherMaster®
Packaged Rooftop Units
15 to 25 Nominal Tons

WeatherMaster®



(Unit shown with EnergyX Installed)

48HC Sizes 17 to 28
Packaged Rooftop Units with Gas Heat, Optional EnergyX® Energy Recovery Device, and ComfortLink Controls

© Carrier Corporation 2018

Features/Benefits

The 15 to 25 Ton WeatherMaster® Carrier rooftop unit (RTU) was designed by customers for customers. With a newly designed cabinet that integrates "no-strip" screw collars, handled access panels, and more, we've made your unit easy to install, easy to maintain, easy to use and reliable.

Easy to install

These WeatherMaster units are designed for dedicated factory-supplied vertical or horizontal air flow duct configurations. No special field kits are required. Designed to fit on pre-installed curbs by another manufacturer, these units also fit on past designed Carrier installed curbs with a new certified and authorized adapter curb. This cabinet design also integrates a large control box that gives you room to work and room to mount Carrier accessory controls.

Easy to maintain

Easy access handles by Carrier provide quick and easy access to all normally serviced components. Our "no-strip" screw system has superior holding power and guides screws into position while preventing the screw from stripping the unit's metal. Take accurate pressure readings by reading system pressures with panels in place as compressors are strategically located to eliminate any air bypass.

Easy to use

The newly designed, central terminal board by Carrier puts all your connections and troubleshooting points in one convenient place, standard. Most low voltage connections are made to the same board and make it easy to find what you're looking for and easy to access it.

Reliable

Each unit comes with precision sized and tested scroll compressor that is internally protected from over temperature and pressures. In addition, each refrigerant circuit is further protected with a high-pressure and low-pressure switch as well as containing a liquid line filter drier. Each unit is factory tested prior to shipment to help ensure unit operation once properly installed.

Key features

- Two stage cooling capability with independent circuits and control.
- High performance copper tube / aluminum plate (RTPF) fin condenser and evaporator coils with optional coating.
- EERs up to 12.0
- IEERs up to 13.2 with single speed indoor fan motor and 13.8 with SAV™ (Staged Air Volume) 2-speed/VFD indoor fan motor.
- Gas heating efficiencies up to 81% thermal efficiency.
- Dedicated vertical and horizontal air flow duct configuration models. No field kits required.
- Utility connections through the side or bottom. Bottom connections are also in an enclosed environment to help prevent water entry. Field supplied couplings are required.
- Standardized components and layout. Standardized components and controls make service and stocking parts easier.
- Scroll compressors on all units. This makes service, stocking parts, replacement, and trouble-shooting easier.
- Precision sized TXV metering device on each refrigerant circuit.
- Easy-adjust, belt-drive motor available. Motor assembly also contains a fan belt break protection system on all models and reliable pillow block bearing system that allows lubrication thru front of the unit.
- Single-point gas/electrical connection.
- Sloped, composite drain pan sheds water; and won't rust.
- Standardized controls and control box layout. Standardized components and controls make stocking parts and service easier.
- Clean, large, easy to use control box.
- Color-coded wiring.
- Large, laminated wiring and power wiring drawings which are affixed to unit make troubleshooting easy.
- Single, central terminal board for test and wiring connections.
- Fast-access, handled, panels for easy access on normally accessed service panels.
- "No-strip" screw system guides screws into the panel and captures them tightly without stripping the screw, the panel, or the unit.
- Mechanical cooling (125°F to 35°F/ 52°C to –2°C) standard on all models. Low ambient controller allows operation down to –20°F/–29°C
- Redundant gas valve for 2-stage gas heating capacity control with induced-draft flue exhaust design to help ensure no flue gas can escape into the indoor air stream.
- Exclusive IGC solid state gas controller for on board diagnostics with LED error code designation, burner control logic and energy saving indoor fan motor delay.
- 2-in. (51 mm) disposable filters on all units, with 4-in. (102 mm) filter track field-installed.
- Refrigerant filter-drier on each circuit.
- High and low pressure switches. Added reliability with high-pressure switch and low-pressure switch.
- Many factory-installed options ranging from air management economizers, 2 position dampers, manual outdoor air dampers, plus convenience outlets, disconnect switch and smoke detectors.
- Factory-installed Humidi-MiZer® adaptive dehumidification system.
- Standard Parts Warranty: 10 year aluminized heat exchanger, 5 year compressor, 1 year others.
- Optional Staged Air Volume (SAV) system utilizes a Variable Frequency Drive (VFD) to automatically adjust the indoor fan motor speed between cooling stages. Available on 2-stage cooling models 17-28 with electromechanical controls or RTU Open.

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Model number nomenclature

48HC MODEL NUMBER NOMENCLATURE

48 HC D E 17 A 2 A 6 - 0 A 3 B 0

Unit Heat Type
48 = Gas Heat Packaged Rooftop

Model Series - WeatherMaster®
HC = High Efficiency

Heat Options
D = Low Gas Heat
E = Medium Gas Heat
F = High Gas Heat
S = Low Heat w/ Stainless Steel Exchanger
R = Medium Heat w/ Stainless Steel Exchanger
T = High Heat w/ Stainless Steel Exchanger

Refrig. Systems Options
D = Two stage cooling model with Round Tube/Plate Fin
E = Two stage cooling models with Humidi-MiZer® System
G = Two stage cooling models with Motormaster® Low Ambient controller

Cooling Tons
17 = 15 tons
20 = 17.5 tons
24 = 20 tons
28 = 25 tons

Sensor Options
A = None
B = RA Smoke Detector
C = SA Smoke Detector
D = RA + SA Smoke Detector
E = CO_2 Sensor
F = RA Smoke Detector and CO_2
G = SA Smoke Detector and CO_2
H = RA + SA Smoke Detector and CO_2
J = Condensate Overflow Switch
K = Condensate Overflow Switch and RA Smoke Detectors
L = Condensate Overflow Switch and RA and SA Smoke Detectors

Indoor Fan Options & Air Flow Configuration
1 = Standard Static/Vertical Supply, Return Air Flow
2 = Medium Static/Vertical Supply, Return Air Flow
3 = High Static/Vertical Supply, Return Air Flow
B = Medium Static, High Efficiency Motor/Vertical Supply, Return Air Flow
C = High Static, High Efficiency Motor/Vertical Supply, Return Air Flow
5 = Standard Static/Horizontal Supply, Return Air Flow
6 = Medium Static/Horizontal Supply, Return Air Flow
7 = High Static/Horizontal Supply, Return Air Flow
F = Medium Static, High Efficiency Motor/Horizontal Supply, Return Air Flow
G = High Static, High Efficiency Motor/Horizontal Supply, Return Air Flow

Coil Options – RTPF (Outdoor - Indoor - Hail Guard)
A = Al/Cu - Al/Cu
B = Precoat Al/Cu - Al/Cu
C = E-coat Al/Cu - Al/Cu
D = E-coat Al/Cu - E-coat Al/Cu
E = Cu/Cu - Al/Cu
F = Cu/Cu - Cu/Cu
M = Al/Cu -Al/Cu — Louvered Hail Guard
N = Precoat Al/Cu - Al/Cu — Louvered Hail Guard
P = E-coat Al/Cu - Al/Cu — Louvered Hail Guard
Q = E-coat Al/Cu - E-coat Al/Cu — Louvered Hail Guard
R = Cu/Cu - Al/Cu — Louvered Hail Guard
S = Cu/Cu - Cu/Cu — Louvered Hail Guard

Packaging
0 = Standard

Electrical Options
A = None
B = HACR Breaker
C = Non-Fused Disconnect
D = Through-the-base Connection
C = Non-Fused Disconnect and Through-the-base Connection
G = 2-Speed Indoor Fan (VFD) Controller
J = 2 Speed Fan Controller (VFD) and Non-Fused Disconnect

Service Options
0 = None
1 = Unpowered Convenience Outlet
2 = Powered Convenience Outlet
3 = Hinged Panels
4 = Hinged Panels & Unpowered Convenience Outlet
5 = Hinged Panels & Powered Convenience Outlet
C = Foil Faced Insulation

Intake / Exhaust Options
A = None
B = Temperature Economizer w/ Barometric Relief
F = Enthalpy Economizer w/ Barometric Relief
K = 2-Position Damper
P = Manual Outdoor Air Damper
Q = EnergyX® Only
R = EnergyX with Economizer Only
S = EnergyX with Frost Protection Only
T = EnergyX with Economizer and Frost Protection
U = Temp Ultra Low Leak Economizer w/ Barometric Relief
V = Temp Ultra Low Leak Economizer w/ Power Exhaust - Vertical Air Only
W= Enthalpy Ultra Low Leak Economizer w/ Barometric Relief
X = Enthalpy Ultra Low Leak Economizer w/ Power Exhaust - Vertical Air Only

Base Unit Controls
0 = Electro-mechanical Controls. Can be used with W7212 EconoMi$er® IV (Non-Fault Detection and Diagnostic)
1 = PremierLink™ Controller
2 = RTU Open Multi-Protocol Controller
6 = Electro-mechanical w/ 2-Speed Fan and W7220 Economizer Controller. Can be used with W7220 EconoMi$er X (with Fault Detection and Diagnostic)
D = ComfortLink Controls (Standard with EnergyX)

Design Revision
- = Factory Design Revision

Voltage
1 = 575/3/60
5 = 208-230/3/60
6 = 460/3/60

Puron

ASHRAE 90.1 COMPLIANT

Capacity ratings

AHRI RATINGS (2-STAGE COOLING)

48HC UNIT	CONFIGURATION	NOM. CAPACITY (TONS)	NET COOLING CAPACITY (MBH)	TOTAL POWER (kW)	EER	IEER (Single Speed)	IEER (2-Speed)
17	Vertical	15.0	174	14.5	12.0	13.0	13.5
	Horizontal			15.1	11.5	12.2	13.0
20	Vertical	17.5	202	16.8	12.0	13.0	13.6
	Horizontal			17.9	11.3	11.5	13.2
24	Vertical	20.0	232	19.3	12.0	13.2	13.8
	Horizontal			20.4	11.4	12.0	13.0
28	Vertical	25.0	282	25.2	11.2	12.0	12.5
	Horizontal			26.9	10.5	N/A	12.2

LEGEND

AHRI — Air-Conditioning, Heating and Refrigeration Institute
EER — Energy Efficiency Ratio
IEER — Integrated Energy Efficiency Ratio

NOTE: 48HC**28 horizontal units are only available with a 2-speed option.

SOUND RATINGS TABLE

48HC UNIT	COOLING STAGES	OUTDOOR SOUND (dB) AT 60Hz											
		A-WEIGHTED	LINEAR	AHRI-370 RATING	31.5	63	125	250	500	1000	2000	4000	8000
17	2	84.1	96.2	84	92.6	92.0	84.0	80.0	82.0	78.7	76.5	72.2	65.4
20	2	84.1	96.2	84	92.6	92.0	84.0	80.0	82.0	78.7	76.5	72.2	65.4
24	2	86.5	99.6	87	96.2	95.6	87.5	84.2	84.2	81.7	77.9	73.2	66.3
28	2	85.9	103.0	86	101.0	97.0	88.0	84.0	83.0	80.7	77.4	73.4	67.3

LEGEND

dB — Decibel

NOTES:

1. Outdoor sound data is measured in accordance with AHRI.
2. Measurements are expressed in terms of sound power. Do not compare these values to sound pressure values because sound pressure depends on specific environmental factors which normally do not match individual applications. Sound power values are independent of the environment and therefore more accurate.
3. A-weighted sound ratings filter out very high and very low frequencies, to better approximate the response of “average” human ear. A-weighted measurements for Carrier units are taken in accordance with AHRI.

MINIMUM - MAXIMUM AIRFLOW RATINGS (CFM) — NATURAL GAS AND PROPANE

48HC UNIT	HEAT LEVEL	COOLING				ALUMINUM HEATING		STAINLESS STEEL HEATING	
		MINIMUM SINGLE SPEED FAN MOTOR	MINIMUM 2-SPEED FAN MOTOR (AT HIGH SPEED)	MINIMUM 2-SPEED FAN MOTOR (AT LOW SPEED)	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
17	LOW	4,500	5,070	3,380	7,500	3,000	8,250	3,000	8,250
	MED					3,880	7,750	3,880	7,750
	HIGH					4,620	8,570	4,620	8,570
20	LOW	5,250	5,915	3,943	9,000	3,000	11,000	3,000	11,000
	MED					3,880	9,300	3,880	9,300
	HIGH					4,620	10,000	4,620	10,000
24	LOW	6,000	7,500	5,000	10,000	3,000	11,000	3,000	11,000
	MED					3,880	11,630	3,880	11,630
	HIGH					4,620	10,000	4,620	10,000
28	LOW	7,500	8,450	5,633	12,500	3,000	16,500	3,000	16,500
	MED					3,880	15,500	3,880	15,500
	HIGH					4,620	15,000	4,620	15,000

HEAT RATING TABLE — NATURAL GAS AND PROPANE

48HC UNIT	GAS HEAT	AL/SS HEAT EXCHANGER		TEMPERATURE RISE (F)	THERMAL EFFICIENCY (%)
		INPUT/OUTPUT STAGE 1 (MBH)	INPUT/OUTPUT STAGE 2 (MBH)		
17	LOW	220/178	176/142	20-55	81%
	MED	310/251	248/200	30-60	
	HIGH	400/324	320/260	35-65	
20	LOW	220/178	176/142	15-55	81%
	MED	310/251	248/200	25-60	
	HIGH	400/324	320/260	30-65	
24	LOW	220/178	176/142	15-55	81%
	MED	310/251	248/200	20-60	
	HIGH	400/324	320/260	30-65	
28	LOW	220/178	176/142	10-55	81%
	MED	310/251	248/200	15-60	
	HIGH	400/324	320/260	20-65	

NOTES:

1. Heat ratings are for natural gas heat exchangers operated at or below 2000 ft (610 m). For information on Propane or altitudes above 2000 ft (610 m), see the Application Data section of this book. Accessory Propane/High Altitude kits are also available.
2. In the USA the input rating for altitudes above 2000 ft (610 m) must be derated by 4% for each 1000 ft (305 m) above sea level. In Canada, the input rating must be derated by 10% for altitudes of 2000 ft (610 m) to 4500 ft (1372 m) above sea level.

Physical data

48HC 15 TO 25 TON PHYSICAL DATA

48HC UNIT		48HC*D17	48HC*E17	48HC*D20	48HC*E20	48HC*D24	48HC*E24	48HC*D28	48HC*E28
48HC BASE UNIT TONS		15	15	17.5	17.5	20	20	25	25
48HC BASE UNIT WEIGHT - lb (kg)		1892 (858)		2102 (953)		2247 (1019)		2292 (1040)	
REFRIGERATION SYSTEM									
	# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll
	R-410A Charge A/B (lbs)	17/16.4	24.5/25.7	17.5/16.8	25.5/25.5	23.8/23.1	30.0/30.7	24.9/27.7	35.1/35.4
	Metering device	TXV	TXV	TXV	TXV	TXV	TXV	TXV	TXV
	High-Pressure Trip / Reset (psig)	630 / 505	630 / 505	630 / 505	630 / 505	630 / 505	630 / 505	630 / 505	630 / 505
	Low-Pressure Trip / Reset (psig)	54 / 117	27 / 44	54 / 117	27 / 44	54 / 117	27 / 44	54 / 117	27 / 44
EVAPORATOR COIL									
	Material	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al	Cu / Al
	Tube Diameter (in.)	3/8 RTPF	3/8 RTPF	3/8 RTPF	3/8 RTPF	3/8 RTPF	3/8 RTPF	3/8 RTPF	3/8 RTPF
	Rows / FPI	4 / 15	4 / 15	4 / 15	4 / 15	4 / 15	4 / 15	4 / 15	4 / 15
	Total Face Area (ft²)	22	22	22	22	26	26	26	26
	Condensate Drain Connection Size (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
HUMIDIMIZER COIL									
	Material	—	Cu / Al	—	Cu / Al	—	Cu / Al	—	Cu / Al
	Tube Diameter		3/8 RTPF		3/8 RTPF		3/8 RTPF		3/8 RTPF
	Rows / FPI		1 / 17		1 / 17		1 / 17		1 / 17
	Total Face Area (ft²)		22		22		26		26
EVAPORATOR FAN AND MOTOR VERTICAL SUPPLY									
STANDARD STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt
	Nominal / Nameplate hp	2.9	2.9	3.7	3.7	N/A	N/A	5.25	5.25
	Max bhp	2.9	2.9	3.7	3.7	N/A	N/A	4.9	4.9
	Rpm Range	514-680	514-680	622-822	622-822	N/A	N/A	717-911	717-911
	Max Blower/Shaft rpm	1200	1200	1200	1200	N/A	N/A	1200	1200
	Motor Frame Size	56	56	56	56	N/A	N/A	56	56
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	N/A	N/A	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in.)	15 X 15	15 X 15	15 X 15	15 X 15	N/A	N/A	15 X 15	15 X 15
MEDIUM STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A	N/A	N/A
	Nominal / Nameplate hp	3.7	3.7	5.25	5.25	N/A	N/A	N/A	N/A
	Max bhp	3.7	3.7	4.9	4.9	N/A	N/A	N/A	N/A
	Rpm Range	679-863	679-863	713-879	713-879	N/A	N/A	N/A	N/A
	Max Blower/Shaft rpm	1200	1200	1200	1200	N/A	N/A	N/A	N/A
	Motor Frame Size	56	56	56	56	N/A	N/A	N/A	N/A
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	N/A	N/A	N/A	N/A
	Fan Diameter (in.)	15 X 15	15 X 15	15 X 15	15 X 15	N/A	N/A	N/A	N/A
HIGH STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1/ BELT	1 / 1/ BELT	N/A	N/A	N/A	N/A	N/A	N/A
	Nominal / Nameplate hp	5.25	5.25	N/A	N/A	N/A	N/A	N/A	N/A
	Max bhp	4.9	4.9	N/A	N/A	N/A	N/A	N/A	N/A
	Rpm Range	826-1009	826-1009	N/A	N/A	N/A	N/A	N/A	N/A
	Max Blower/Shaft rpm	1200	1200	N/A	N/A	N/A	N/A	N/A	N/A
	Motor Frame Size	56	56	N/A	N/A	N/A	N/A	N/A	N/A
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	N/A	N/A	N/A	N/A	N/A	N/A
	Fan Diameter (in.)	15 X 15	15 X 15	N/A	N/A	N/A	N/A	N/A	N/A

48HC 15 TO 25 TON PHYSICAL DATA (CONT)

48HC UNIT		48HC*D17	48HC*E17	48HC*D20	48HC*E20	48HC*D24	48HC*E24	48HC*D28	48HC*E28
EVAPORATOR FAN AND MOTOR VERTICAL SUPPLY (CONT)									
STANDARD STATIC - HIGH EFFCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A
	Nominal / Nameplate hp	N/A	N/A	N/A	N/A	5.0	5.0	N/A	N/A
	Max bhp	N/A	N/A	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	N/A	N/A
	Rpm Range	N/A	N/A	N/A	N/A	690-863	690-863	N/A	N/A
	Max Blower/Shaft rpm	N/A	N/A	N/A	N/A	1200	1200	N/A	N/A
	Motor Frame Size	N/A	N/A	N/A	N/A	184T	184T	N/A	N/A
	Fan Qty / Type	N/A	N/A	N/A	N/A	2 / Centrifugal	2 / Centrifugal	N/A	N/A
	Fan Diameter (in.)	N/A	N/A	N/A	N/A	15 X 15	15 X 15	N/A	N/A
MEDIUM STATIC - HIGH EFFICIENCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	N/A	N/A	1 / 1/ Belt	1 / 1/ Belt	1 / 1/ Belt	1 / 1/ Belt
	Nominal / Nameplate hp	N/A	N/A	N/A	N/A	5.0	5.0	5.0	5.0
	Max bhp	N/A	N/A	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3
	Rpm Range	N/A	N/A	N/A	N/A	835-1021	835-1021	913-1116	913-1116
	Max Blower/Shaft rpm	N/A	N/A	N/A	N/A	1200	1200	1200	1200
	Motor Frame Size	N/A	N/A	N/A	N/A	184T	184T	184T	184T
	Fan Qty / Type	N/A	N/A	N/A	N/A	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in.)	N/A	N/A	N/A	N/A	15 X 15	15 X 15	15 X 15	15 X 15
HIGH STATIC- HIGH EFFICIENCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt
	Nominal Nameplate H.p.	N/A	N/A	5.0	5.0	7.5	7.5	7.5	7.5
	Max Bhp (208/230/460/ 575v)	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11
	Rpm Range	N/A	N/A	882-1078	882-1078	941-1176	941-1176	941-1176	941-1176
	Max Blower/shaft Rpm	N/A	N/A	1200	1200	1200	1200	1200	1200
	Motor Frame Size	N/A	N/A	184T	184T	213T	213T	213T	213T
	Fan Qty / Type	N/A	N/A	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (In)	N/A	N/A	15 X 15	15 X 15	15 X 15	15 X 15	15 X 15	15 X 15
EVAPORATOR FAN AND MOTOR HORIZONTAL SUPPLY									
STANDARD STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A	N/A	N/A
	Nominal / Nameplate hp	2.9	2.9	3.7	3.7	N/A	N/A	N/A	N/A
	Max bhp	2.9	2.9	3.7	3.7	N/A	N/A	N/A	N/A
	Rpm Range	514-680	514-680	622-822	622-822	N/A	N/A	N/A	N/A
	Max Blower/Shaft rpm	1100	1100	1100	1100	N/A	N/A	N/A	N/A
	Motor Frame Size	56	56	56	56	N/A	N/A	N/A	N/A
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	N/A	N/A	N/A	N/A
	Fan Diameter (in.)	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	N/A	N/A	N/A	N/A
MEDIUM STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A	N/A	N/A
	Nominal / Nameplate hp	3.7	3.7	5.25	5.25	N/A	N/A	N/A	N/A
	Max bhp	3.7	3.7	4.9	4.9	N/A	N/A	N/A	N/A
	Rpm Range	614-780	614-780	713-879	713-879	N/A	N/A	N/A	N/A
	Max Blower/Shaft rpm	1100	1100	1100	1100	N/A	N/A	N/A	N/A
	Motor Frame Size	56	56	56	56	N/A	N/A	N/A	N/A
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	N/A	N/A	N/A	N/A
	Fan Diameter (in.)	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	N/A	N/A	N/A	N/A

Physical data (cont)

48HC 15 TO 25 TON PHYSICAL DATA (CONT)

48HC UNIT		48HC*D17	48HC*E17	48HC*D20	48HC*E20	48HC*D24	48HC*E24	48HC*D28	48HC*E28
HIGH STATIC	Motor Qty / Belt Qty / Driver Type	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A	N/A	N/A	N/A	N/A
	Nominal / Nameplate hp	4.9	4.9	N/A	N/A	N/A	N/A	N/A	N/A
	Max bhp	4.9	4.9	N/A	N/A	N/A	N/A	N/A	N/A
	Rpm Range	746-912	746-912	N/A	N/A	N/A	N/A	N/A	N/A
	Max Blower/Shaft rpm	1100	1100	N/A	N/A	N/A	N/A	N/A	N/A
	Motor Frame Size	56	56	N/A	N/A	N/A	N/A	N/A	N/A
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	N/A	N/A	N/A	N/A	N/A	N/A
	Fan Diameter (in.)	18 x 15/15 X 11	18 x 15/15 X 11	N/A	N/A	N/A	N/A	N/A	N/A
STANDARD STATIC - HIGH EFFICIENCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt	N/A	N/A
	Nominal / Nameplate hp	N/A	N/A	N/A	N/A	5.0	5.0	N/A	N/A
	Max bhp	N/A	N/A	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	N/A	N/A
	Rpm Range	N/A	N/A	N/A	N/A	690-863	690-863	N/A	N/A
	Max Blower/Shaft rpm	N/A	N/A	N/A	N/A	1200	1200	N/A	N/A
	Motor Frame Size	N/A	N/A	N/A	N/A	184T	184T	N/A	N/A
	Fan Qty / Type	N/A	N/A	N/A	N/A	2 / Centrifugal	2 / Centrifugal	N/A	N/A
	Fan Diameter (in.)	N/A	N/A	N/A	N/A	18 x 15/15 X 11	18 x 15/15 X 11	N/A	N/A
MEDIUM STATIC - HIGH EFFICIENCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt
	Nominal / Nameplate hp	N/A	N/A	N/A	N/A	5.0	5.0	5.0	5.0
	Max bhp	N/A	N/A	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3
	Rpm Range	N/A	N/A	N/A	N/A	835-1021	835-1021	755-923	755-923
	Max Blower/Shaft rpm	N/A	N/A	N/A	N/A	1100	1100	1100	1100
	Motor Frame Size	N/A	N/A	N/A	N/A	184T	184T	184T	184T
	Fan Qty / Type	N/A	N/A	N/A	N/A	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in.)	N/A	N/A	N/A	N/A	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11
HIGH STATIC- HIGH EFFICIENCY	Motor Qty / Belt Qty / Driver Type	N/A	N/A	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt	1 / 1 /Belt
	Nominal / Nameplate hp	N/A	N/A	5.0	5.0	7.5	7.5	7.5	7.5
	Max bhp	N/A	N/A	6.5/ 6.9/ 7.0/ 8.3	6.5/ 6.9/ 7.0/ 8.3	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11	10.5/11.9/11.9/ 11
	Rpm Range	N/A	N/A	835-1021	835-1021	941-1100	941-1100	906-1100	906-1100
	Max Blower/Shaft rpm	N/A	N/A	1100	1100	1100	1100	1100	1100
	Motor Frame Size	N/A	N/A	184T	184T	213T	213T	213T	213T
	Fan Qty / Type	N/A	N/A	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in.)	N/A	N/A	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11	18 x 15/15 X 11
COND. COIL (CIRCUIT A)									
	Coil Type	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF
	Coil Length (in.)	70	70	72	72	82	82	95	95
	Coil Height (in.)	44	44	44	44	52	52	52	52
	Rows / fpi	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17
	Total Face Area (Ft^2)	21.4	21.4	22.0	22.0	29.6	29.6	34.3	34.3
COND. COIL (CIRCUIT B)									
	Coil Type	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF	RTPF
	Coil Type	70	70	64	64	80	80	95	95
	Coil Length (in.)	44	44	44	44	52	52	52	52
	Coil Height (in.)	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17	2 /17
	Rows / fpi	21.4	21.4	19.5	19.5	29.6	29.6	34.3	34.3
COND. FAN / MOTOR									
	Qty / Motor Drive Type	3 / direct	3 / direct	4 / direct	4 / direct	4/ direct	4/ direct	6 / direct	6 / direct
	Motor Hp / Rpm	1/4 / 1100	1/4 / 1100	1/4 / 1100	1/4 / 1100	1/4 / 1100	1/4 / 1100	1/4 / 1100	1/4 / 1100
	Fan Diameter (in.)	22	22	22	22	22	22	22	22
FILTERS									
	RA Filter # / Size (in.)	6 / 20 x 25 x 2	6 / 20 x 25 x 2	6 / 20 x 25 x 2	6 / 20 x 25 x 2	9 / 16 x 25 x 2	9 / 16 x 25 x 2	9 / 16 x 25 x 2	9 / 16 x 25 x 2
	OA Inlet Screen # / Size (in.)	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1

48HC 15 TO 25 TON PHYSICAL DATA (CONT)

48HC UNIT		48HC*D17	48HC*E17	48HC*D20	48HC*E20	48HC*D24	48HC*E24	48HC*D28	48HC*E28
GAS CONNECTION									
Number of Gas Valves		1		1		1		1	
Nat. gas supply line press (in. wg) / (PSIG)		5 -13 / 0.18-0.47		5 -13 / 0.18-0.47		5 -13 / 0.18-0.47		5 -13 / 0.18-0.47	
LP supply line press (in. wg) / (PSIG)		11-13 / 0.40-0.47		11-13 / 0.40-0.47		11-13 / 0.40-0.47		11-13 / 0.40-0.47	
HEAT ANTICIPATOR SETTING (AMPS)									
1st stage		0.14		0.14		0.14		0.14	
2nd stage		0.14		0.14		0.14		0.14	
NATURAL GAS HEAT									
LOW	**# of stages / # of burners (total)**	2 / 5		2 / 5		2 / 5		2 / 5	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		195 / 115		195 / 115		195 / 115	
	Temperature Rise (F)	25 - 55		25 - 55		25 - 55		25 - 55	
MED	**# of stages / # of burners (total)**	2 / 7		2 / 7		2 / 7		2 / 7	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		195 / 115		195 / 115		195 / 115	
	Temperature Rise (F)	30- 60		30- 60		30- 60		30- 60	
HIGH	**# of stages / # of burners (total)**	2 / 10		2 / 10		2 / 10		2 / 10	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		195 / 115		195 / 115		195 / 115	
	Temperature Rise (F)	35- 65		35- 65		35- 65		35- 65	
LIQUID PROPANE HEAT									
LOW	**# of stages / # of burners (total)**	2 / 5		2 / 5		2 / 5		2 / 5	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		195 / 115		195 / 115		195 / 115	
	Temperature Rise (F)	25 - 55		25 - 55		25 - 55		25 - 55	
MED	**# of stages / # of burners (total)**	2 / 7		2 / 7		2 / 7		2 / 7	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		196 / 115		197 / 115		198 / 115	
	Temperature Rise (F)	30- 60		30- 60		30- 60		30- 60	
HIGH	**# of stages / # of burners (total)**	2 / 10		2 / 10		2 / 10		2 / 10	
	Connection Size (in.)	3/4 NPT		3/4 NPT		3/4 NPT		3/4 NPT	
	Rollout switch opens / closes (F)	195 / 115		195 / 115		195 / 115		195 / 115	
	Temperature Rise (F)	35- 65		35- 65		35- 65		35- 65	

Physical data (cont)

48HC 15 TO 25 TON PHYSICAL DATA (CONT)

48HC UNIT	48HC*D17	48HC*E17	48HC*D20	48HC*E20	48HC*D24	48HC*E24	48HC*D28	48HC*E28
ENERGYX® UNIT TYPE	Modulating Air Flow Capability / Electro-Mechanical Constant Speed				Modulating Air Flow Capability / Electro-Mechanical Constant Speed			
ENERGYX WHEEL OA (CFM)	1400-3675				2200-6000			
ENERGYX WHEEL EA (CFM)	1400-3675				2200-6000			
ENERGYX RECOVERY WHEEL								
Type	Enthalpy Lightweight Polymer with Silica Gel Desiccant Coating				Enthalpy Lightweight Polymer with Silica Gel Desiccant Coating			
Model (AirXchange)	ERC-3628C				ERC-4646C			
Size (Dia. x Depth) (in.)	36 x 3				46 x 3			
Nominal Drive Motor Hp	0.1				1/6			
ENERGYX SUPPLY FAN #1								
Qty - Type	1 - Backward Curved				1 - Backward Curved			
Drive Type	Direct				Direct			
Blower Size (Diameter)	15.75" (400 mm)				17.7" (450 mm)			
Nominal Motor Hp	1.2				3.7			
ENERGYX SUPPLY FAN #2								
Qty - Type	1 - Backward Curved				1 - Backward Curved			
Drive Type	Direct				Direct			
Blower Size	15.75" (400 mm)				17.7" (450 mm)			
Nominal Motor Hp	1.2				3.7			
ENERGYX EXHAUST FAN #1								
Qty - Type	1 - Backward Curved				1 - Backward Curved			
Drive Type	Direct				Direct			
Blower Size	17.7" (450 mm)				17.7" (450 mm)			
Nominal Motor Hp	3.7				3.7			
ENERGYX EXHAUST FAN #2*								
Qty - Type	1 - Backward Curved				1 - Backward Curved			
Drive Type	Direct				Direct			
Blower Size	17.7" (450 mm)				17.7" (450 mm)			
Nominal Motor Hp	3.7				3.7			
ENERGYX FILTERS								
Type	2-in. Pleated, 30% Efficiency				2-in. Pleated, 30% Efficiency			
Supply Air (Qty) - Size	(2) 16 x 20 x 2				(2) 20 x 25 x 2			
Exhaust Air (Qty) - Size	(2) 16 x 20 x 2				(2)20 x 25 x 2			
Type	Aluminum Water Filter				Aluminum Water Filter			
Water Entrapment (Qty) - Size	(2) 34.375" x 17.25" x 1"				(2) 34.375" x 24.5" x 1"			

LEGEND

BHP — Brake Horsepower
EA — Entering Air
FPI — Fins Per Inch
OA — Outdoor Air

* Exhaust fan #2 data is not applicable to 15-17.5 ton high non-economizer models.

Options and accessories

ITEM	OPTION*	ACCESSORY†
CABINET		
Dedicated Vertical Air Flow Duct Configuration	X	
Dedicated Horizontal Air Flow Duct Configuration	X	
Hinged Access Panels	X	
Foil Faced Insulation Throughout Entire Cabinet	X	
Thru-the-Base Electrical or Gas-Line Connections	X	
COIL OPTIONS		
Cu/Cu (Indoor) Coils	X	
Premium, E-coated Outdoor Coils	X	
Pre-coated (outdoor and indoor) Coils	X	
HUMIDITY CONTROL		
Humidi-MiZer® Adaptive Dehumidification System	X	
CONDENSER PROTECTION		
Condenser Coil Louvered Hail Guard	X	X
CONTROLS		
PremierLink™ DDC Communicating Controller	X	X
ComfortLink Controller	X	
RTU Open Multi-Protocol Controller	X	
Thermostats, Temperature Sensors, and Subbase		X
Smoke Detector (Supply and/or Return Air)	X	X
Horn/Strobe Annunciator[1]		X
Time Guard II Compressor Delay Control Circuit		X
Phase Monitor		X
Condensate Overflow Switch	X	X
ECONOMIZERS AND OUTDOOR AIR DAMPERS		
Economi$er IV for Electro-Mechanical Controls — Non-FDD (Standard Air Leak Damper Models) [2]	X	X
EconoMi$er 2 for DDC controls (Standard and Ultra Low Leak Air Damper Models) [2, 3]	X	X
EconoMi$er X For Electro-Mechanical Controls, Complies with FDD. (Standard and Ultra Low Leak air damper models) [2]	X	X
Motorized 2 Position Outdoor-Air Damper[9]	X	X
Manual Outdoor-Air Damper (25%)[9]		X
Barometric Relief [4]	X	X
Barometric Hood (Horizontal economizer)		X
Power Exhaust (Prop Design)	X	X
ECONOMIZER SENSORS AND IAQ DEVICES		
Single Dry Bulb Temperature Sensors [5]	X	X
Differential Dry Bulb Temperature Sensors [5]		X
Single Enthalpy Sensors [5]	X	X
Differential Enthalpy Sensors [5]		X
Wall or Duct Mounted CO_2 Sensor [5]		X
Unit Mounted CO_2 Sensor [5]	X	X
4-in. Filter Track Assembly		X
GAS HEAT		
Propane Conversion Kit		X
Stainless Steel Heat Exchanger	X	
High Altitude Conversion Kit		X
Flue Discharge Deflector		X
INDOOR MOTOR AND DRIVE		
Multiple Motor and Drive Packages	X	
Staged Air Volume (SAV™) System with VFD Controller (2-Stage Cooling Models Only)	X	
Display Kit or SAV System with VFD		X
LOW AMBIENT CONTROL		
Winter Start Kit [6]		X
Motormaster® Head Pressure Controller to –20°F [6]		X
POWER OPTIONS		
Cooling Low Ambient Controller to 0°F	X	
Powered Convenience Outlet	X	
Unpowered Convenience Outlet (125 amp Factory-Installed, 20 amp Field-Installed)	X	X
HACR Circuit Breaker [7]	X	
Non-Fused Disconnect [8]	X	
ROOF CURBS		
Roof Curb 14-in. (356 mm)		X
Roof Curb 24-in. (610 mm)		X
Horizontal Curb Adapter (Vertical to Horizontal Airflow)		X
EnergyX® SYSTEM		
EnergyX Energy Recovery	X	
EnergyX with Economizer	X	
EnergyX with Frost Protection	X	
EnergyX with Frost Protection and Economizer	X	
Filter Maintenance Sensor		X
Motor Status Sensor		X

*Factory-installed option.

†Field-installed accessory.

NOTES:

1. Requires a field-supplied 24V transformer for each application. See price page for details.
2. FDD (Fault Detection and Diagnostics System) capability per ASHRAE 90.1-2016 and California Title 24-2015 Section 120.2.
3. Models with RTU Open and ComfortLink DDC controls comply with ASHRAE 90.1-2016 section 6.4.3.1.b and California Title 24-2015 section 120.2.
4. Included with economizer.
5. Sensors used to optimize economizer performance.
6. See application data for assistance.
7. HACR circuit breaker cannot be used when rooftop MOCP electrical rating exceeds 200 amps at 208/230 volt, and 90 amps at 460 and 575 volt, 575 volt can only be used on Wye power supply. Delta power supply is prohibited. Carrier RTUBuilder selects this automatically.
8. Non-fused disconnect switch cannot be used when MOCP electrical rating exceeds 70 amps at 460/575 volt and 150 amps at 208/230 volt. Carrier Packaged RTUBuilder selects this automatically.
9. Not compatible with Staged Air Volume (SAV) system.

Options and accessories (cont)

Factory Installed Options

Economizer (dry-bulb or enthalpy) — Economizers save money. They bring in fresh, outside air for ventilation; and provide cool, outside air to cool your building. This is the preferred method of low-ambient cooling. When coupled to CO_2 sensors, economizers can provide even more savings by coupling the ventilation air to only that amount required.

Economizers are available, installed and tested by the factory, with either enthalpy or dry-bulb temperature inputs. Additional sensors are available as accessories to optimize the economizers. Economizers include a powered exhaust system to help equalize building pressures.

Economizers include gravity controlled barometric relief that helps equalize building pressure and ambient air pressures. This can be a cost effective solution to prevent building pressurization. Economizers are available in Ultra Low Leak and standard low leak versions. Economizers can be factory-installed or easily field-installed.

Optional Humidi-MiZer® Adaptive Dehumidification System — Carrier's Humidi-MiZer adaptive dehumidification system is an all-inclusive factory-installed option that can be ordered with any WeatherMaster 48HC17-28 rooftop unit.

This system expands the envelope of operation of Carrier's WeatherMaster rooftop products to provide unprecedented flexibility to meet year round comfort conditions.

The Humidi-MiZer adaptive dehumidification system has a unique dual operational mode setting. The Humidi-MiZer system includes two new modes of operation.

The WeatherMaster 48HC17-28 rooftop coupled with the Humidi-MiZer system is capable of operating in normal design cooling mode, subcooling mode, and hot gas reheat mode. Normal design cooling mode is when the unit will operate under its normal sequence of operation by cycling compressors to maintain comfort conditions.

Subcooling mode will operate to satisfy part load type conditions when the space requires combined sensible and a higher proportion of latent load control. Hot Gas Reheat mode will operate when outdoor temperatures diminish and the need for latent capacity is required for sole humidity control. Hot Gas Reheat mode will provide neutral air for maximum dehumidification operation.

Thru-the-Base Connections — Thru-the-base provisions/connection points are available as standard with every unit. When bottom connections are required, field furnished couplings are required.

Hinged Access Panels — Allows access to unit's major components with specifically designed hinged access panels. Panels are filter, control box, indoor fan motor.

Cu/Cu (Indoor) Coils (3-Phase Models Only) — Copper fins and copper tubes are mechanically bonded to copper tubes and copper tube sheets. A polymer strip prevents coil assembly from contacting the sheet metal coil pan to minimize potential for galvanic corrosion between coil and pan.

E-coated (Outdoor and Indoor) Coils — A flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.

Pre-Coated Outdoor Coils — A durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments. The coating minimizes galvanic action between dissimilar metals. Coating is applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube.

Condenser Coil Hail Guard — Sleek, louvered panels protect the condenser coil from hail damage, foreign objects, and incidental contact. This can be purchased as a factory installed option or as a field installed accessory.

Smoke Detectors — Trust the experts. Smoke detectors make your application safer and your job easier. Carrier smoke detectors immediately shut down the rooftop unit when smoke is detected. They are available, installed by the factory, for supply air, return air, or both.

Optional Stainless Steel Heat Exchanger — The stainless steel heat exchanger option provides the tubular heat exchanger be made out of a minimum 20 gauge type 409 stainless steel for applications where the mixed air to the heat exchanger is expected to drop below 45°F (7°C). Stainless steel may be specified on applications where the presence of airborne contaminants require its use (applications such as paper mills) or in area with very high outdoor humidity that may result in severe condensation in the heat exchanger during cooling operation.

Convenience Outlet (Powered or Un-powered) — Reduce service and/or installation costs by including a convenience outlet in your specification. Carrier will install this service feature at our factory. Provides a convenient, 15 amp, 115v GFCI receptacle with "Wet in Use" cover. The "powered" option allows the installer to power the outlet from the line side of the disconnect side as required by code. The "unpowered" option is to be powered from a separate 115/120v power source.

Non-Fused Disconnect — This OSHA-compliant, factory-installed, safety switch allows a service technician to locally secure power to the rooftop.

When selecting a factory-installed non-fused disconnect, note they are sized for unit as ordered from the factory. The sizing of these does not accommodate any power exhaust devices, etc.

HACR Breaker — These manual reset devices provide overload and short circuit protection for the unit. Factory wired and mounted with the units with access cover to help provide environment protection.

On 575V applications, HACR breaker can only be used with WYE power distribution systems. Use on Delta power distribution systems is prohibited.

Foil Faced Insulated Cabinet — Cabinet is fully insulated with non-fibrous, foil faced cleanable insulation that is secured and encapsulated in unit design.

PremierLink™ DDC Controller — This CCN controller regulates your rooftop's performance to tighter tolerances and expanded limits, as well as facilitates zoning systems and digital accessories. It also unites your Carrier HVAC equipment together on one, coherent CCN network. The PremierLink Controller can be factory-installed, or easily field-installed.

ComfortLink Controls — Models with the optional Carrier ComfortLink Controls allow added unit diagnostics and operation setup capabilities, as well as controlling logic for single zone Variable Air Volume (VAV) applications.

The ComfortLink control is your link to a world of simple and easy to use rooftop units that offer outstanding performance and value. It optimizes the performance of the refrigeration circuits as conditions change, resulting in the following features:

- Better control of temperature and humidity
- Superior reliability
- Automatic redundancy
- Low ambient cooling operation to 0°F (–18°C)
- More accurate diagnostics, at unit or remote

The ComfortLink Scrolling Marquee is very easy to use. The messages are displayed in easy to understand English, no decoding is required. A scrolling readout provides detailed explanations of control information. Only four, large, easy-to-use buttons are required to maneuver through the entire menu. The readout is designed to be visible even in the brightest sunlight. A hand-held Navigator™ accessory or wall-mounted System Pilot™ accessory can be used for added service flexibility.

The ComfortLink control provides service diagnostic information. Temperature and pressure can be read directly from the display with no need for separate gauges. Other data, such as compressor cycles, unit run time hours, current alarms, can also be accessed. A history of alarms is also available for viewing.

The service run test can be very helpful when troubleshooting. The user can run test major components to determine the root cause of a problem. The unit can be run-tested before an installation is complete to ensure satisfactory start-up. To ensure reliability, the ComfortLink control prevents reverse compressor rotation. No laptop computers are required for start-up.

Time schedules are built in and the Scrolling Marquee display provides easy access to setpoints. The ComfortLink control accepts input from a CO_2 sensor and a smoke detector. Both are available as factory-installed options or as field-installed accessories.

RTU Open Protocol Controller — Connect the rooftop to an existing BAS without needing complicated translators or adapter modules using the RTU Open controller. This new controller speaks the 4 most common building automation system languages (BACnet[1], Modbus[2], N2, and LonWorks[3]). Use this controller when you have an existing BAS.

Condensate Overflow Switch (Factory-Installed Option) — This sensor and related controller monitors the condensate level in the drain pan and shuts down compression operation when overflow conditions occur. It includes:

- Indicator light - solid red (more than 10 seconds on water contact - compressors disabled), blinking red (sensor disconnected)
- 10 second delay to break - eliminates nuisance trips from splashing or waves in pan (sensor needs 10 seconds of constant water contact before tripping)
- Disables the compressor(s) operation when condensate plug is detected, but still allows fans to run for Economizer.

Power Exhaust with Barometric Relief — Superior internal building pressure control. This field-installed accessory or factory-installed option may eliminate the need for costly, external pressure control fans.

Low Ambient Controller — The low ambient controller is a head pressure controller kit that is designed to maintain the unit's condenser head pressure during periods of low ambient cooling operation. This device should be used as an alternative to economizer free cooling not when economizer usage is either not appropriate or desired. The low ambient controller will either cycle the outdoor fan motors or operate them at reduced speed to maintain the unit operation, depending on the model. This controller allows cooling operation down to 0°F (–18°C) ambient conditions.

Manual OA Damper — Manual outdoor air dampers are an economical way to bring in ventilation air. The dampers are available in 25% versions.

Staged Air Volume (SAV™) Indoor Fan Speed System — Carrier's Staged Air Volume (SAV) system saves energy and installation time by utilizing a Variable Frequency Drive (VFD) to automatically adjust the indoor fan motor speed in sequence with the units cooling operation. Per ASHRAE 90.1-2016 standard, during the first stage of cooling operation the VFD will adjust the fan motor to provide 66% of the total cfm established for the unit. When a call for the second stage of cooling is required, the VFD will allow the total cfm for the unit established (100%). During the heating mode the VFD will allow total design cfm (100%) operation and during the ventilation mode the VFD will allow operation to 66% of total cfm. Compared to single speed indoor fan motor systems, Carrier's SAV system

1. BACnet is a registered trademark of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers).
2. Modbus is a registered trademark of Schneider Electric.
3. LonWorks is a registered trademark of Echelon Corporation.

can save substantial energy, 25%+, versus single speed indoor fan motor systems.

IMPORTANT: Data based on .10 ($/kWh) in an office application utilizing Carrier's HAP 4.6 simulation software program.

The VFD used in Carrier's SAV system has soft start capabilities to slowly ramp up the speeds, thus eliminating any high inrush air volume during initial start-up. It also has internal over current protection for the fan motor and a field-installed display kit that allows adjustment and in depth diagnostics of the VFD.

This SAV system is available on models with 2-stage cooling operation with electrical mechanical or RTU Open, Multi Protocol controls. Both space sensor and conventional thermostats controls can be used to provide accurate control in any application.

The SAV system is very flexible for initial fan performance set up and adjustment. The standard factory shipped VFD is pre-programmed to automatically stage the fan speed between the first and second stage of cooling. The unit fan performance static pressure and cfm can be easily adjusted using the traditional means of pulley adjustments. The other means to adjust the unit static and cfm performance is to utilize the field-installed Display Kit and adjust the frequency and voltage in the VFD to required performance requirements. In either case, once set up, the VFD will automatically adjust the speed between the cooling stage operations.

Alternate Motors and Drives — Some applications need larger horsepower motors, some need more airflow, and some need both. Regardless of the case, your Carrier expert has a factory-installed combination to meet your application. A wide selection of motors and pulleys (drives) are available, factory-installed, to handle nearly any application.

Barometric Hood — For Horizontal Economizer applications where relief damper is installed in duct work. This kit provides the needed protection.

EnergyX® Energy Recovery Ventilator (ERV) — EnergyX System is a factory installed Energy Recovery Ventilator (ERV) module on a Carrier packaged rooftop unit. It is integrated with the base rooftop unit structurally, electrically and with regard to controls operation.

EnergyX with Economizer (3-phase Models Only) — Allows true modulating economizer capability when OA is suitable for free cooling.

- operates as a true wheel bypass
- uses stop/jog operation for wheel required when using CO_2 sensor for DCV operation
- economizer integrated into EnergyX unit

EnergyX with Economizer (3-phase Models Only) — Senses pressure differential across the energy recovery cassette. Uses exhaust air to defrost the wheel when necessary.

Field-Installed Accessories

Differential Enthalpy Sensor — The differential enthalpy sensor is comprised of an outdoor and return air enthalpy sensors to provide differential.

Wall or duct mounted CO_2 Sensor — The IAQ sensor shall be available in duct or wall mount. The sensor provides demand ventilation indoor air quality (IAQ) control.

Time Guard II Control Circuit — This accessory protects your compressor by preventing short-cycling in the event of some other failure, prevents the compressor from restarting for 30 seconds after stopping. Not required with PremierLink, RTU Open, or authorized commercial thermostats.

Propane Conversion Kit — Convert your gas heat rooftop from standard natural gas operation to Propane using this field-installed kit.

High Altitude Heating — High altitudes have less oxygen, which affects the fuel/air mixture in heat exchangers. In order to maintain a proper fuel/air mixture, heat exchangers operating in altitudes above 2000 ft (610 m) require different orifices. To select the correct burner orifices or determine the heat capacity for a high altitude application, use either the selection software, or the unit's service manual. High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion on altitudes above 2000 ft (610 m).

NOTE: Typical natural gas heating value ranges from 975 to 1050 Btu/ft^3 at sea level nationally. The heating value goes down approximately 1.7% per every thousand feet elevation. Standard factory orifices can typically be used up to 2000 ft (610 m) elevation without any operational issues.

Flue Discharge Deflector — The flue discharge deflector is a useful accessory when flue gas recirculation is a concern. By venting the flue discharge upwards, the deflector minimizes the chance for a neighboring unit to intake the flue exhaust.

Winter Start Kit — The winter start kit by Carrier extends the low ambient limit of your rooftop to 25°F (–4°C). The kit bypasses the low pressure switch, preventing nuisance tripping of the low pressure switch. Other low ambient precautions may still be prudent.

Motormaster® Head Pressure Controller — The Motormaster motor controller is a low ambient, head pressure controller kit that is designed to maintain the unit's condenser head pressure during periods of low ambient cooling operation. This device should be used as an alternative to economizer free cooling when economizer usage is either not appropriate or desired. The Motormaster controller will either cycle the outdoor-fan motors or operate them at reduced speed to maintain the unit operation, depending on the model.

Motormaster controller allows cooling operation down to –20°F (–29°C) ambient conditions.

Roof Curb (14-in./356 mm or 24-in./610 mm) — Full perimeter roof curb with exhaust capability provides separate air streams for energy recovery from the exhaust air without supply air contamination.

Horizontal Roof Curb Adapter (Vertical to Horizontal Airflow) — Horizontal Roof Curb Adapters — Used when horizontal supply and/or return is desired. Motor Status Indicator Accessory – monitors wheel, supply and exhaust motors and provides indication if not operating. Filter status indicator accessory – monitors static pressure across supply and exhaust filters and provides indication when filters become clogged.

EnergyX Filter Maintenance Sensor — When the optional factory installed filter maintenance indicator is used, a factory-installed differential pressure switch measures pressure drop across the outside air filter and activates a field-supplied dry contact indicator when the pressure differential exceeds the adjustable switch setpoint. The EnergyX® wheel operation is not interrupted.

EnergyX Motor Status Sensor — Monitors the EnergyX wheel/motor and supply and exhaust fan motors to provide indication of operation.

EnergyX Motorized Exhaust Damper Accessory — Replaces the standard barometric exhaust damper blades with motorized (open/shut) damper.

OPTIONS AND ACCESSORY WEIGHTS

OPTION / ACCESSORY NAME	48HC UNIT WEIGHT							
	17		20		24		28	
	lb	kg	lb	kg	lb	kg	lb	kg
EnergyX Energy Recovery Ventilator	1466	665	1466	665	1676	760	1676	760
Barometric Relief Damper	50	23	50	23	50	23	50	23
Humidi-MiZer® System*	110	50	120	55	120	55	120	55
Economizer	498	226	498	226	505	229	505	229
Power Exhaust	125	57	125	57	125	57	125	57
EconoMi$er® (IV, X, or 2)	170	77	170	77	170	77	195	88
Copper Tube/Fin Condenser Coil	28	13	30	14	34	15	34	15
Copper Tube/Fin Evaporator Coil	110	50	110	50	135	61	16	73
Copper Tube/Fin Condenser and Evaporator Coil	—	—	—	—	—	—	—	—
Low Gas Heat	85	39	85	39	85	39	85	39
Medium Gas Heat	90	41	90	41	90	41	90	41
High Gas Heat	113	51	113	51	113	51	113	51
Flue Discharge Deflector	7	3	7	3	7	3	7	3
Roof Curb 14-in. (356 mm)	240	109	240	109	240	109	255	116
Roof Curb 24-in. (610 mm)	340	154	340	154	340	154	355	161
Louvered Hail Guard	60	27	60	27	120	54	150	68
CO_2 Sensor	5	2	5	2	5	2	5	2
Return Smoke Detector	5	2	5	2	5	2	5	2
Supply Smoke Detector	5	2	5	2	5	2	5	2
Fan/Filter Status Switch	2	1	2	1	2	1	2	1
Non-Fused Disconnect	15	7	15	7	15	7	15	7
HACR Circuit Breaker	2	1	2	1	2	1	2	1
Powered Convenience Outlet	35	16	35	16	35	16	35	16
Powered Exhaust	125	57	125	57	125	57	125	57
Non-Powered Convenience Outlet	5	2	5	2	5	2	5	2
Enthalpy Sensor	2	1	2	1	2	1	2	1
Differential Enthalpy Sensor	3	1	3	1	3	1	3	1
Two Position Motorized Damper	50	23	50	23	50	23	65	29
Manual Damper	35	16	35	16	35	16	40	18
Field Filter Track 4-in. (102mm)	12	5	12	5	12	5	12	5
Motormaster® Controller	35	16	35	16	35	16	35	16
Medium Static Motor/Drive	5	2	6	3	6	3	6	3
High Static Motor/Drive	11	5	12	5	16	7	16	7
Barometric Relief Hood (Horizontal)	25	11	25	11	25	11	25	11
SAV™ System with VFD	20	9	20	9	20	9	20	9

LEGEND

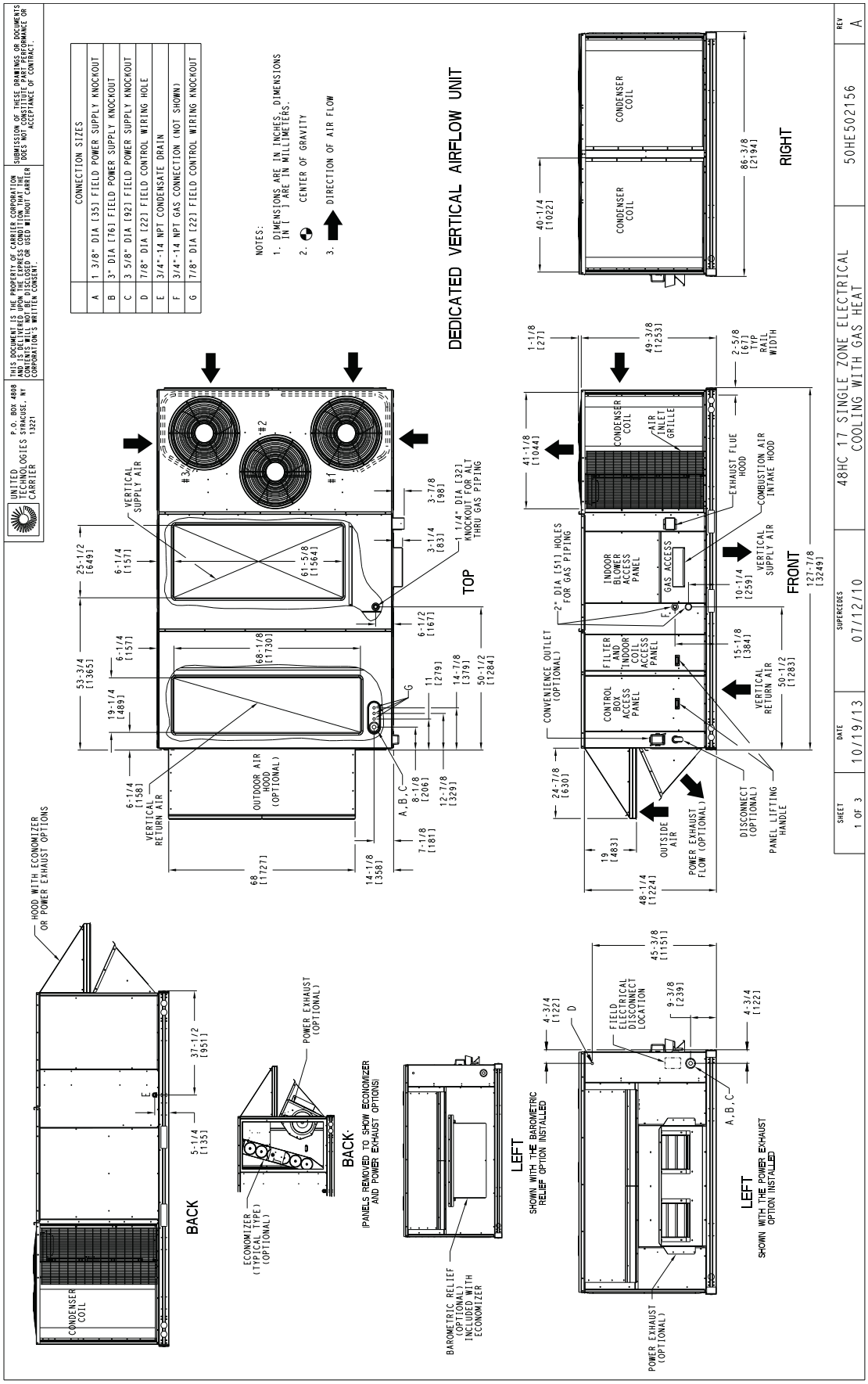
— Not Available

* For Humidi-MiZer® system add Motormaster® controller.

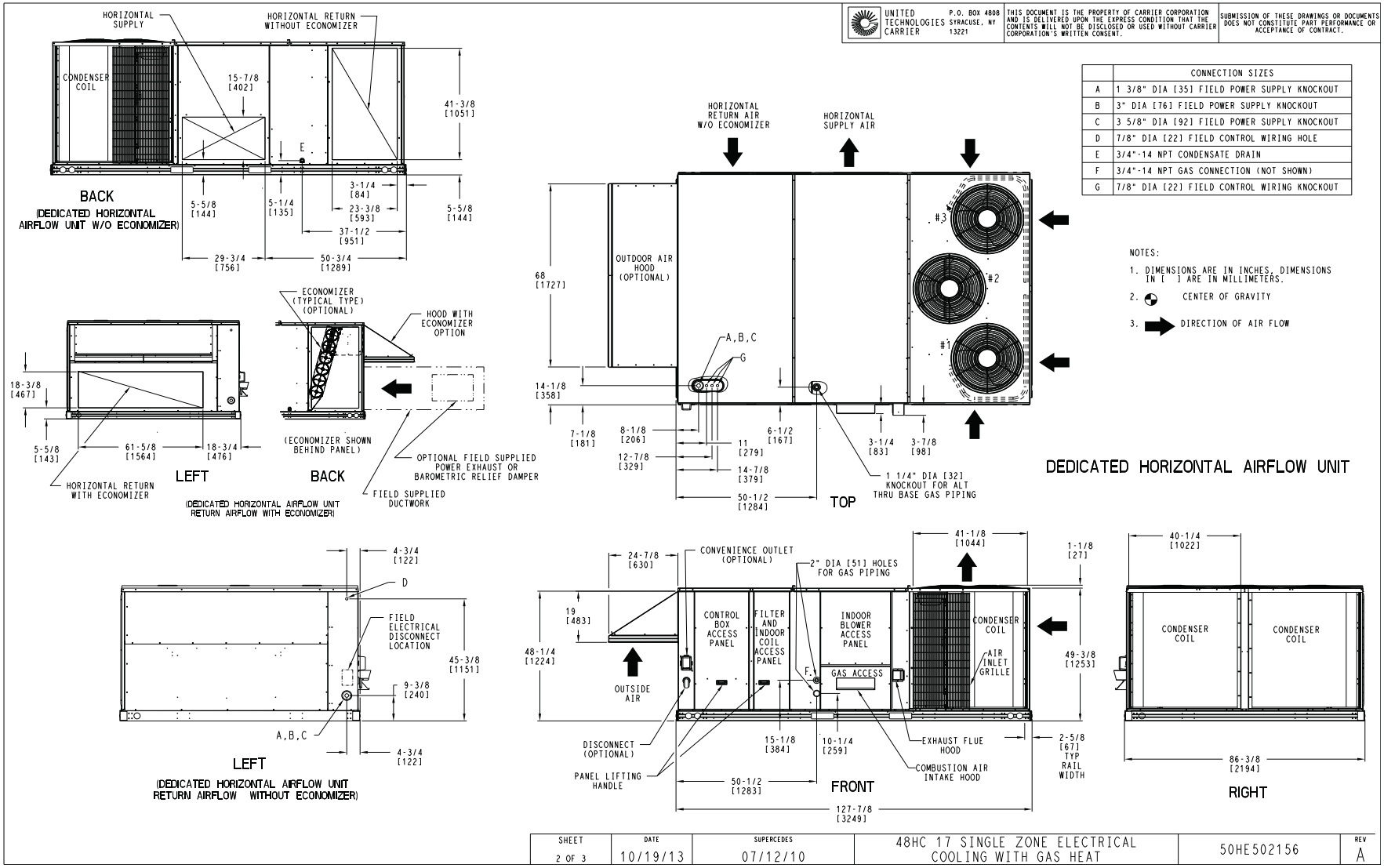
NOTE: Where multiple variations are available, the heaviest combination is listed.

Dimensions

48HC**17 BASE UNIT DIMENSIONS



48HC**17 BASE UNIT DIMENSIONS (cont)

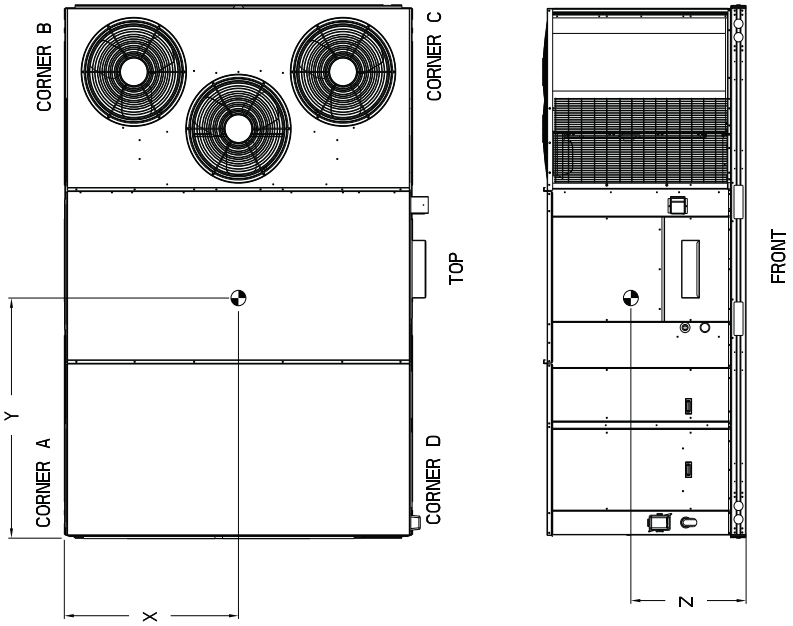


Dimensions (cont)

48HC**17 CORNER WEIGHTS

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.			
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z	
48HC17	1892	860	401	182	449	204	565	257	505	230	48 [1219]	67 3/8 [1711]	16 1/2 [419]	

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.



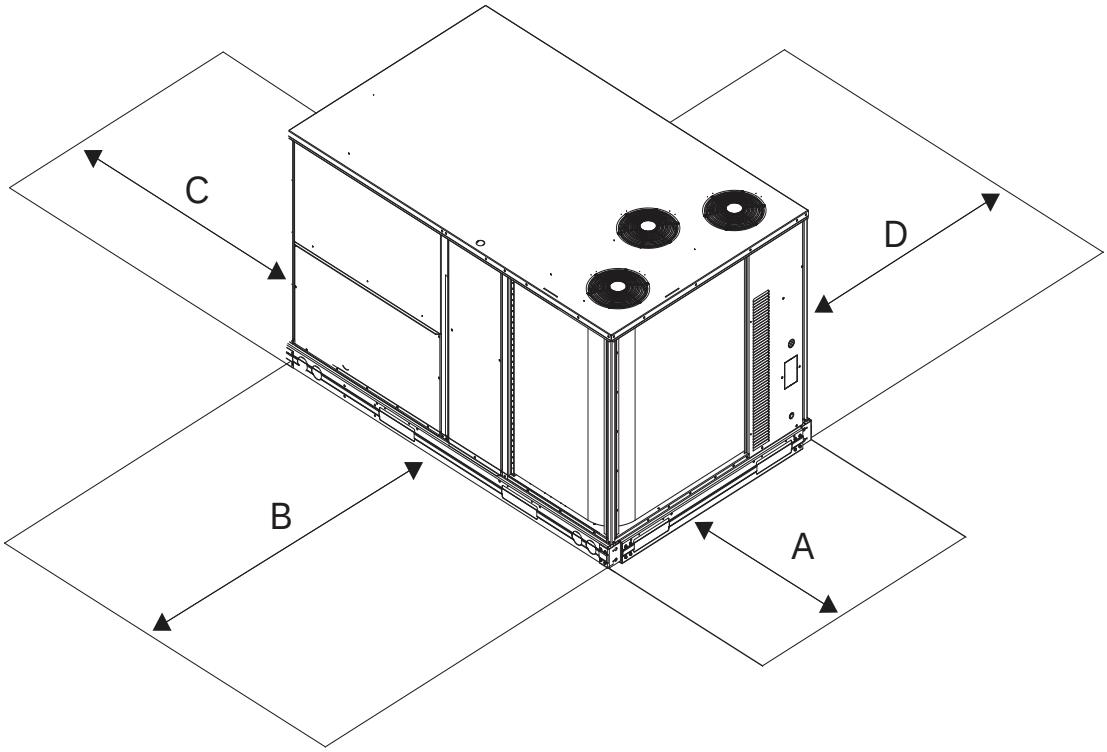
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SHEET	DATE	SUPERCEDES	48HC 17 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT	50HE502156	REV
3 OF 3	10/19/13	07/12/10			A

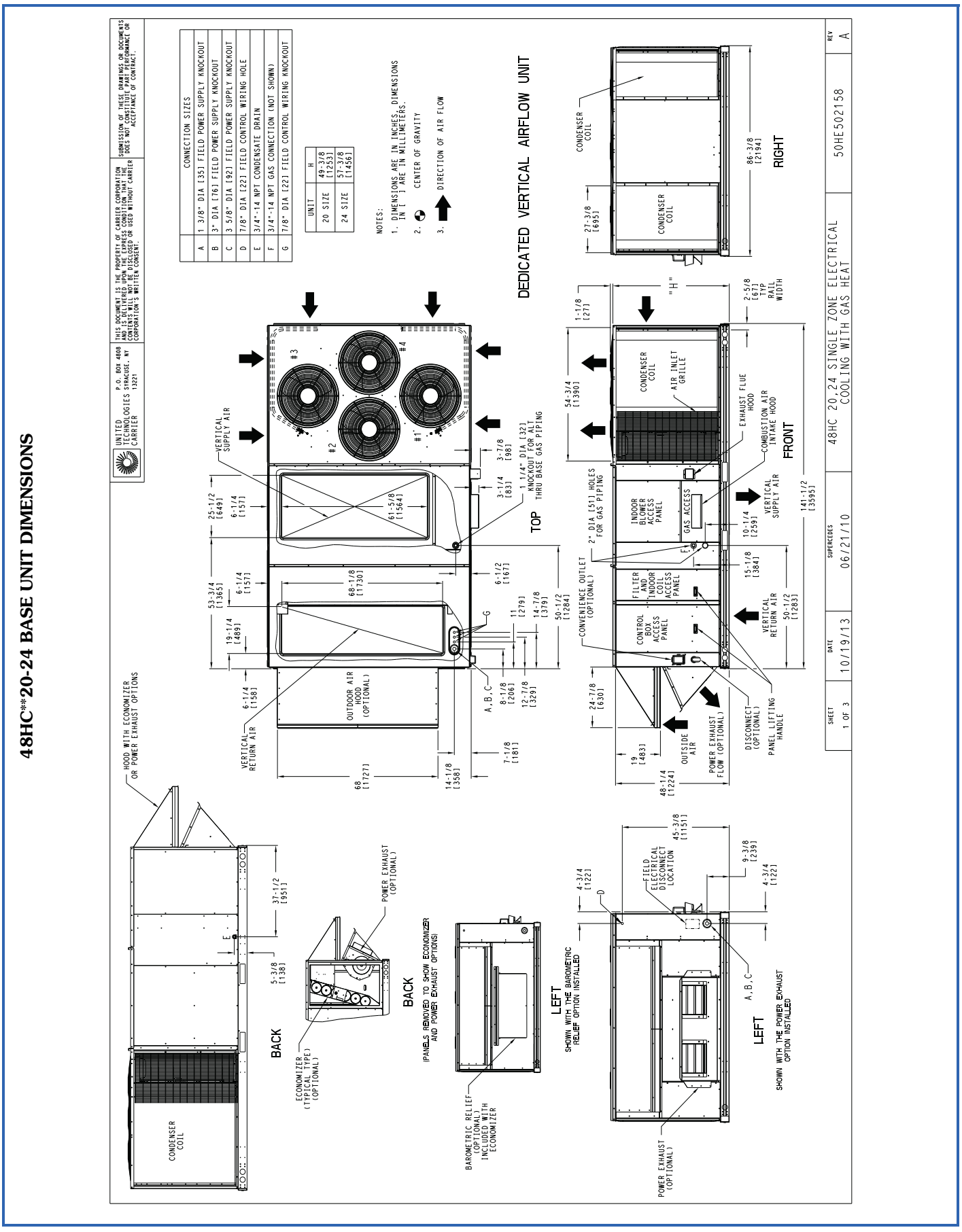
48HC**17 SERVICE CLEARANCES



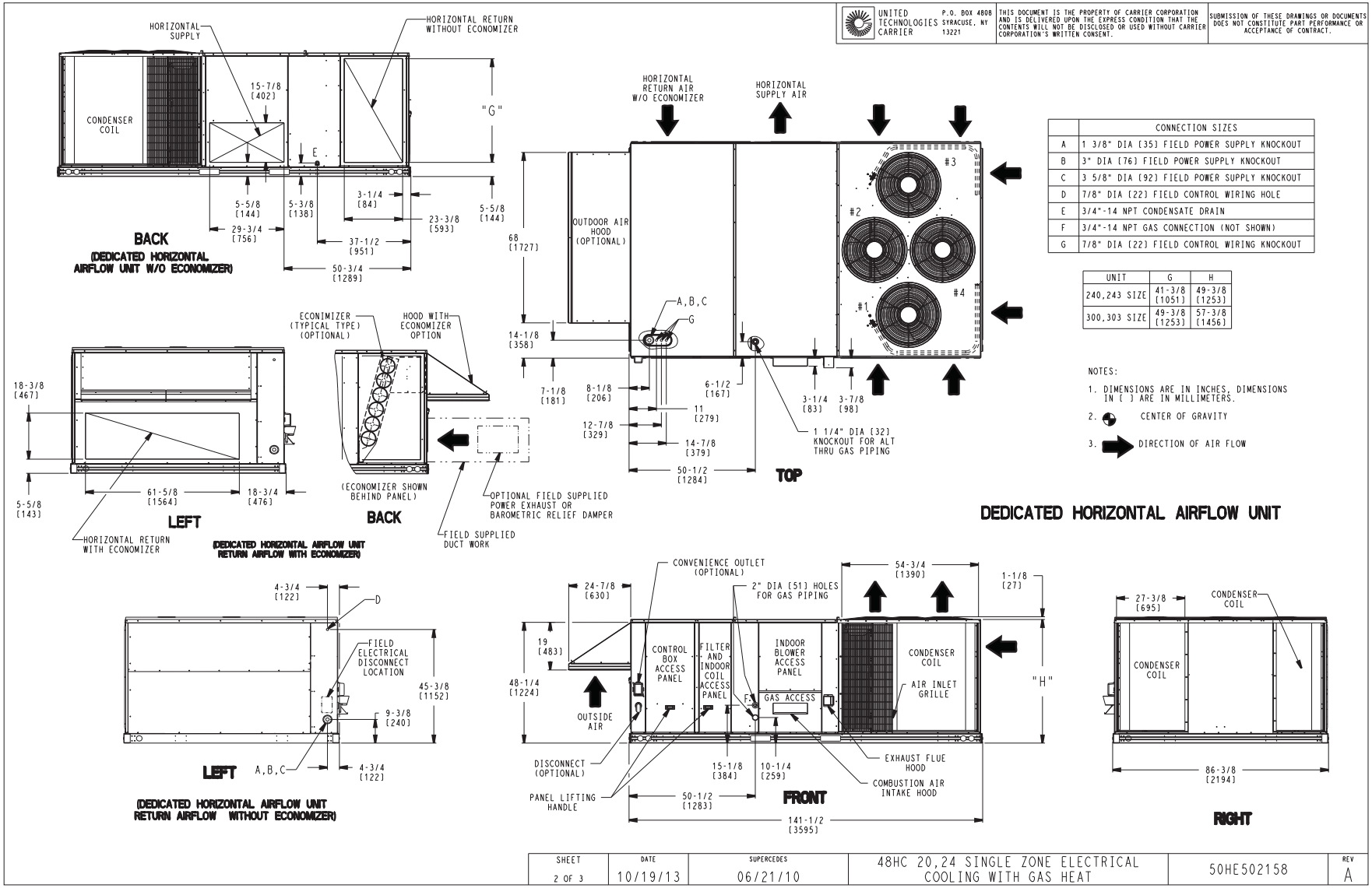
LOCATION	DIMENSION (in.)	CONDITION
A	36	Recommended clearance for airflow and service.
B	42	Recommended clearance for airflow and service.
C	18	No convenience outlet. No economizer. No field-installed disconnect on economizer hood side (factory-installed disconnect installed).
	36	Convenience outlet installed. Vertical surface behind servicer is electrically non-conductive (e.g. wood, fiberglass).
	42	Convenience outlet installed. Vertical surface behind servicer is electrically conductive (e.g. metal, masonry)
	96	Economizer and/or Power Exhaust installed. Check for sources of flue products within 10-ft. of economizer fresh air intake.
D	42	Recommended clearance for service.

NOTE: Unit is not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

Dimensions (cont)



48HC**20-24 BASE UNIT DIMENSIONS (cont)

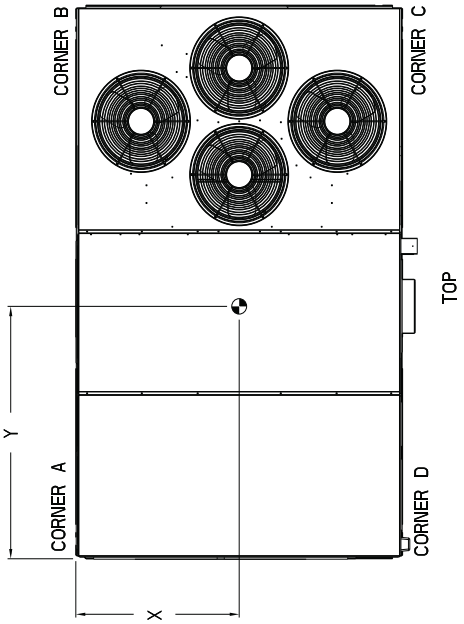


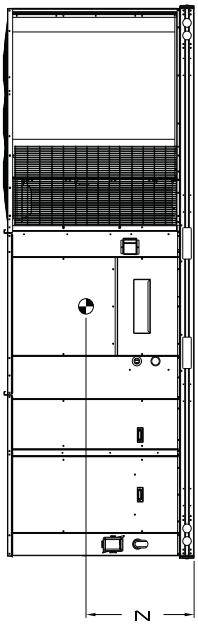
Dimensions (cont)

48HC**20-24 CORNER WEIGHTS

UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC20	2102	956	474	215	390	177	593	269	582	265	47 1/2 [1207]	71 1/4 [1810]	16 1/2 [419]
48HC24	2247	1021	540	246	556	253	598	272	581	264	44 5/8 [1133]	71 5/8 [1819]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.





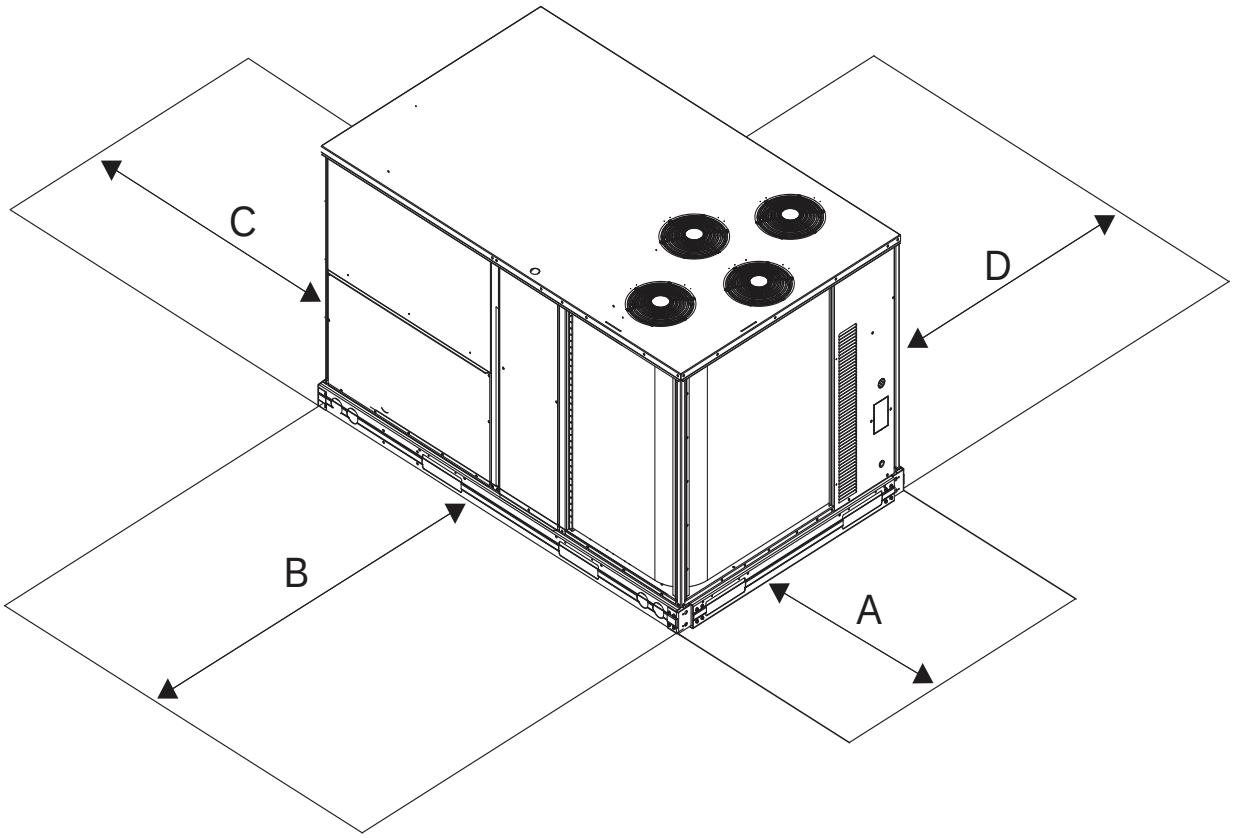
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SHEET	DATE	SUPERCEDES	48HC 20,24 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT	50HE502158	REV
3 OF 3	10/19/13	06/21/10			A

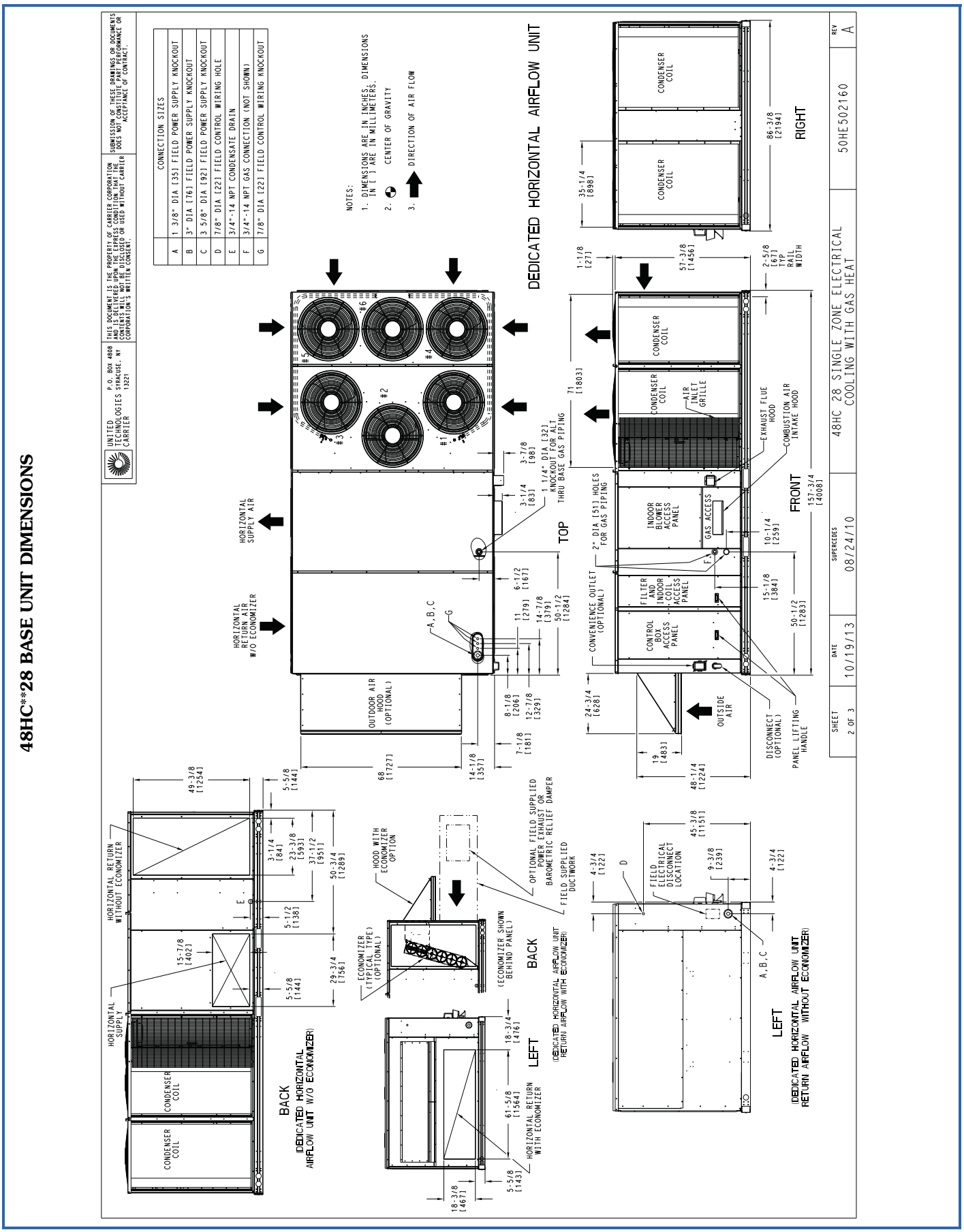
48HC**20-24 SERVICE CLEARANCES



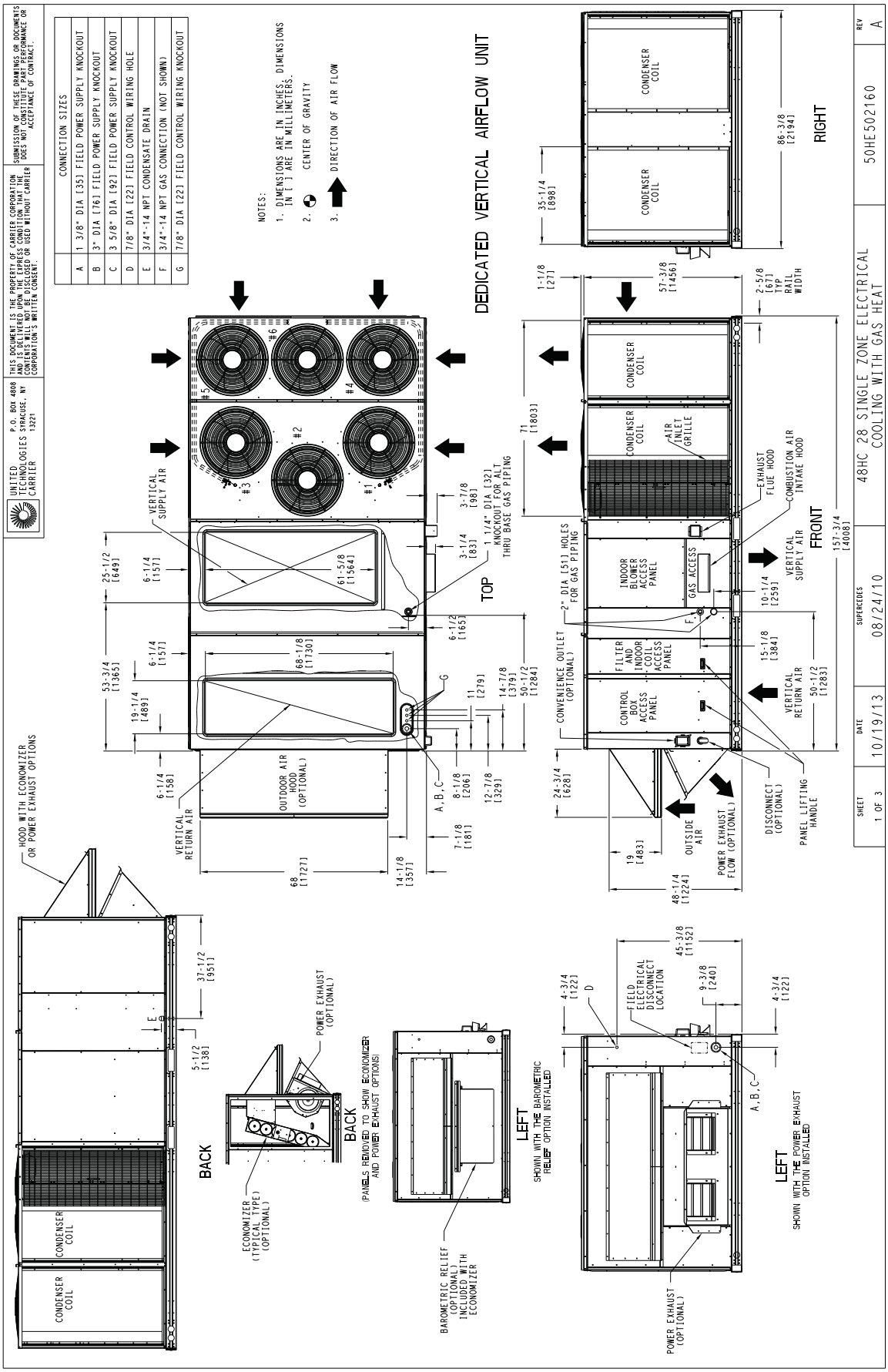
LOCATION	DIMENSION (in.)	CONDITION
A	36	Recommended clearance for airflow and service.
B	42	Recommended clearance for airflow and service.
C	18	No convenience outlet. No economizer. No field-installed disconnect on economizer hood side (factory-installed disconnect installed).
	36	Convenience outlet installed. Vertical surface behind servicer is electrically non-conductive (e.g. wood, fiberglass).
	42	Convenience outlet installed. Vertical surface behind servicer is electrically conductive (e.g. metal, masonry)
	96	Economizer and/or Power Exhaust installed. Check for sources of flue products within 10-ft. of economizer fresh air intake.
D	42	Recommended clearance for service.

NOTE: Unit is not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

Dimensions (cont)



48HC**28 BASE UNIT DIMENSIONS (cont)

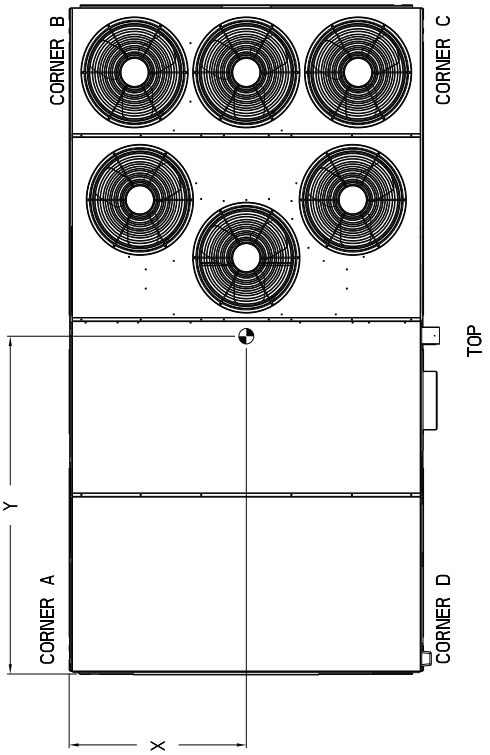


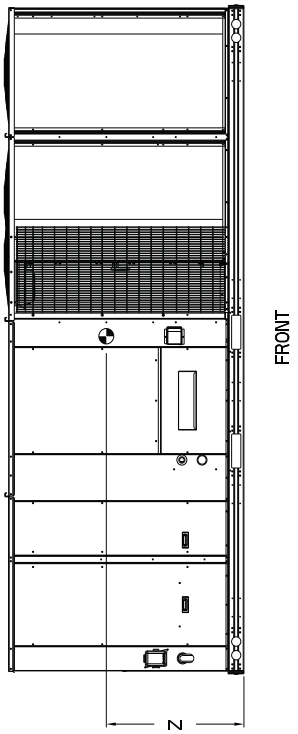
Dimensions (cont)

48HC**28 CORNER WEIGHTS

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC28	2292	1042	577	262	559	254	583	265	602	274	44 [1118]	77 1/2 [1969]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.





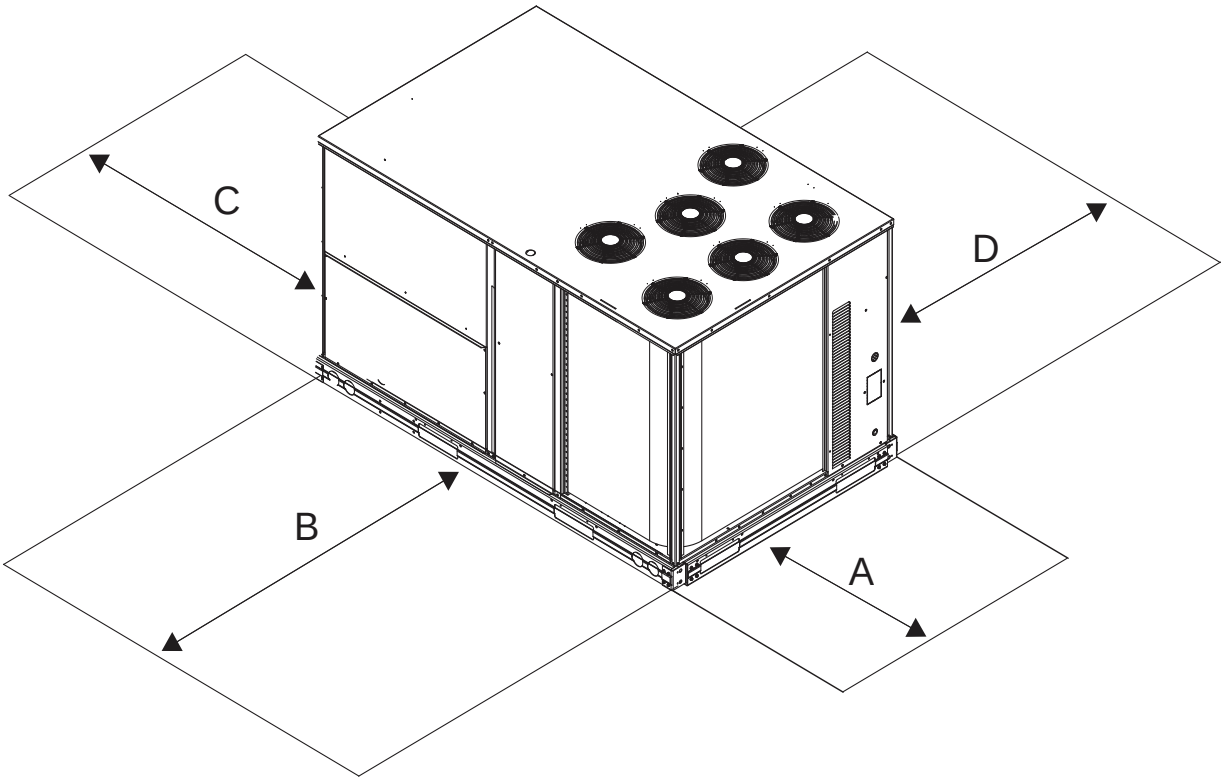
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SHEET	DATE	SUPERCEDES	48HC 28 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT		REV
3 OF 3	10/19/13	08/24/10		50HE502160	A

48HC**28 SERVICE CLEARANCES

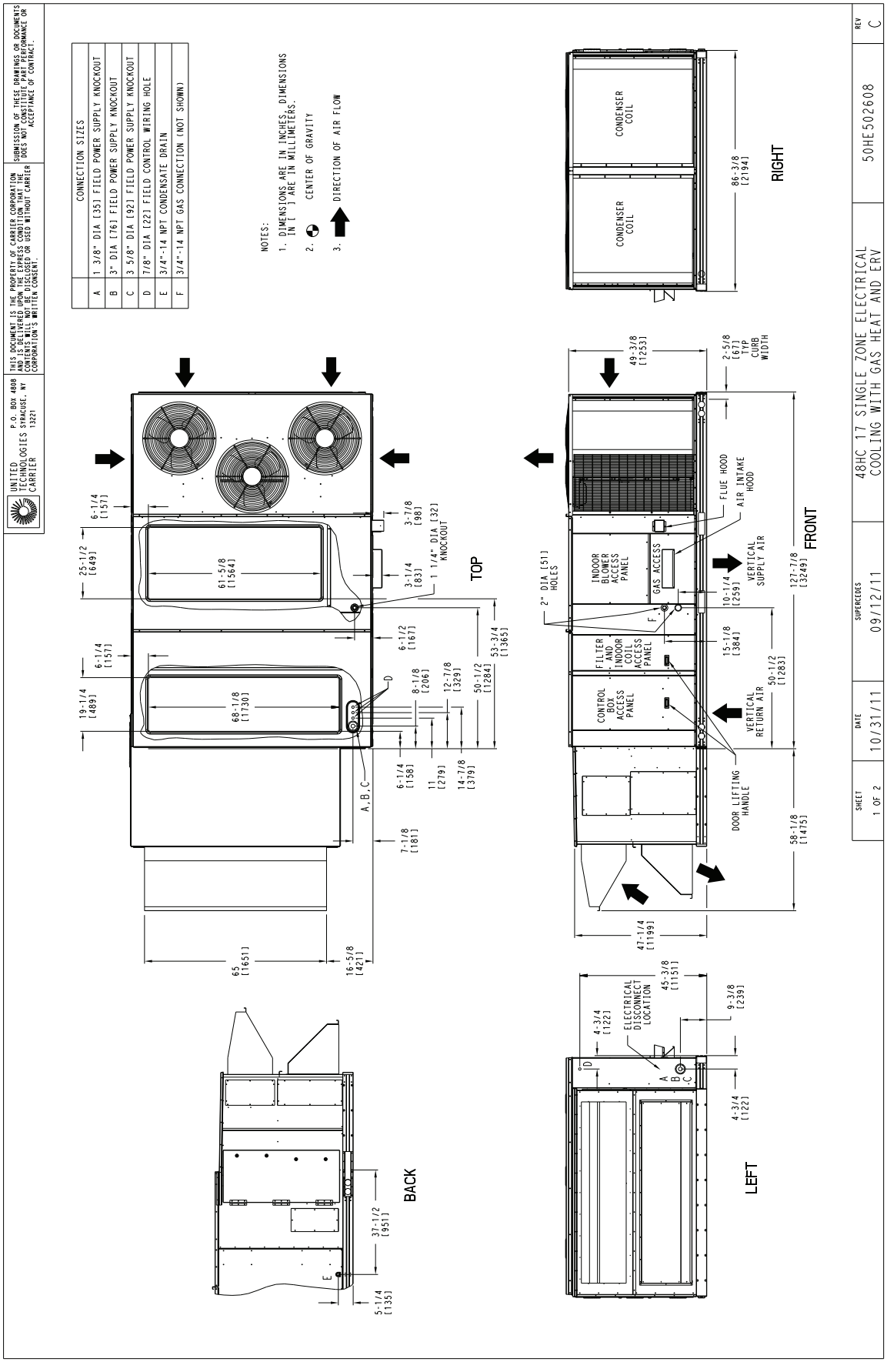


LOCATION	DIMENSION (in.)	CONDITION
A	36	Recommended clearance for airflow and service.
B	42	Recommended clearance for airflow and service.
C	18	No convenience outlet. No economizer. No field-installed disconnect on economizer hood side (factory-installed disconnect installed).
	36	Convenience outlet installed. Vertical surface behind servicer is electrically non-conductive (e.g. wood, fiberglass).
	42	Convenience outlet installed. Vertical surface behind servicer is electrically conductive (e.g. metal, masonry)
	96	Economizer and/or Power Exhaust installed. Check for sources of flue products within 10-ft. of economizer fresh air intake.
D	42	Recommended clearance for service.

NOTE: Unit is not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

Dimensions (cont)

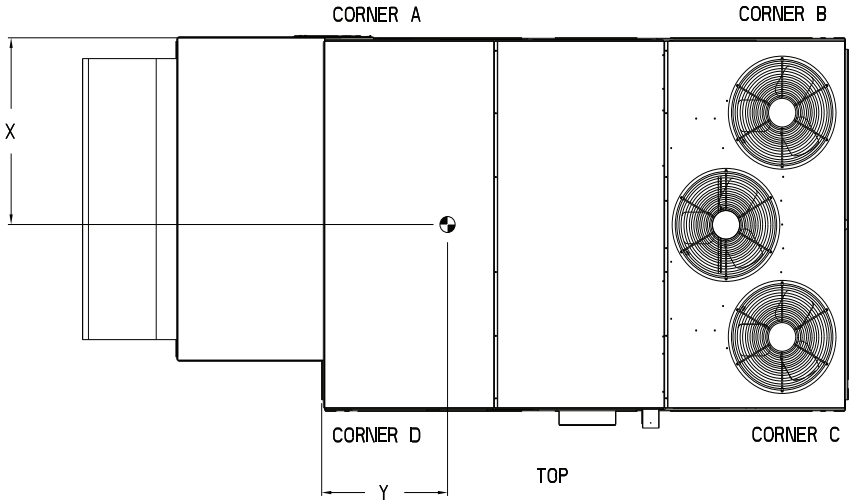
48HC**17 WITH EnergyX SYSTEM DIMENSIONS

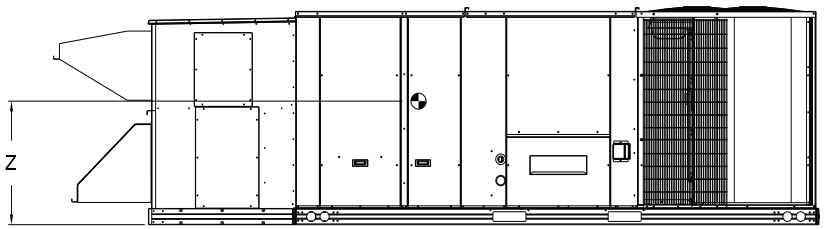


48HC**17 WITH EnergyX SYSTEM CORNER WEIGHTS

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC17	3358	1526	1178	535	499	227	500	227	1180	537	43 1/8 [1095]	38 [965]	16 1/2 [419]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.





FRONT

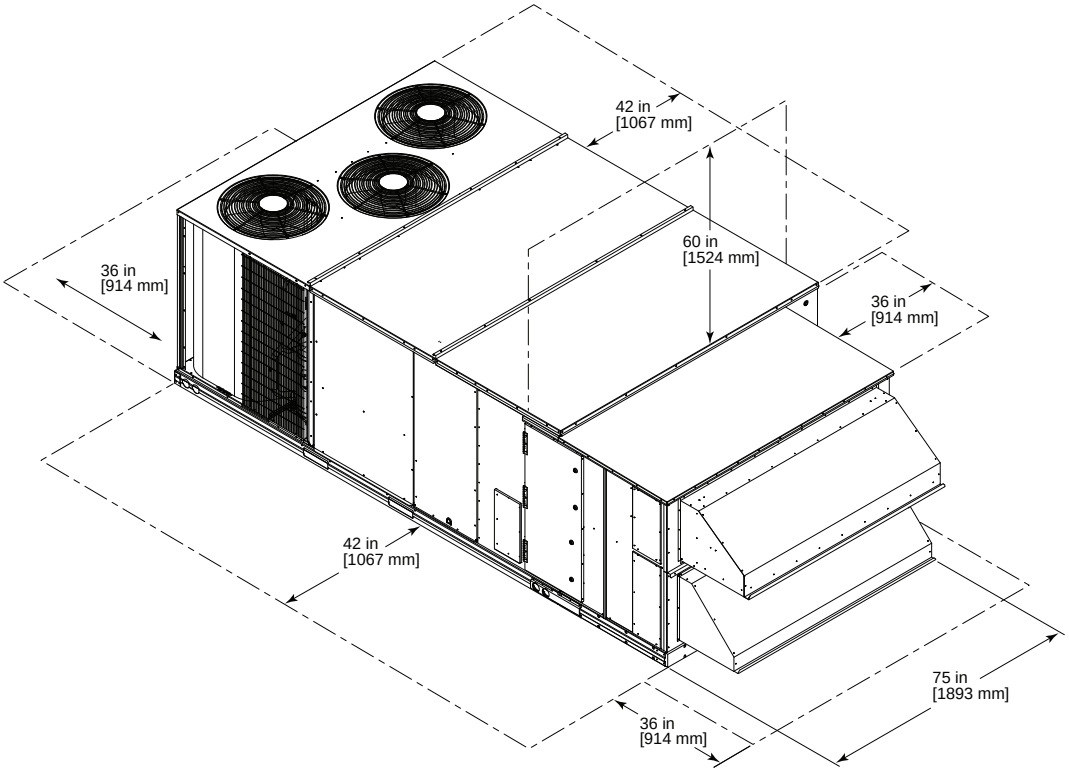
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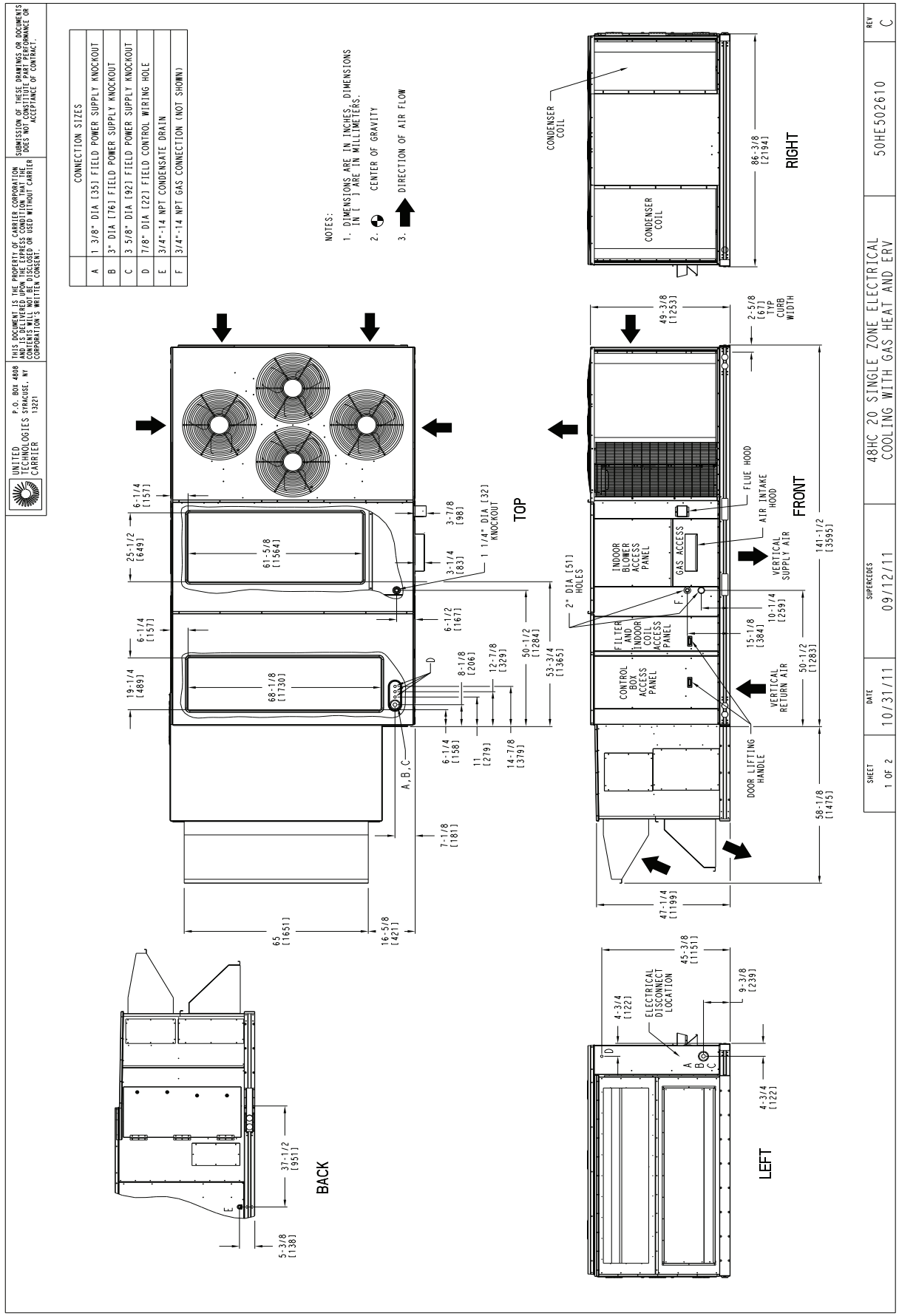
Dimensions (cont)

48HC**17 WITH EnergyX SYSTEM SERVICE CLEARANCES



NOTE: Unit is not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

48HC**20 WITH EnergyX SYSTEM DIMENSIONS

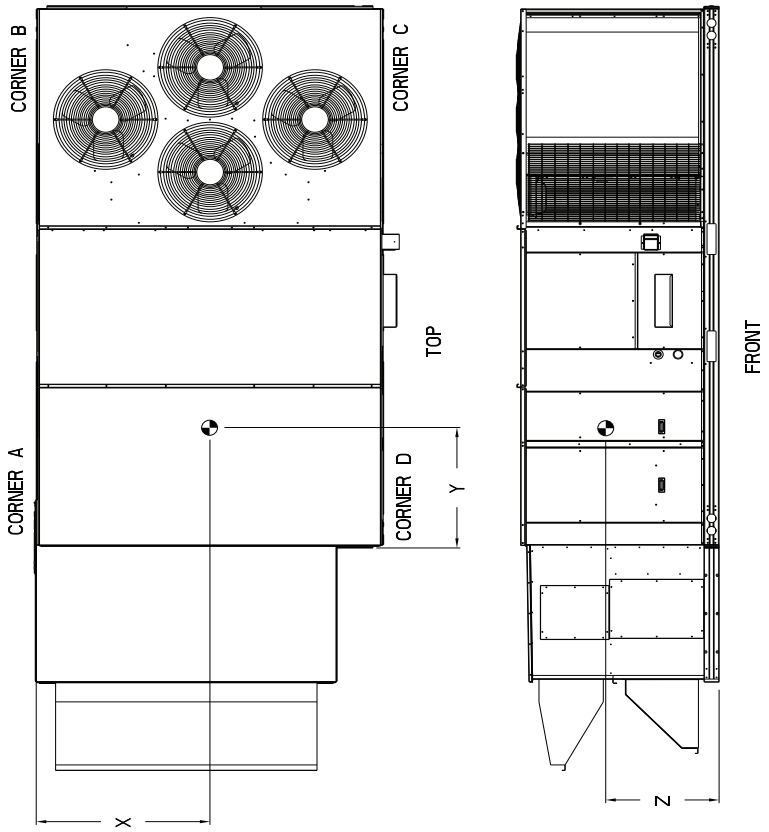


Dimensions (cont)

48HC**20 WITH EnergyX SYSTEM CORNER WEIGHTS

UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC20	3568	1622	1184	538	451	205	608	276	1150	523	42 1/2 [1079]	49 [1241]	16 1/2 [419]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.



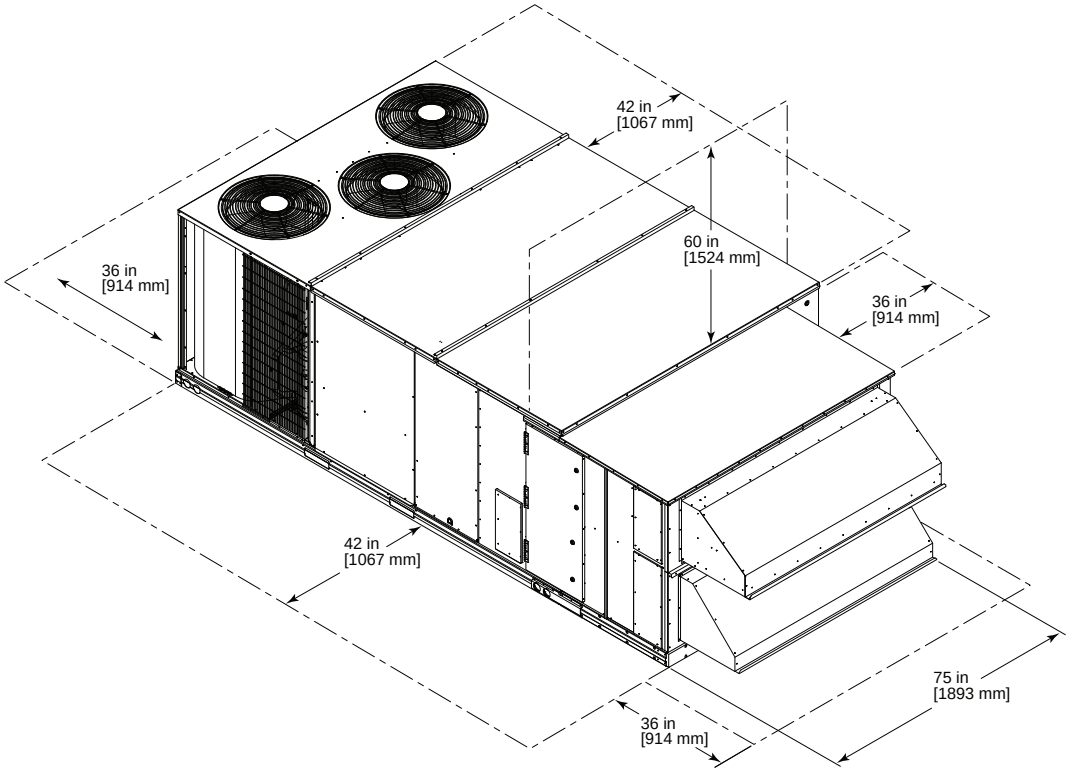
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SHEET	DATE	SUPERCEDES	48HC 20 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502610	REV
2 OF 2	10/31/11	09/12/11			C

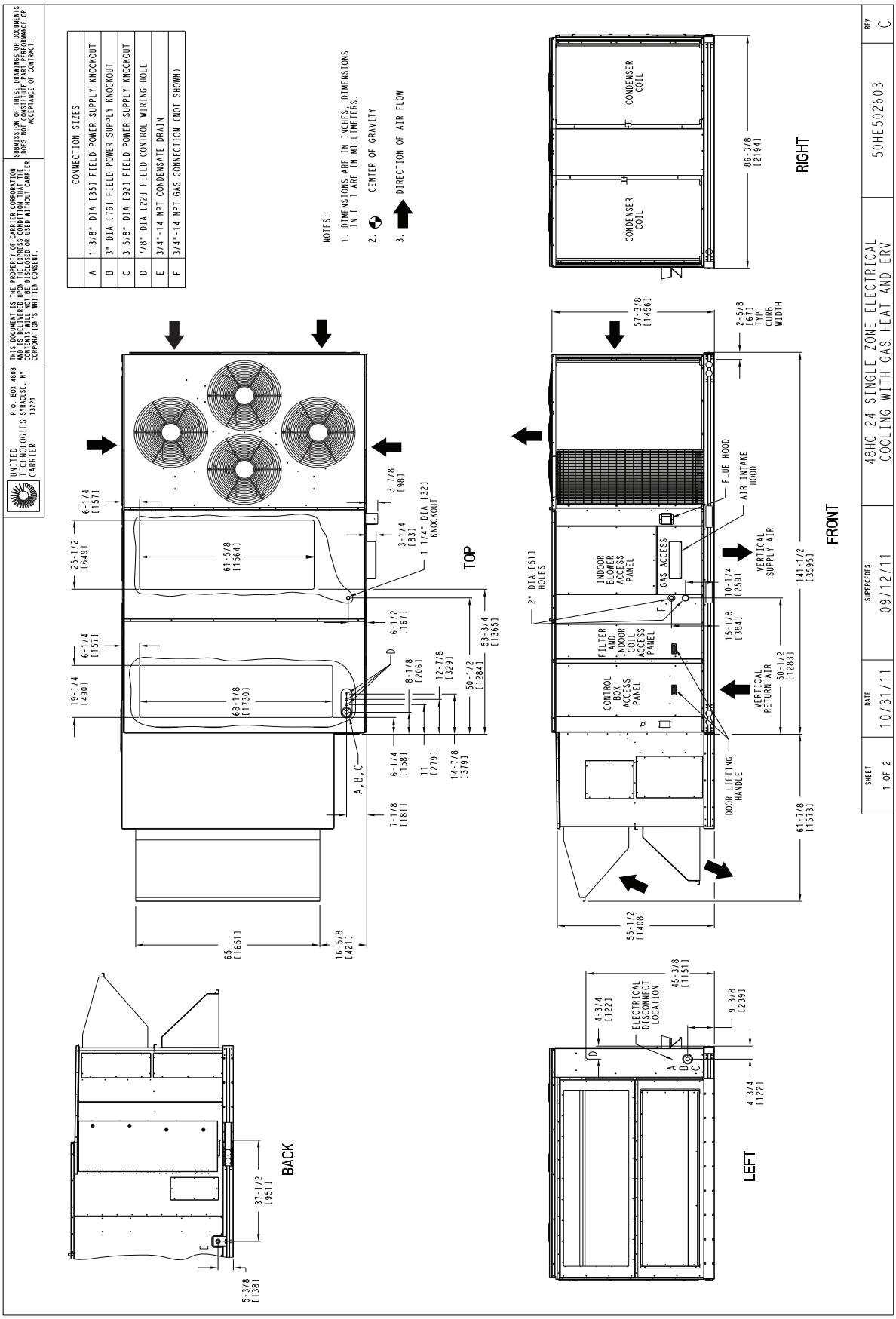
48HC**20 WITH EnergyX SYSTEM SERVICE CLEARANCES



NOTE: Unit is not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

Dimensions (cont)

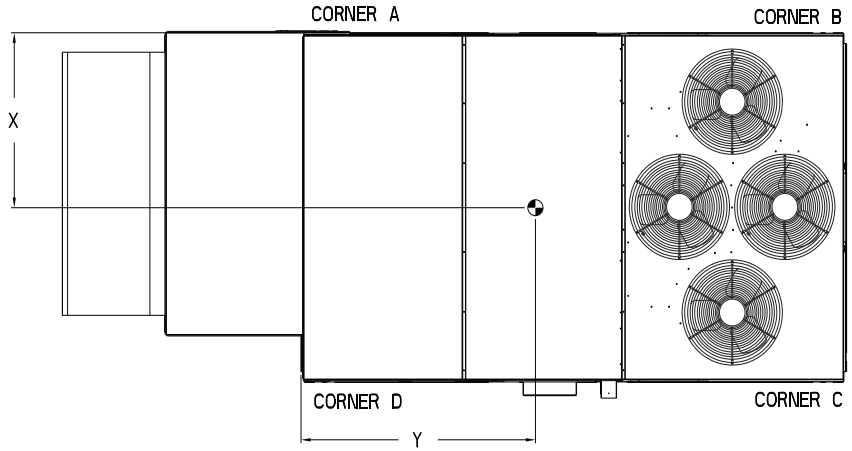
48HC**24 WITH EnergyX SYSTEM DIMENSIONS



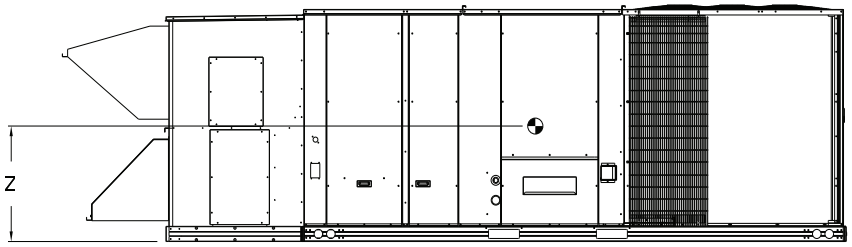
48HC**24 WITH EnergyX SYSTEM CORNER WEIGHTS

UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC24	3923	1783	1368	622	586	266	591	268	1379	627	43 1/4 [1099]	42 3/8 [1076]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.



TOP



FRONT

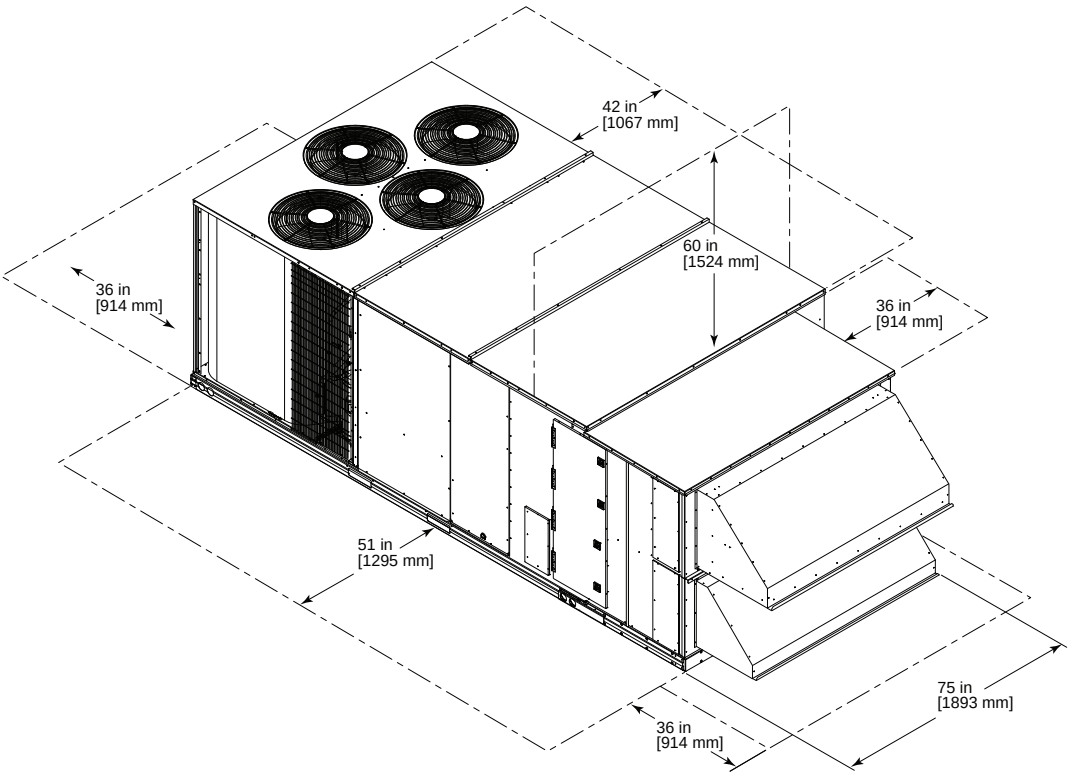
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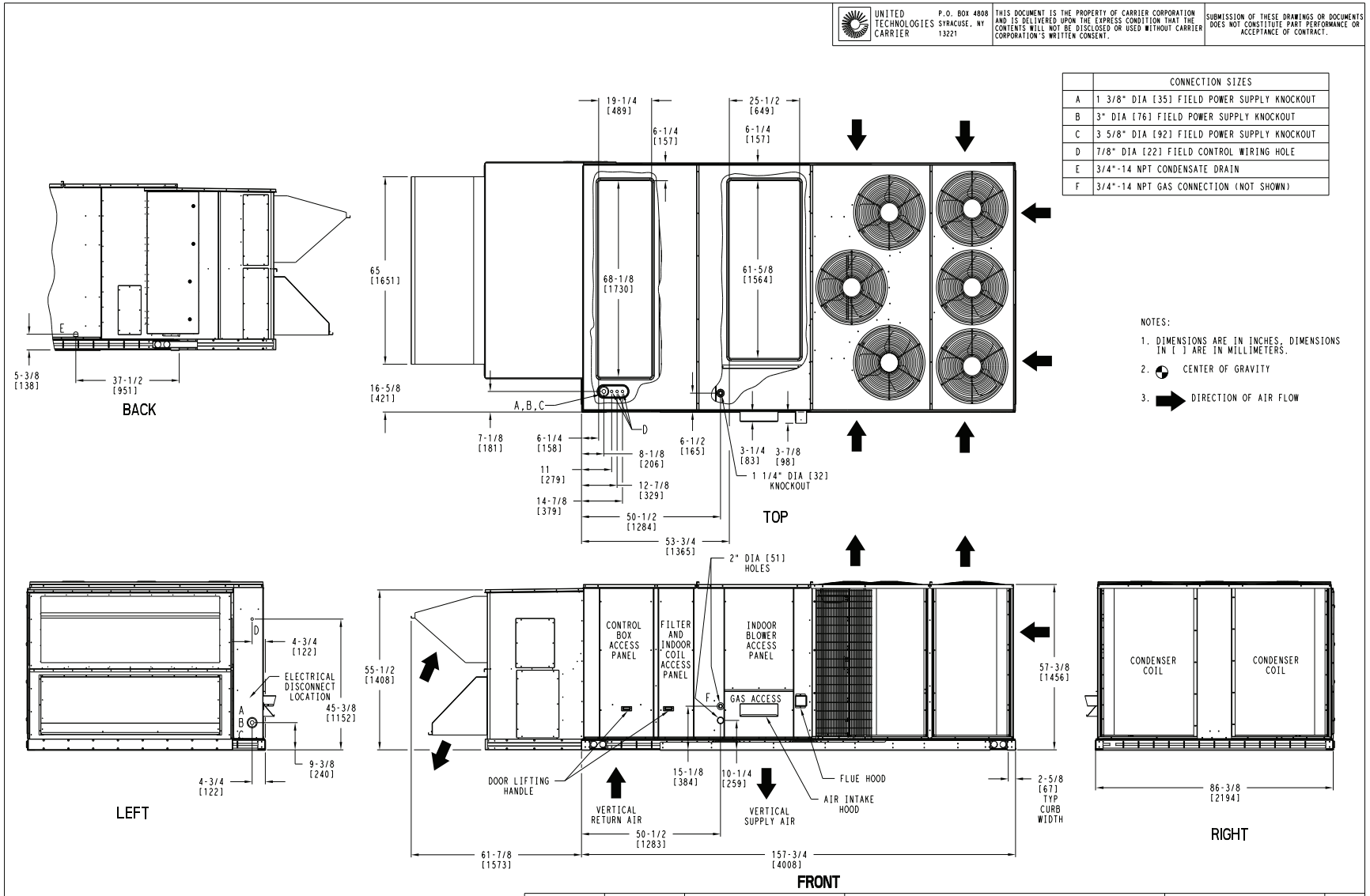
Dimensions (cont)

48HC**24 WITH EnergyX SYSTEM SERVICE CLEARANCES



NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

48HC**28 WITH EnergyX SYSTEM DIMENSIONS

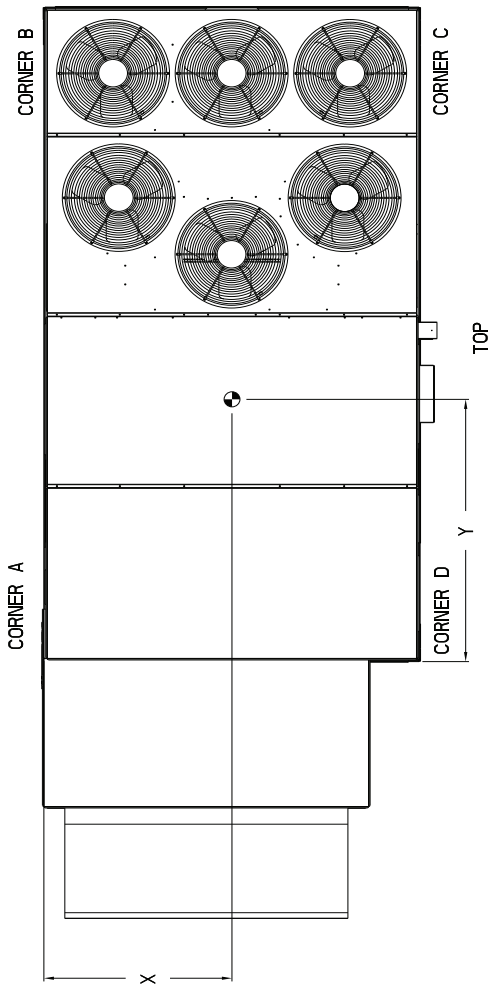


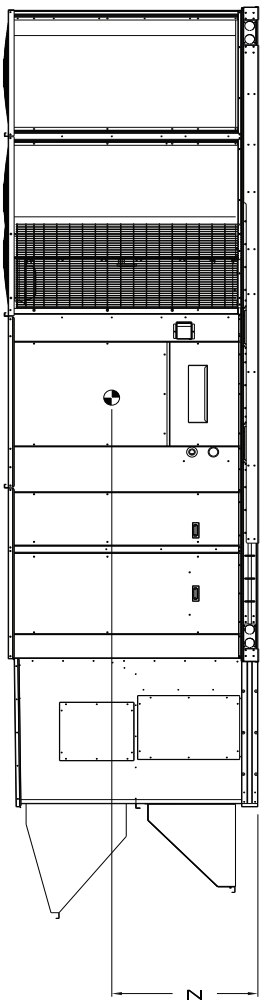
Dimensions (cont)

48HC**28 WITH EnergyX SYSTEM CORNER WEIGHTS

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC28	3968	1804	1447	658	724	329	599	272	1198	544	39 [991]	52 1/2 [1334]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.





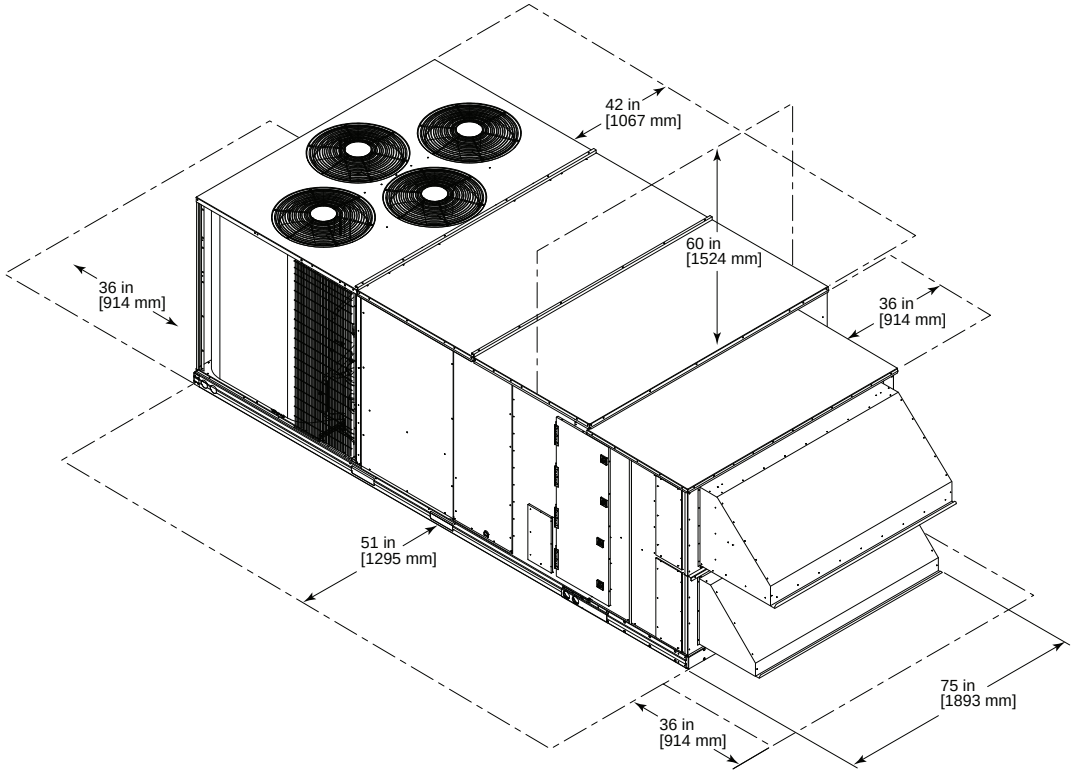
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SHEET	DATE	SUPERCEDES	48HC 28 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502612	REV
2 OF 2	10/31/11	09/12/11			C

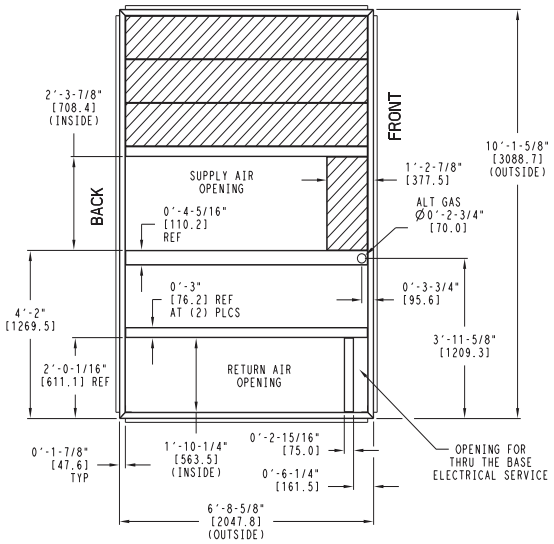
48HC**28 WITH EnergyX SYSTEM SERVICE CLEARANCES



NOTE: Unit not designed to have overhead obstruction. Contact Application Engineering for guidance on any application planning overhead obstruction or for vertical clearances.

Accessory dimensions

48HC**17 — ROOF CURB DIMENSIONS



UNIT SIZE	"A"	ROOF CURB ACCESSORY
17	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB045A00 CRRFCURB046A00

NOTES:

1 ROOF CURB ACCESSORY IS SHIPPED UNASSEMBLED.

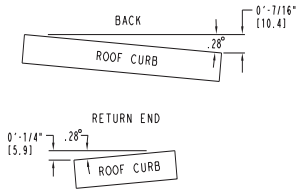
2 DIMENSIONS IN [ ] ARE IN MILLIMETERS.

3 ROOF CURB GALVANIZED STEEL.

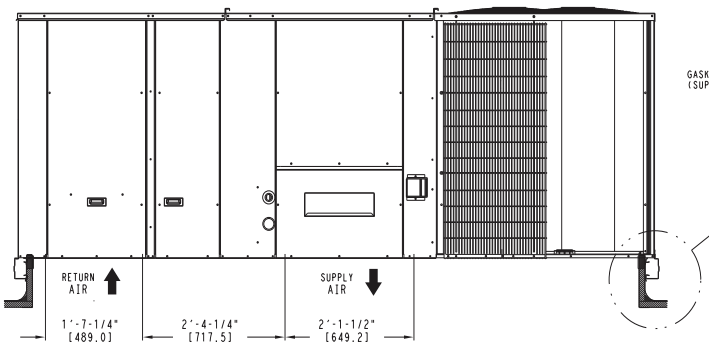
4 ATTACH DUCTWORK TO CURB (FLANGES ON DUCT REST ON CURB)

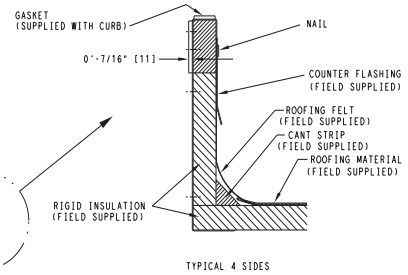
5 SERVICE CLEARANCE 4 ft ON EACH SIDE

DIRECTION OF AIR FLOW

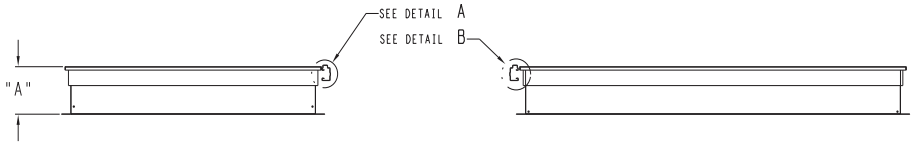


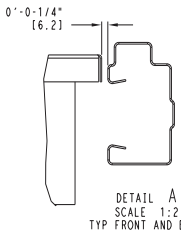
MAX CURB LEVELING TOLERANCES



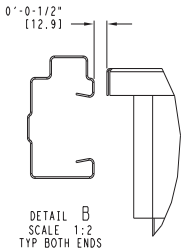


TYPICAL 4 SIDES

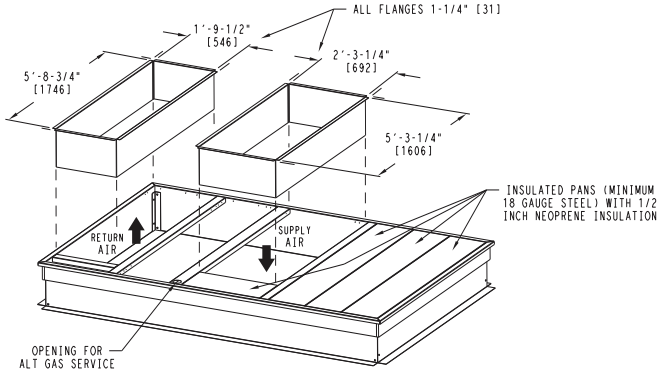




DETAIL A
SCALE 1:2
TYP FRONT AND BACK



DETAIL B
SCALE 1:2
TYP BOTH ENDS



48HC**20, 24 — ROOF CURB DIMENSIONS

UNIT SIZE	"A"	ROOF CURB ACCESSORY
20, 24	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB047A00 CRRFCURB048A00

NOTES:

1 ROOF CURB ACCESSORY IS SHIPPED UNASSEMBLED.

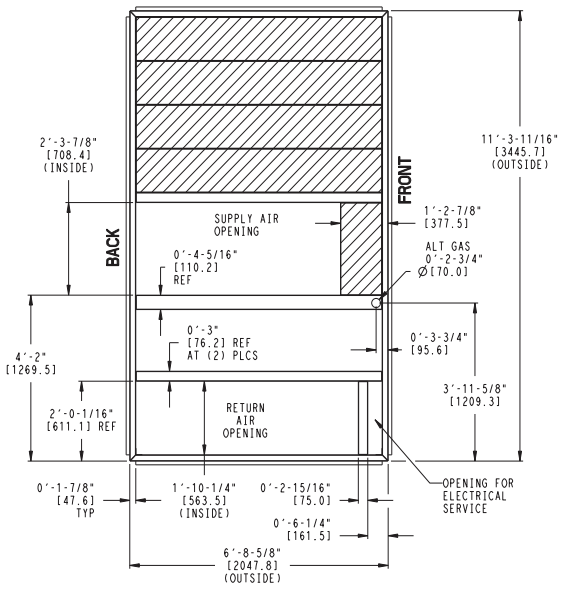
2 DIMENSIONS IN [ ] ARE IN MILLIMETERS.

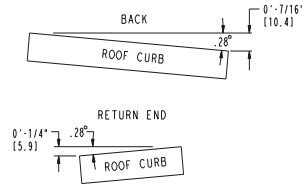
3 ROOF CURB GALVANIZED STEEL.

4 ATTACH DUCTWORK TO CURB (FLANGES ON DUCT REST ON CURB)

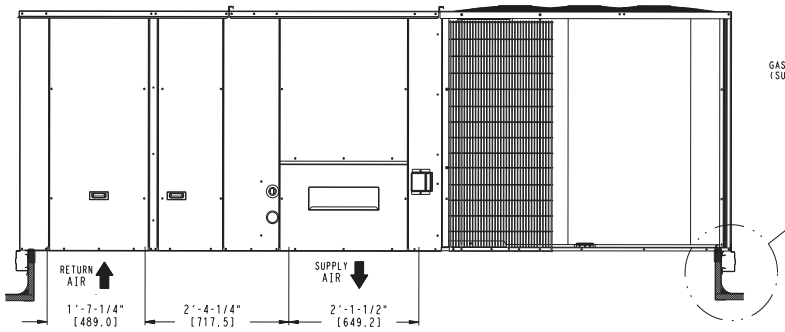
5 SERVICE CLEARANCE 4 ft ON EACH SIDE

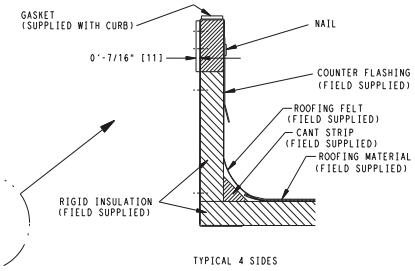
DIRECTION OF AIR FLOW



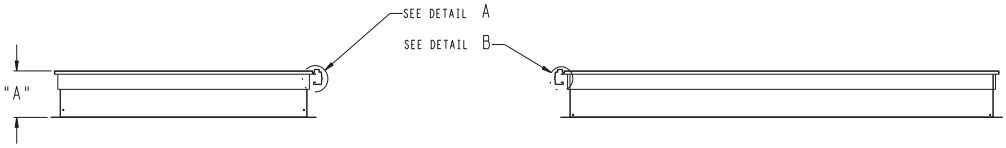


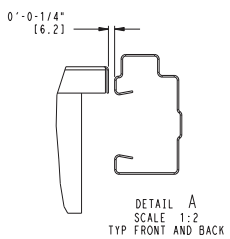
MAX CURB LEVELING TOLERANCES



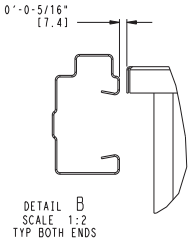


TYPICAL 4 SIDES

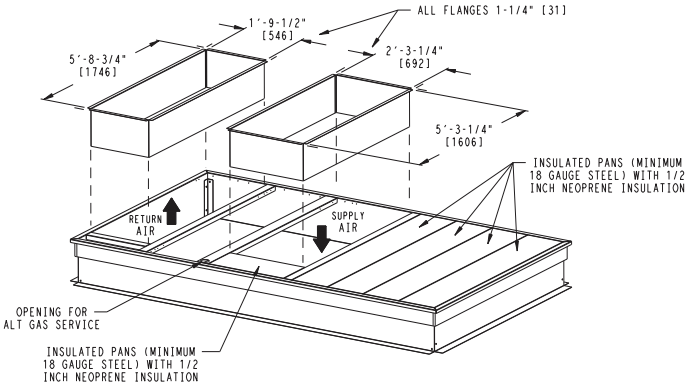




DETAIL A
SCALE 1:2
TYP FRONT AND BACK



DETAIL B
SCALE 1:2
TYP BOTH ENDS



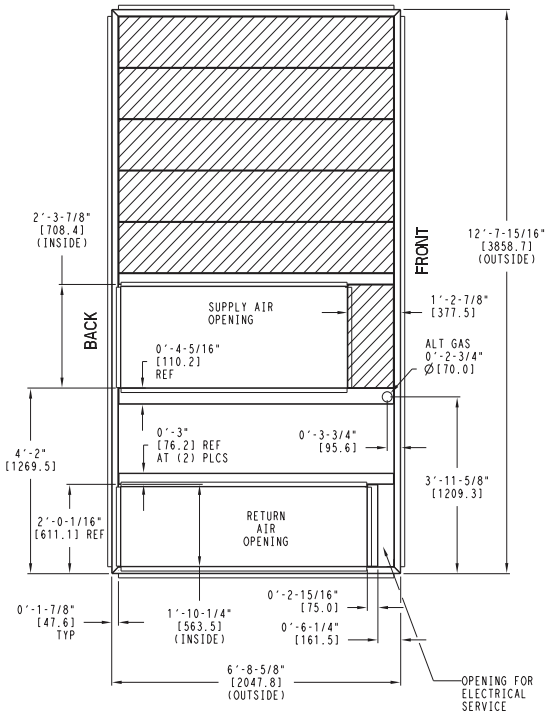
Accessory dimensions (cont)

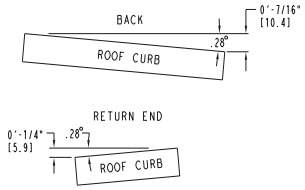
48HC**28 — ROOF CURB DIMENSIONS

UNIT SIZE	"A"	ROOF CURB ACCESSORY
28	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB049A00 CRRFCURB050A00

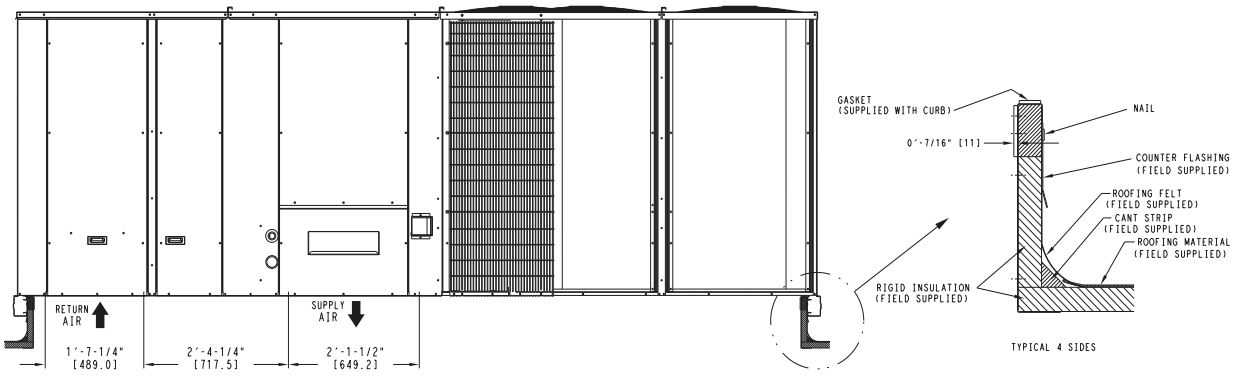
NOTES:
1 ROOF CURB ACCESSORY IS SHIPPED UNASSEMBLED.
2 BOLT HEADS TO BE ON INSIDE OF FLANGE. CLEARANCE IS [11] 0-0-7/16" TYP ALL CORNERS.
3 DIMENSIONS IN [ ] ARE IN MILLIMETERS.
4 ROOF CURB GALVANIZED STEEL.
5 ATTACH DUCTWORK TO CURB (FLANGES ON DUCT REST ON CURB)
6 SERVICE CLEARANCE 4 ft ON EACH SIDE
7 GAS SERVICE PLATE IS PART OF A SEPARATELY SHIPPED ACCESSORY PACKAGE.
8 GAS SERVICE PLATE CAN BE USED WITH EITHER ACCESSORY ROOFCURB.

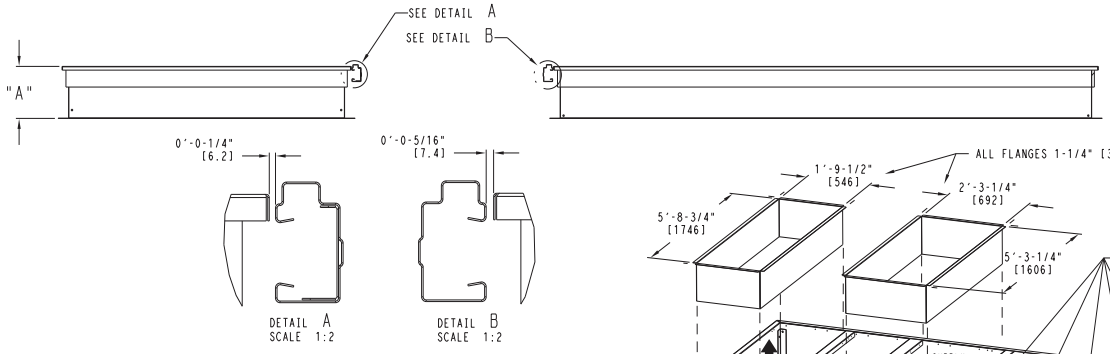
➡ DIRECTION OF AIR FLOW

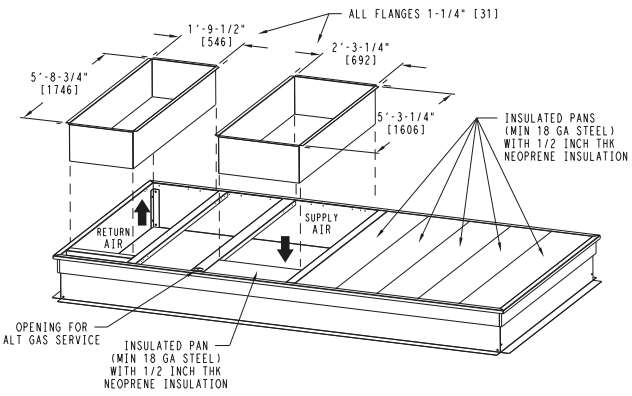




MAX CURB LEVELING TOLERANCES







Performance data

48HC*D17 — 15 TON — COOLING CAPACITIES

48HC17				AMBIENT TEMPERATURE (F)															
				85			95			105			115			125			
				EAT (db)			EAT (db)			EAT (db)			EAT (db)			EAT (db)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
4500 Cfm	EAT (wb)	58	THC	158.3	158.3	179.2	152.6	152.6	172.9	146.6	146.6	166.1	140.2	140.2	158.8	133.2	133.2	150.8	
			SHC	137.3	158.3	179.2	132.4	152.6	172.9	127.2	146.6	166.1	121.6	140.2	158.8	115.5	133.2	150.8	
		62	THC	166.8	166.8	169.0	159.5	159.5	165.6	151.8	151.8	161.9	143.6	143.6	157.9	134.9	134.9	153.4	
			SHC	123.1	146.1	169.0	119.7	142.6	165.6	116.1	139.0	161.9	112.3	135.1	157.9	108.2	130.8	153.4	
		67	THC	182.9	182.9	182.9	174.9	174.9	174.9	166.3	166.3	166.3	157.2	157.2	157.2	147.6	147.6	147.6	
			SHC	100.0	123.1	146.1	96.7	119.8	142.8	93.2	116.3	139.4	89.7	112.7	135.7	85.9	108.9	131.9	
		72	THC	200.5	200.5	200.5	191.6	191.6	191.6	182.2	182.2	182.2	172.2	172.2	172.2	161.7	161.7	161.7	
			SHC	76.1	99.5	122.8	72.9	96.2	119.5	69.5	92.8	116.1	66.0	89.3	112.5	62.4	85.6	108.8	
		76	THC	—	215.4	215.4	—	205.8	205.8	—	195.6	195.6	—	184.8	184.8	—	173.6	173.6	
			SHC	—	80.2	105.0	—	77.1	101.7	—	73.7	98.2	—	70.2	94.5	—	66.7	90.7	
5250 Cfm	EAT (wb)	58	THC	166.7	166.7	188.8	160.6	160.6	181.9	154.0	154.0	174.4	147.0	147.0	166.5	139.5	139.5	157.9	
			SHC	144.6	166.7	188.8	139.3	160.6	181.9	133.6	154.0	174.4	127.6	147.0	166.5	121.0	139.5	157.9	
		62	THC	172.0	172.0	185.1	164.3	164.3	181.2	156.3	156.3	177.0	147.8	147.8	172.4	139.6	139.6	164.3	
			SHC	132.5	158.8	185.1	128.9	155.1	181.2	125.0	151.0	177.0	120.9	146.6	172.4	114.9	139.6	164.3	
		67	THC	188.3	188.3	188.3	179.7	179.7	179.7	170.7	170.7	170.7	161.0	161.0	161.0	150.9	150.9	150.9	
			SHC	106.1	132.7	159.3	102.8	129.3	155.9	99.3	125.8	152.4	95.6	122.1	148.6	91.7	118.2	144.7	
		72	THC	206.1	206.1	206.1	196.7	196.7	196.7	186.7	186.7	186.7	176.2	176.2	176.2	165.3	165.3	165.3	
			SHC	78.8	105.6	132.5	75.5	102.3	129.1	72.1	98.8	125.6	68.5	95.2	121.9	64.8	91.4	118.0	
		76	THC	—	221.2	221.2	—	211.0	211.0	—	200.3	200.3	—	189.0	189.0	—	177.2	177.2	
			SHC	—	83.6	111.7	—	80.3	108.2	—	76.9	104.6	—	73.3	100.9	—	69.7	97.1	
6000 Cfm	EAT (wb)	58	THC	173.8	173.8	196.8	167.2	167.2	189.4	160.2	160.2	181.4	152.7	152.7	173.0	144.7	144.7	163.8	
			SHC	150.8	173.8	196.8	145.1	167.2	189.4	139.0	160.2	181.4	132.5	152.7	173.0	125.5	144.7	163.8	
		62	THC	176.3	176.3	199.5	168.5	168.5	194.9	160.5	160.5	188.9	152.9	152.9	179.9	144.8	144.8	170.4	
			SHC	140.9	170.2	199.5	136.9	165.9	194.9	132.1	160.5	188.9	125.8	152.9	179.9	119.2	144.8	170.4	
		67	THC	192.3	192.3	192.3	183.4	183.4	183.4	173.9	173.9	173.9	164.0	164.0	164.0	153.4	153.4	156.9	
			SHC	112.0	142.0	172.0	108.5	138.5	168.5	104.9	134.9	164.8	101.2	131.1	161.0	97.2	127.1	156.9	
		72	THC	210.4	210.4	210.4	200.6	200.6	200.6	190.2	190.2	190.2	179.3	179.3	179.3	167.9	167.9	167.9	
			SHC	81.2	111.4	141.7	77.9	108.0	138.2	74.4	104.5	134.6	70.7	100.8	130.8	67.0	96.9	126.9	
		76	THC	—	225.6	225.6	—	215.0	215.0	—	203.8	203.8	—	192.1	192.1	—	180.0	180.0	
			SHC	—	86.7	117.9	—	83.3	114.5	—	79.9	110.8	—	76.3	107.1	—	72.6	103.2	
6750 Cfm	EAT (wb)	58	THC	179.8	179.8	203.7	172.9	172.9	195.8	165.5	165.5	187.4	157.5	157.5	178.4	149.0	149.0	168.8	
			SHC	156.0	179.8	203.7	150.0	172.9	195.8	143.5	165.5	187.4	136.7	157.5	178.4	129.3	149.0	168.8	
		62	THC	180.5	180.5	210.7	173.0	173.0	203.6	165.6	165.6	194.9	157.7	157.7	185.5	149.1	149.1	175.5	
			SHC	147.6	179.2	210.7	142.4	173.0	203.6	136.3	165.6	194.9	129.8	157.7	185.5	122.8	149.1	175.5	
		67	THC	195.6	195.6	195.6	186.2	186.2	186.2	176.5	176.5	176.8	166.2	166.2	172.7	155.4	155.4	168.4	
			SHC	117.5	150.8	184.1	114.0	147.3	180.5	110.4	143.6	176.8	106.5	139.6	172.7	102.4	135.4	168.4	
		72	THC	213.8	213.8	213.8	203.6	203.6	203.6	192.9	192.9	192.9	181.6	181.6	181.6	169.9	169.9	169.9	
			SHC	83.5	117.0	150.5	80.1	113.5	147.0	76.5	109.9	143.3	72.8	106.1	139.4	69.1	102.3	135.5	
		76	THC	—	229.1	229.1	—	218.1	218.1	—	206.6	206.6	—	194.6	194.6	—	182.1	182.1	
			SHC	—	89.6	124.0	—	86.2	120.5	—	82.7	116.8	—	79.0	113.0	—	75.2	109.0	
7500 Cfm	EAT (wb)	58	THC	185.1	185.1	209.6	177.7	177.7	201.3	170.0	170.0	192.5	161.6	161.6	183.0	152.8	152.8	173.0	
			SHC	160.6	185.1	209.6	154.2	177.7	201.3	147.5	170.0	192.5	140.2	161.6	183.0	132.5	152.8	173.0	
		62	THC	185.2	185.2	218.0	177.9	177.9	209.3	170.1	170.1	200.2	161.8	161.8	190.4	152.9	152.9	179.9	
			SHC	152.5	185.2	218.0	146.4	177.9	209.3	140.0	170.1	200.2	133.2	161.8	190.4	125.8	152.9	179.9	
		67	THC	198.1	198.1	198.1	188.6	188.6	192.1	178.6	178.6	188.1	168.1	168.1	183.8	157.2	157.2	179.1	
			SHC	122.8	159.3	195.9	119.2	155.7	192.1	115.5	151.8	188.1	111.5	147.7	183.8	107.3	143.2	179.1	
		72	THC	216.6	216.6	216.6	206.1	206.1	206.1	195.1	195.1	195.1	183.5	183.5	183.5	171.6	171.6	171.6	
			SHC	85.6	122.3	159.0	82.2	118.8	155.5	78.6	115.2	151.7	74.9	111.3	147.8	71.1	107.4	143.8	
		76	THC	—	231.9	231.9	—	220.7	220.7	—	208.9	208.9	—	196.5	196.5	—	183.8	183.8	
			SHC	—	92.4	129.9	—	88.9	126.3	—	85.4	122.6	—	81.6	118.7	—	77.8	114.6	

LEGEND

— — Do Not Operate
Cfm — Cubic Feet Per Minute (Supply Air)
EAT (db) — Entering Air Temperature (Wet Bulb)
EAT (wb) — Entering Air Temperature (Wet Bulb)
SHC — Sensible Heat Capacity (1000 Btuh) Gross
THC — Total Heat Capacity (1000 Btuh) Gross

Performance data (cont)

48HC*D20 — 17.5 TON — COOLING CAPACITIES

48HC20				AMBIENT TEMPERATURE (F)															
				85			95			105			115			125			
				EAT (db)			EAT (db)			EAT (db)			EAT (db)			EAT (db)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
5250 Cfm	EAT (wb)	58	THC	185.1	185.1	209.2	178.7	178.7	201.9	171.8	171.8	194.1	164.5	164.5	185.8	156.7	156.7	177.0	
			SHC	161.1	185.1	209.2	155.4	178.7	201.9	149.4	171.8	194.1	143.1	164.5	185.8	136.3	156.7	177.0	
		62	THC	193.8	193.8	199.5	185.6	185.6	195.4	176.9	176.9	191.1	167.7	167.7	186.4	158.2	158.2	181.1	
			SHC	145.6	172.6	199.5	141.7	168.6	195.4	137.6	164.4	191.1	133.2	159.8	186.4	128.3	154.7	181.1	
		67	THC	212.2	212.2	212.2	203.3	203.3	203.3	193.8	193.8	193.8	183.8	183.8	183.8	173.1	173.1	173.1	
			SHC	119.0	146.0	173.1	115.3	142.3	169.4	111.4	138.4	165.4	107.3	134.3	161.3	103.0	130.0	157.0	
		72	THC	232.3	232.3	232.3	222.7	222.7	222.7	212.4	212.4	212.4	201.6	201.6	201.6	190.1	190.1	190.1	
			SHC	91.5	118.8	146.2	87.9	115.2	142.5	84.1	111.4	138.7	80.2	107.4	134.6	76.0	103.2	130.4	
		76	THC	—	249.5	249.5	—	239.2	239.2	—	228.2	228.2	—	216.6	216.6	—	204.3	204.3	
			SHC	—	96.7	125.3	—	93.2	121.7	—	89.5	117.9	—	85.6	113.8	—	81.5	109.5	
6125 Cfm	EAT (wb)	58	THC	194.7	194.7	220.0	187.8	187.8	212.2	180.4	180.4	203.8	172.5	172.5	194.9	164.1	164.1	185.5	
			SHC	169.4	194.7	220.0	163.3	187.8	212.2	156.9	180.4	203.8	150.1	172.5	194.9	142.8	164.1	185.5	
		62	THC	199.6	199.6	218.0	191.1	191.1	213.5	182.1	182.1	208.4	173.0	173.0	201.2	164.3	164.3	192.8	
			SHC	156.5	187.2	218.0	152.3	182.9	213.5	147.7	178.0	208.4	141.8	171.5	201.2	135.8	164.3	192.8	
		67	THC	218.0	218.0	218.0	208.7	208.7	208.7	198.7	198.7	198.7	188.2	188.2	188.2	177.1	177.1	177.1	
			SHC	126.2	157.4	188.6	122.4	153.6	184.7	118.4	149.6	180.7	114.3	145.4	176.5	109.9	141.0	172.1	
		72	THC	238.5	238.5	238.5	228.4	228.4	228.4	217.7	217.7	217.7	206.3	206.3	206.3	194.3	194.3	194.3	
			SHC	94.7	126.1	157.5	91.0	122.4	153.8	87.2	118.5	149.8	83.1	114.4	145.7	78.9	110.1	141.4	
		76	THC	—	255.9	255.9	—	245.1	245.1	—	233.6	233.6	—	221.4	221.4	—	208.5	208.5	
			SHC	—	100.7	133.3	—	97.1	129.6	—	93.3	125.6	—	89.3	121.5	—	85.1	117.1	
7000 Cfm	EAT (wb)	58	THC	202.7	202.7	229.1	195.4	195.4	220.8	187.5	187.5	211.9	179.2	179.2	202.5	170.3	170.3	192.4	
			SHC	176.4	202.7	229.1	170.0	195.4	220.8	163.1	187.5	211.9	155.9	179.2	202.5	148.1	170.3	192.4	
		62	THC	204.6	204.6	234.4	196.0	196.0	228.0	187.7	187.7	220.3	179.3	179.3	210.5	170.4	170.4	200.0	
			SHC	166.0	200.2	234.4	160.8	194.4	228.0	155.1	187.7	220.3	148.2	179.3	210.5	140.8	170.4	200.0	
		67	THC	222.5	222.5	222.5	212.8	212.8	212.8	202.4	202.4	202.4	191.5	191.5	191.5	180.0	180.0	186.4	
			SHC	133.0	168.2	203.4	129.2	164.3	199.5	125.1	160.3	195.4	120.9	156.0	191.0	116.4	151.4	186.4	
		72	THC	243.3	243.3	243.3	232.7	232.7	232.7	221.6	221.6	221.6	209.9	209.9	209.9	197.4	197.4	197.4	
			SHC	97.5	132.9	168.3	93.8	129.2	164.5	89.9	125.2	160.5	85.8	121.1	156.3	81.6	116.7	151.9	
		76	THC	—	260.8	260.8	—	249.6	249.6	—	237.7	237.7	—	225.1	225.1	—	211.7	211.7	
			SHC	—	104.4	140.8	—	100.7	137.0	—	96.9	133.0	—	92.8	128.8	—	88.5	124.4	
7875 Cfm	EAT (wb)	58	THC	209.6	209.6	236.8	201.8	201.8	228.1	193.6	193.6	218.8	184.8	184.8	208.9	175.5	175.5	198.3	
			SHC	182.3	209.6	236.8	175.6	201.8	228.1	168.4	193.6	218.8	160.8	184.8	208.9	152.7	175.5	198.3	
		62	THC	209.8	209.8	246.2	202.0	202.0	237.1	193.8	193.8	227.4	185.0	185.0	217.1	175.6	175.6	206.1	
			SHC	173.4	209.8	246.2	167.0	202.0	237.1	160.1	193.8	227.4	152.9	185.0	217.1	145.1	175.6	206.1	
		67	THC	226.1	226.1	226.1	216.0	216.0	216.0	205.4	205.4	209.4	194.2	194.2	204.8	182.4	182.4	199.9	
			SHC	139.6	178.6	217.7	135.6	174.7	213.7	131.5	170.5	209.4	127.1	166.0	204.8	122.5	161.2	199.9	
		72	THC	247.0	247.0	247.0	236.2	236.2	236.2	224.7	224.7	224.7	212.7	212.7	212.7	199.9	199.9	199.9	
			SHC	100.2	139.5	178.8	96.5	135.7	174.9	92.5	131.7	170.9	88.4	127.5	166.6	84.1	123.1	162.1	
		76	THC	—	264.7	264.7	—	253.1	253.1	—	240.9	240.9	—	227.9	227.9	—	—	—	
			SHC	—	107.9	148.1	—	104.2	144.3	—	100.2	140.2	—	96.1	135.9	—	—	—	
8750 Cfm	EAT (wb)	58	THC	215.4	215.4	243.4	207.3	207.3	234.3	198.7	198.7	224.6	189.6	189.6	214.2	179.9	179.9	203.2	
			SHC	187.4	215.4	243.4	180.3	207.3	234.3	172.9	198.7	224.6	164.9	189.6	214.2	156.5	179.9	203.2	
		62	THC	215.5	215.5	253.0	207.5	207.5	243.5	198.9	198.9	233.4	189.7	189.7	222.7	180.0	180.0	211.2	
			SHC	178.1	215.5	253.0	171.5	207.5	243.5	164.4	198.9	233.4	156.8	189.7	222.7	148.8	180.0	211.2	
		67	THC	228.9	228.9	231.5	218.7	218.7	227.3	207.8	207.8	222.8	196.4	196.4	217.9	184.5	184.5	212.6	
			SHC	145.8	188.6	231.5	141.8	184.5	227.3	137.5	180.1	222.8	133.0	175.5	217.9	128.2	170.4	212.6	
		72	THC	250.1	250.1	250.1	239.0	239.0	239.0	227.3	227.3	227.3	214.9	214.9	214.9	201.8	201.8	201.8	
			SHC	102.8	145.8	188.9	99.0	142.0	185.0	95.0	137.9	180.9	90.8	133.7	176.5	86.4	129.2	172.0	
		76	THC	—	267.8	267.8	—	256.0	256.0	—	243.5	243.5	—	230.2	230.2	—	—	—	
			SHC	—	111.2	155.2	—	107.4	151.3	—	103.5	147.1	—	99.3	142.8	—	—	—	

LEGEND

— — Do Not Operate
Cfm — Cubic Feet Per Minute (Supply Air)
EAT (db) — Entering Air Temperature (Wet Bulb)
EAT (wb) — Entering Air Temperature (Wet Bulb)
SHC — Sensible Heat Capacity (1000 Btuh) Gross
THC — Total Heat Capacity (1000 Btuh) Gross

48HC*D24 — 20 TON — COOLING CAPACITIES

48HC24				AMBIENT TEMPERATURE (F)															
				85			95			105			115			125			
				EAT (db)			EAT (db)			EAT (db)			EAT (db)			EAT (db)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
6000 Cfm	EAT (wb)	58	THC	214.4	214.4	242.5	207.0	207.0	234.2	199.0	199.0	225.1	190.2	190.2	215.2	180.6	180.6	204.3	
			SHC	186.3	214.4	242.5	179.9	207.0	234.2	173.0	199.0	225.1	165.3	190.2	215.2	157.0	180.6	204.3	
		62	THC	226.8	226.8	227.7	217.3	217.3	223.0	206.9	206.9	218.0	195.8	195.8	212.5	183.7	183.7	206.4	
			SHC	167.0	197.3	227.7	162.4	192.7	223.0	157.6	187.8	218.0	152.3	182.4	212.5	146.6	176.5	206.4	
		67	THC	248.4	248.4	248.4	237.9	237.9	237.9	226.6	226.6	226.6	214.3	214.3	214.3	201.0	201.0	201.0	
			SHC	136.5	167.1	197.6	132.2	162.7	193.2	127.5	158.0	188.4	122.5	152.9	183.4	117.2	147.6	178.0	
		72	THC	271.9	271.9	271.9	260.3	260.3	260.3	247.9	247.9	247.9	234.5	234.5	234.5	220.1	220.1	220.1	
			SHC	105.1	136.0	167.0	100.8	131.7	162.5	96.3	127.1	157.9	91.4	122.1	152.9	86.3	116.9	147.6	
		76	THC	—	291.7	291.7	—	279.2	279.2	—	265.7	265.7	—	251.3	251.3	—	235.8	235.8	
			SHC	—	110.7	143.7	—	106.5	139.5	—	102.0	134.7	—	97.2	129.7	—	92.1	124.3	
7000 Cfm	EAT (wb)	58	THC	225.8	225.8	255.3	217.8	217.8	246.3	209.1	209.1	236.5	199.6	199.6	225.7	189.2	189.2	214.0	
			SHC	196.2	225.8	255.3	189.3	217.8	246.3	181.7	209.1	236.5	173.4	199.6	225.7	164.4	189.2	214.0	
		62	THC	233.9	233.9	248.8	223.8	223.8	243.8	213.1	213.1	238.2	201.4	201.4	231.8	190.0	190.0	221.5	
			SHC	179.4	214.1	248.8	174.6	209.2	243.8	169.4	203.8	238.2	163.7	197.8	231.8	155.9	188.7	221.5	
		67	THC	255.7	255.7	255.7	244.6	244.6	244.6	232.6	232.6	232.6	219.6	219.6	219.6	205.7	205.7	205.7	
			SHC	144.7	179.7	214.8	140.2	175.2	210.2	135.4	170.4	205.4	130.3	165.2	200.2	124.9	159.8	194.7	
		72	THC	279.4	279.4	279.4	267.3	267.3	267.3	254.1	254.1	254.1	240.1	240.1	240.1	224.9	224.9	224.9	
			SHC	108.7	144.1	179.6	104.3	139.7	175.1	99.6	135.0	170.3	94.7	129.9	165.1	89.5	124.6	159.7	
		76	THC	—	299.4	299.4	—	286.2	286.2	—	272.1	272.1	—	256.9	256.9	—	240.7	240.7	
			SHC	—	115.3	152.9	—	110.9	148.2	—	106.3	143.3	—	101.3	138.0	—	96.1	132.6	
8000 Cfm	EAT (wb)	58	THC	235.3	235.3	266.2	226.8	226.8	256.5	217.5	217.5	246.0	207.4	207.4	234.5	196.3	196.3	222.0	
			SHC	204.5	235.3	266.2	197.1	226.8	256.5	189.0	217.5	246.0	180.2	207.4	234.5	170.6	196.3	222.0	
		62	THC	239.7	239.7	268.1	229.4	229.4	262.0	219.0	219.0	253.3	208.3	208.3	241.9	196.7	196.7	231.0	
			SHC	190.7	229.4	268.1	185.4	223.7	262.0	178.6	215.9	253.3	170.4	206.2	241.9	162.3	196.7	231.0	
		67	THC	261.3	261.3	261.3	249.6	249.6	249.6	237.1	237.1	237.1	223.6	223.6	223.6	209.2	209.2	210.6	
			SHC	152.3	191.8	231.2	147.7	187.1	226.6	142.9	182.2	221.6	137.7	177.0	216.3	132.2	171.4	210.6	
		72	THC	285.3	285.3	285.3	272.5	272.5	272.5	258.9	258.9	258.9	244.2	244.2	244.2	228.6	228.6	228.6	
			SHC	111.9	151.7	191.5	107.5	147.2	186.9	102.7	142.4	182.0	97.7	137.2	176.7	92.4	131.8	171.2	
		76	THC	—	305.4	305.4	—	291.6	291.6	—	276.8	276.8	—	261.2	261.2	—	244.4	244.4	
			SHC	—	119.4	161.0	—	114.9	156.2	—	110.1	151.2	—	105.1	146.0	—	99.8	140.4	
9000 Cfm	EAT (wb)	58	THC	243.5	243.5	275.4	234.5	234.5	265.2	224.6	224.6	254.0	213.9	213.9	241.9	202.3	202.3	228.8	
			SHC	211.6	243.5	275.4	203.8	234.5	265.2	195.2	224.6	254.0	185.9	213.9	241.9	175.8	202.3	228.8	
		62	THC	245.4	245.4	282.9	235.4	235.4	274.6	225.0	225.0	264.3	214.4	214.4	251.7	202.5	202.5	237.8	
			SHC	199.7	241.3	282.9	193.2	233.9	274.6	185.6	224.9	264.3	176.8	214.3	251.7	167.1	202.5	237.8	
		67	THC	265.6	265.6	265.6	253.6	253.6	253.6	240.7	240.7	240.7	226.8	226.8	231.8	212	212.0	225.8	
			SHC	159.6	203.3	247.1	154.9	198.6	242.3	150.0	193.6	237.3	144.7	188.3	231.8	139.0	182.4	225.8	
		72	THC	289.9	289.9	289.9	276.7	276.7	276.7	262.6	262.6	262.6	247.5	247.5	247.5	231.4	231.4	231.4	
			SHC	114.9	159.0	203.0	110.4	154.4	198.3	105.6	149.5	193.3	100.5	144.2	188.0	95.2	138.7	182.3	
		76	THC	—	310.1	310.1	—	295.8	295.8	—	280.6	280.6	—	264.4	264.4	—	247.3	247.3	
			SHC	—	123.2	168.9	—	118.6	164.1	—	113.8	159.0	—	108.7	153.6	—	103.4	147.9	
10000 Cfm	EAT (wb)	58	THC	250.4	250.4	283.2	240.9	240.9	272.5	230.7	230.7	260.9	219.5	219.5	248.2	207.3	207.3	234.5	
			SHC	217.7	250.4	283.2	209.4	240.9	272.5	200.5	230.7	260.9	190.7	219.5	248.2	180.2	207.3	234.5	
		62	THC	250.8	250.8	294.6	241.1	241.1	283.3	231.1	231.1	271.4	219.6	219.6	258.0	207.5	207.5	243.7	
			SHC	207.0	250.8	294.6	199.0	241.1	283.3	190.7	231.1	271.4	181.2	219.6	258.0	171.2	207.5	243.7	
		67	THC	269.2	269.2	269.2	256.8	256.8	257.6	243.5	243.5	252.3	229.4	229.4	246.4	214.3	214.3	240.0	
			SHC	166.6	214.5	262.5	161.9	209.7	257.6	156.8	204.5	252.3	151.3	198.9	246.4	145.5	192.8	240.0	
		72	THC	293.7	293.7	293.7	280.1	280.1	280.1	265.6	265.6	265.6	250.2	250.2	250.2	233.7	233.7	233.7	
			SHC	117.8	166.0	214.2	113.2	161.3	209.3	108.3	156.3	204.3	103.2	151.0	198.8	97.8	145.4	193.1	
		76	THC	—	313.9	313.9	—	299.3	299.3	—	283.7	283.7	—	267.1	267.1	—	249.6	249.6	
			SHC	—	126.8	176.5	—	122.2	171.6	—	117.3	166.5	—	112.1	161.0	—	106.7	155.1	

LEGEND

— — Do Not Operate
Cfm — Cubic Feet Per Minute (Supply Air)
EAT (db) — Entering Air Temperature (Wet Bulb)
EAT (wb) — Entering Air Temperature (Wet Bulb)
SHC — Sensible Heat Capacity (1000 Btuh) Gross
THC — Total Heat Capacity (1000 Btuh) Gross

Performance data (cont)

48HC*D28 — 25 TON — COOLING CAPACITIES

48HC28				AMBIENT TEMPERATURE (F)														
				85			95			105			115			125		
				EAT (db)			EAT (db)			EAT (db)			EAT (db)			EAT (db)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
7500 Cfm	EAT (wb)	58	THC	264.4	264.4	298.9	254.6	254.6	287.9	244.1	244.1	276.0	232.7	232.7	263.1	220.3	220.3	249.1
			SHC	229.9	264.4	298.9	221.4	254.6	287.9	212.2	244.1	276.0	202.3	232.7	263.1	191.5	220.3	249.1
		62	THC	278.7	278.7	282.4	266.3	266.3	276.4	252.8	252.8	269.8	238.5	238.5	262.4	223.9	223.9	251.3
			SHC	206.8	244.6	282.4	200.9	238.7	276.4	194.6	232.2	269.8	187.7	225.0	262.4	178.7	215.0	251.3
		67	THC	305.3	305.3	305.3	291.9	291.9	291.9	277.3	277.3	277.3	261.5	261.5	261.5	244.5	244.5	244.5
			SHC	169.0	207.0	245.0	163.4	201.4	239.4	157.4	195.3	233.3	151.0	188.9	226.8	144.2	182.1	219.9
		72	THC	334.0	334.0	334.0	319.4	319.4	319.4	303.6	303.6	303.6	286.5	286.5	286.5	268.1	268.1	268.1
			SHC	129.9	168.5	207.1	124.5	163.0	201.5	118.7	157.1	195.5	112.5	150.8	189.2	106.0	144.2	182.3
		76	THC	—	358.2	358.2	—	342.4	342.4	—	325.4	325.4	—	307.1	307.1	—	287.4	287.4
			SHC	—	137.0	178.2	—	131.7	172.9	—	126.0	166.9	—	119.9	160.4	—	113.4	153.4
8750 Cfm	EAT (wb)	58	THC	278.2	278.2	314.5	267.8	267.8	302.8	256.5	256.5	289.9	244.2	244.2	276.1	230.8	230.8	261.0
			SHC	241.9	278.2	314.5	232.8	267.8	302.8	223.0	256.5	289.9	212.3	244.2	276.1	200.7	230.8	261.0
		62	THC	287.2	287.2	308.3	274.3	274.3	301.5	260.8	260.8	291.7	247.0	247.0	280.9	232.0	232.0	269.1
			SHC	222.1	265.2	308.3	215.7	258.6	301.5	207.7	249.7	291.7	199.0	240.0	280.9	189.7	229.4	269.1
		67	THC	314.0	314.0	314.0	299.8	299.8	299.8	284.4	284.4	284.4	267.8	267.8	267.8	250.0	250.0	250.0
			SHC	179.1	222.7	266.4	173.3	216.9	260.6	167.2	210.8	254.3	160.7	204.2	247.7	153.7	197.2	240.6
		72	THC	343.0	343.0	343.0	327.7	327.7	327.7	311.1	311.1	311.1	293.1	293.1	293.1	273.8	273.8	273.8
			SHC	134.3	178.5	222.6	128.8	172.9	216.9	122.9	166.9	210.8	116.6	160.4	204.3	109.9	153.6	197.3
		76	THC	—	367.3	367.3	—	350.8	350.8	—	333.0	333.0	—	313.8	313.8	—	293.2	293.2
			SHC	—	142.6	189.4	—	137.1	183.5	—	131.2	177.3	—	125.0	170.7	—	118.4	163.7
10000 Cfm	EAT (wb)	58	THC	289.7	289.7	327.5	278.7	278.7	315.0	266.6	266.6	301.4	253.6	253.6	286.7	239.4	239.4	270.7
			SHC	251.9	289.7	327.5	242.3	278.7	315.0	231.8	266.6	301.4	220.5	253.6	286.7	208.2	239.4	270.7
		62	THC	294.6	294.6	329.6	282.2	282.2	319.7	268.7	268.7	309.1	254.1	254.1	298.4	239.7	239.7	281.4
			SHC	234.7	282.1	329.6	226.8	273.3	319.7	218.4	263.7	309.1	209.7	254.1	298.4	197.9	239.7	281.4
		67	THC	320.6	320.6	320.6	305.9	305.9	305.9	289.9	289.9	289.9	272.7	272.7	272.7	254.3	254.3	260.3
			SHC	188.6	237.7	286.8	182.7	231.8	280.9	176.5	225.5	274.5	169.8	218.8	267.7	162.8	211.5	260.3
		72	THC	350.0	350.0	350.0	334.0	334.0	334.0	316.8	316.8	316.8	298.2	298.2	298.2	278.3	278.3	278.3
			SHC	138.4	187.9	237.5	132.8	182.2	231.7	126.8	176.1	225.5	120.4	169.6	218.8	113.6	162.6	211.7
		76	THC	—	374.4	374.4	—	357.3	357.3	—	338.7	338.7	—	318.9	318.9	—	297.5	297.5
			SHC	—	147.7	199.5	—	142.1	193.7	—	136.1	187.4	—	129.7	180.6	—	123.0	173.5
11250 Cfm	EAT (wb)	58	THC	299.4	299.4	338.4	287.8	287.8	325.4	275.2	275.2	311.1	261.4	261.4	295.6	246.6	246.6	278.8
			SHC	260.3	299.4	338.4	250.2	287.8	325.4	239.2	275.2	311.1	227.3	261.4	295.6	214.4	246.6	278.8
		62	THC	302.2	302.2	346.0	289.3	289.3	335.7	275.5	275.5	323.5	262.1	262.1	307.7	246.8	246.8	289.8
			SHC	244.8	295.4	346.0	236.7	286.2	335.7	227.5	275.5	323.5	216.4	262.1	307.7	203.8	246.8	289.8
		67	THC	325.9	325.9	325.9	310.7	310.7	310.7	294.2	294.2	294.2	276.6	276.6	286.7	257.7	257.7	278.9
			SHC	197.6	252.1	306.5	191.7	246.1	300.4	185.3	239.6	293.9	178.5	232.6	286.7	171.2	225.1	278.9
		72	THC	355.5	355.5	355.5	339.1	339.1	339.1	321.3	321.3	321.3	302.2	302.2	302.2	281.8	281.8	281.8
			SHC	142.1	197.0	251.8	136.4	191.2	245.9	130.4	185.0	239.6	123.9	178.3	232.8	117.1	171.3	225.5
		76	THC	—	380.0	380.0	—	362.4	362.4	—	343.3	343.3	—	322.8	322.8	—	300.9	300.9
			SHC	—	152.4	209.4	—	146.8	203.4	—	140.7	197.0	—	134.2	190.2	—	127.3	182.8
12500 Cfm	EAT (wb)	58	THC	307.7	307.7	347.9	295.7	295.7	334.2	282.5	282.5	319.3	268.2	268.2	303.2	252.7	252.7	285.7
			SHC	267.6	307.7	347.9	257.1	295.7	334.2	245.6	282.5	319.3	233.2	268.2	303.2	219.7	252.7	285.7
		62	THC	308.4	308.4	362.2	295.9	295.9	347.4	283.1	283.1	332.4	268.4	268.4	315.2	252.8	252.8	296.9
			SHC	254.6	308.4	362.2	244.4	295.9	347.4	233.8	283.1	332.4	221.7	268.4	315.2	208.8	252.8	296.9
		67	THC	330.2	330.2	330.2	314.6	314.6	319.2	297.8	297.8	312.3	279.8	279.8	304.7	260.6	260.6	295.9
			SHC	206.3	265.9	325.5	200.3	259.7	319.2	193.8	253.1	312.3	186.7	245.7	304.7	179.0	237.4	295.9
		72	THC	360.1	360.1	360.1	343.2	343.2	343.2	325.0	325.0	325.0	305.4	305.4	305.4	284.6	284.6	284.6
			SHC	145.7	205.7	265.7	139.9	199.8	259.7	133.8	193.5	253.3	127.3	186.8	246.3	120.4	179.7	238.9
		76	THC	—	384.6	384.6	—	366.5	366.5	—	346.9	346.9	—	325.9	325.9	—	303.5	303.5
			SHC	—	157.0	218.9	—	151.2	212.9	—	145.1	206.3	—	138.5	199.3	—	131.5	191.7

LEGEND

— — Do Not Operate
Cfm — Cubic Feet Per Minute (Supply Air)
EAT (db) — Entering Air Temperature (Wet Bulb)
EAT (wb) — Entering Air Temperature (Wet Bulb)
SHC — Sensible Heat Capacity (1000 Btuh) Gross
THC — Total Heat Capacity (1000 Btuh) Gross

48HC*E17 COOLING CAPACITIES, SUBCOOLING MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - CFM								
		4,500			6,000			7,500		
		Air Entering Evaporator - Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	202.90	184.60	166.20	213.70	194.60	175.40	222.30	202.50	182.70
	SHC	91.90	112.40	132.90	106.10	126.40	146.80	117.50	137.70	158.00
	kW	10.19	10.12	9.78	10.51	10.19	9.95	10.61	10.36	10.12
85	TC	189.80	171.80	153.80	201.00	182.20	163.30	209.90	190.40	170.80
	SHC	75.90	101.00	126.20	91.20	116.30	141.30	103.40	128.40	153.50
	kW	11.57	11.49	11.15	11.88	11.56	11.32	11.98	11.73	11.49
95	TC	176.70	159.10	141.40	188.30	169.70	151.20	197.50	178.20	159.00
	SHC	59.80	89.70	119.60	76.20	106.10	135.90	89.40	119.20	149.00
	kW	12.87	12.81	12.47	13.20	12.88	12.64	13.30	13.05	12.81
105	TC	163.60	146.30	129.00	175.60	157.30	139.10	185.10	166.10	147.10
	SHC	43.80	78.40	112.90	61.30	95.90	130.40	75.30	109.90	144.40
	kW	14.05	14.00	13.65	14.39	14.07	13.82	14.40	14.24	14.00
115	TC	150.50	133.50	116.50	162.90	144.90	127.00	172.70	154.00	135.30
	SHC	27.70	67.00	106.30	46.40	85.70	125.00	61.30	100.60	133.40
	kW	15.44	15.36	15.02	15.75	15.43	15.19	15.85	15.60	15.36
125	TC	137.40	120.80	104.10	150.20	132.50	114.90	160.30	141.90	123.50
	SHC	11.70	55.70	99.60	31.40	75.50	112.90	47.30	91.30	123.00
	kW	16.77	16.71	16.37	17.10	16.78	16.54	17.20	16.95	16.71

48HC*E17 COOLING CAPACITIES, HOT GAS REHEAT MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator - Cfm								
		4,500	6,000	7,500	4,500	6,000	7,500	4,500	6,000	7,500
80	TC	64.50	71.00	73.30	68.40	74.50	77.30	71.20	79.70	80.60
	SHC	12.60	24.90	36.80	6.80	13.70	23.90	-0.80	5.50	13.80
	kW	10.10	10.26	10.42	10.18	10.40	10.56	10.33	10.47	10.67
75	TC	66.60	73.10	75.60	70.50	76.60	79.50	73.20	80.80	82.90
	SHC	14.30	26.70	38.50	8.10	14.90	25.70	0.70	7.00	15.00
	kW	10.05	10.22	10.36	10.14	10.36	10.52	10.28	10.43	10.62
70	TC	68.70	75.10	77.40	72.50	78.60	81.40	75.20	82.80	84.90
	SHC	15.40	27.80	40.00	9.50	16.20	26.80	2.10	8.40	16.30
	kW	10.00	10.18	10.33	10.10	10.31	10.47	10.23	10.40	10.58
60	TC	72.80	79.30	81.60	76.70	82.80	85.70	79.40	86.90	88.80
	SHC	19.00	31.10	43.20	12.70	19.90	30.10	5.30	11.60	20.00
	kW	9.92	10.09	10.24	10.01	10.22	10.37	10.14	10.31	10.49
50	TC	76.80	83.40	85.70	80.80	86.90	89.70	83.50	90.90	92.80
	SHC	21.70	34.20	46.20	15.80	22.70	33.20	8.40	14.70	22.80
	kW	9.83	10.00	10.15	9.92	10.13	10.29	10.05	10.21	10.39
40	TC	80.90	87.30	89.60	84.90	90.80	93.60	87.40	94.80	96.70
	SHC	24.90	37.10	49.30	19.00	26.00	36.10	11.60	17.90	26.20
	kW	9.74	9.91	10.06	9.83	10.04	10.20	9.96	10.12	10.30

LEGEND

Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Kilowatts
SHC — Sensible Heat Capacity
TC — Total Capacity

Performance data (cont)

48HC*E20 COOLING CAPACITIES, SUBCOOLING MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - CFM								
		5250			7000			8750		
		Air Entering Evaporator - Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	232.00	211.30	190.60	242.40	221.00	199.70	250.70	228.90	207.00
	SHC	110.90	133.70	156.40	127.60	150.30	173.00	141.10	163.70	186.40
	kW	12.45	12.16	11.81	12.74	12.41	12.02	12.93	12.51	12.18
85	TC	215.90	195.70	175.50	226.00	205.20	184.40	234.20	212.80	191.50
	SHC	90.60	118.80	147.00	108.40	136.60	164.90	122.70	151.00	179.20
	kW	13.48	13.20	12.88	13.77	13.47	13.07	13.96	13.58	13.23
95	TC	199.70	180.00	160.30	209.70	189.40	169.10	217.60	196.80	176.10
	SHC	70.30	104.00	137.70	89.20	123.00	156.70	104.40	138.20	172.10
	kW	14.60	14.25	13.94	14.89	14.51	14.15	15.08	14.63	14.31
105	TC	183.60	164.50	145.20	193.30	173.50	153.80	201.00	180.80	160.60
	SHC	50.00	89.10	128.30	70.00	109.30	148.60	86.00	125.50	158.60
	kW	15.64	15.36	15.01	15.93	15.60	15.21	16.12	15.72	15.37
115	TC	167.50	148.80	130.10	176.90	157.70	138.50	184.50	164.80	145.10
	SHC	29.70	74.30	118.90	50.70	95.60	138.10	67.70	112.70	145.10
	kW	16.70	16.38	15.82	16.98	16.63	16.03	17.17	16.75	16.19
125	TC	151.40	133.20	115.00	160.60	141.90	123.10	167.90	148.80	129.70
	SHC	9.40	59.50	109.60	31.50	81.90	123.00	49.30	100.00	129.70
	kW	17.71	17.39	17.09	18.01	17.65	17.30	18.20	17.76	17.46

48HC*E20 COOLING CAPACITIES, HOT GAS REHEAT MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator - Cfm								
		5,250	7,000	8,750	5,250	7,000	8,750	5,250	7,000	8,750
80	TC	67.80	71.30	74.10	70.50	74.80	79.80	73.30	78.20	82.40
	SHC	9.00	26.50	41.70	2.20	13.20	26.90	-5.20	2.90	13.80
	kW	11.65	11.75	11.87	11.82	11.90	11.98	11.93	12.10	12.19
75	TC	72.50	76.00	78.80	75.00	79.20	84.30	78.00	83.00	86.90
	SHC	13.40	30.90	46.10	6.50	18.00	31.30	-2.10	7.20	17.90
	kW	11.44	11.54	11.66	11.61	11.68	11.75	11.70	11.86	11.95
70	TC	77.10	80.60	83.40	79.50	83.90	88.90	82.40	87.30	91.10
	SHC	17.60	34.70	49.90	10.80	22.20	35.10	3.20	11.50	22.20
	kW	11.22	11.33	11.45	11.40	11.46	11.54	11.49	11.64	11.75
60	TC	86.30	89.90	92.70	88.80	93.20	98.20	91.70	96.60	100.50
	SHC	26.20	43.20	58.40	19.40	30.80	43.60	11.60	20.10	30.70
	kW	10.76	10.86	10.98	10.93	11.00	11.07	11.03	11.18	11.28
50	TC	95.50	99.10	101.90	98.00	102.40	107.40	101.00	106.00	109.80
	SHC	34.80	51.80	67.00	28.00	39.40	52.20	20.10	28.70	39.40
	kW	10.33	10.43	10.55	10.50	10.52	10.63	10.59	10.74	10.85
40	TC	104.80	108.40	111.20	107.30	111.70	116.60	110.30	115.30	119.10
	SHC	43.40	60.40	75.60	36.60	48.00	60.80	28.80	37.30	47.90
	kW	9.87	9.97	10.09	10.04	10.11	10.18	10.14	10.28	10.40

LEGEND

Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Kilowatts
SHC — Sensible Heat Capacity
TC — Total Capacity

48HC*E24 COOLING CAPACITIES, SUBCOOLING MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - CFM								
		6,000			8,000			10,000		
		Air Entering Evaporator - Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	281.60	256.50	231.30	293.10	267.00	240.90	302.30	275.40	248.60
	SHC	114.70	141.00	167.40	140.60	166.60	192.60	161.60	187.30	212.90
	kW	13.52	13.25	12.95	13.82	13.46	13.21	13.97	13.60	13.31
85	TC	261.30	236.90	212.40	272.10	247.70	221.30	280.70	254.60	228.50
	SHC	90.90	123.50	156.10	118.80	151.10	183.30	141.40	173.40	205.40
	kW	14.95	14.68	14.48	15.25	14.89	14.64	15.40	15.03	14.74
95	TC	241.10	217.20	193.40	251.10	226.40	201.70	259.20	233.80	208.40
	SHC	67.20	106.00	144.80	97.10	120.10	174.10	121.20	159.50	197.80
	kW	16.52	16.25	15.95	16.82	16.46	16.21	16.97	16.60	16.31
105	TC	220.80	197.50	174.40	230.20	206.20	182.20	237.70	213.00	188.40
	SHC	43.40	88.40	133.50	75.30	120.10	164.90	101.00	145.70	178.90
	kW	18.09	17.82	17.52	18.39	18.03	17.78	18.54	18.17	17.88
115	TC	200.50	178.00	155.50	209.20	185.90	162.60	216.20	192.20	168.70
	SHC	19.70	70.90	122.20	53.50	104.60	155.70	80.90	131.80	161.20
	kW	19.65	19.38	19.08	19.95	19.59	19.34	20.10	19.73	19.44
125	TC	180.20	158.40	136.50	188.20	165.60	143.00	194.70	171.40	148.20
	SHC	-4.10	53.40	110.80	31.70	89.10	142.20	60.70	118.00	145.10
	kW	20.59	20.32	20.02	20.89	20.53	20.28	21.04	20.67	20.38

48HC*E24 COOLING CAPACITIES, HOT GAS REHEAT MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator - Cfm								
		6,000	8,000	10,000	6,000	8,000	10,000	6,000	8,000	10,000
80	TC	115.20	123.30	130.60	120.40	129.30	138.20	122.80	135.00	143.70
	SHC	40.80	58.30	76.10	32.30	45.50	60.40	20.10	34.30	48.00
	kW	13.24	13.32	13.39	13.43	13.57	13.65	13.49	13.68	13.74
75	TC	119.80	128.60	135.90	125.50	135.30	143.20	128.00	139.50	148.40
	SHC	45.60	62.80	82.10	37.00	49.80	65.20	24.30	38.70	52.60
	kW	13.05	13.10	13.17	13.21	13.35	13.43	13.27	13.46	13.52
70	TC	122.50	133.10	140.20	129.80	140.70	147.60	132.40	144.40	153.20
	SHC	49.80	76.00	86.10	41.10	54.30	69.20	28.80	41.40	56.80
	kW	12.80	12.87	12.94	12.98	13.12	13.20	13.04	13.23	13.29
60	TC	133.80	142.50	149.60	139.30	150.40	157.40	141.50	154.20	163.00
	SHC	58.60	76.00	95.00	50.20	63.50	78.10	37.80	52.10	65.90
	kW	12.34	12.42	12.49	12.53	12.67	12.75	12.59	12.78	12.84
50	TC	143.50	151.80	159.30	149.00	160.00	167.00	151.30	163.60	172.50
	SHC	67.70	84.80	103.80	59.10	72.40	87.00	46.70	61.00	74.90
	kW	11.88	11.95	12.03	12.07	12.21	12.29	12.13	12.32	12.38
40	TC	153.20	161.30	168.70	158.60	169.20	176.60	160.80	173.10	182.00
	SHC	76.50	93.60	111.60	68.00	81.50	95.80	55.80	69.80	84.00
	kW	11.42	11.49	11.56	11.60	11.74	11.82	11.66	11.85	11.91

LEGEND

Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Kilowatts
SHC — Sensible Heat Capacity
TC — Total Capacity

Performance data (cont)

48HC*E28 COOLING CAPACITIES, SUBCOOLING MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - CFM								
		7,500			10,000			12,500		
		Air Entering Evaporator - Ewb (F)								
		72	67	62	72	67	62	72	67	62
75	TC	351.30	319.50	287.80	370.40	337.30	304.10	385.80	351.50	317.20
	SHC	166.50	199.40	232.30	191.20	245.60	258.50	211.40	245.60	279.90
	kW	16.75	16.55	15.20	17.30	16.75	15.85	17.80	17.50	16.50
85	TC	327.50	296.40	265.30	346.10	313.60	281.20	361.10	327.50	294.00
	SHC	137.40	178.20	219.00	162.60	204.50	246.40	183.30	226.00	268.70
	kW	18.65	18.45	17.25	19.20	18.65	17.80	19.45	19.15	18.15
95	TC	303.70	273.30	242.90	321.80	290.00	258.30	336.40	303.50	270.70
	SHC	108.20	157.00	205.80	134.00	184.10	234.30	155.10	206.40	257.60
	kW	20.60	20.40	19.34	21.15	20.60	19.95	21.60	21.30	20.30
105	TC	279.90	250.20	220.40	297.50	266.40	235.30	311.70	279.50	247.40
	SHC	79.00	135.80	192.50	105.40	163.80	222.20	127.10	186.70	246.40
	kW	22.85	22.65	21.45	23.40	22.85	22.05	23.70	23.40	22.40
115	TC	256.20	227.10	198.00	273.20	242.80	212.40	287.00	255.50	224.10
	SHC	49.90	114.50	179.20	76.80	143.40	210.10	98.90	167.10	223.80
	kW	25.05	24.85	23.65	25.60	25.05	24.25	25.90	25.60	24.60
125	TC	232.40	203.90	175.50	248.90	219.20	189.50	262.30	231.50	200.80
	SHC	20.70	93.30	166.00	48.20	123.10	188.90	70.80	147.40	200.80
	kW	27.25	27.05	25.80	27.80	27.25	26.50	28.15	27.85	26.85

48HC*E28 COOLING CAPACITIES, HOT GAS REHEAT MODE

TEMP (F) AIR ENT CONDENSER (Edb)		AIR ENTERING EVAPORATOR - Ewb (F)								
		75 Dry Bulb 62.5 Wet Bulb (50% Relative)			75 Dry Bulb 64 Wet Bulb (56% Relative)			75 Dry Bulb 65.3 Wet Bulb (60% Relative)		
		Air Entering Evaporator - Cfm								
		7,500	10,000	12,500	7,500	10,000	12,500	7,500	10,000	12,500
80	TC	124.40	133.90	139.00	132.00	142.10	145.10	135.60	149.10	151.50
	SHC	37.60	60.70	82.20	27.80	45.40	65.80	17.50	34.20	50.10
	kW	15.83	15.90	16.00	15.97	16.13	16.16	16.11	16.31	16.38
75	TC	129.00	138.50	144.60	136.60	147.60	150.10	140.60	154.00	156.30
	SHC	47.10	70.60	92.10	37.30	55.30	75.70	27.00	43.70	60.00
	kW	15.77	15.83	15.94	15.91	16.07	16.10	16.05	16.25	16.32
70	TC	133.60	143.10	149.20	141.20	152.30	154.80	145.30	158.80	161.10
	SHC	57.30	80.70	102.20	47.50	65.40	85.80	37.20	53.90	70.10
	kW	15.68	15.75	15.86	15.83	16.00	16.04	15.88	16.08	16.15
60	TC	142.80	158.40	158.40	150.40	161.40	163.90	153.90	167.40	169.70
	SHC	76.50	121.40	121.40	66.70	84.60	105.00	56.40	73.10	89.30
	kW	15.54	15.60	15.71	15.68	15.84	15.87	15.82	16.02	16.09
50	TC	151.80	161.30	167.40	159.40	170.50	173.20	162.80	176.20	178.80
	SHC	94.10	117.50	139.00	84.30	102.20	122.60	74.00	90.70	106.90
	kW	15.40	15.47	15.58	15.54	15.68	15.71	15.66	15.86	15.93
40	TC	161.20	170.70	176.80	168.80	179.80	182.50	172.20	185.70	188.20
	SHC	114.10	137.60	159.10	104.30	122.30	142.70	94.00	110.70	127.00
	kW	15.24	15.31	15.42	15.39	15.55	15.58	15.53	15.73	15.80

LEGEND

Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Kilowatts
SHC — Sensible Heat Capacity
TC — Total Capacity

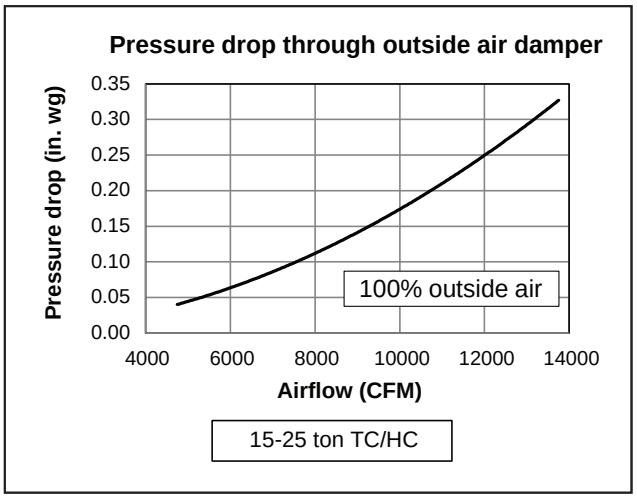
GENERAL FAN PERFORMANCE NOTES:

1. Interpolation is permissible. Do not extrapolate.
2. External static pressure is the static pressure difference between the return duct and the supply duct plus the static pressure caused by any FIOPs or accessories.
3. Tabular data accounts for pressure loss due to clean filters, unit casing, and wet coils. Factory options and accessories may add static pressure losses. Selection software is available, through your salesperson, to help you select the best motor/drive combination for your application.
4. The Fan Performance tables offer motor/drive recommendations. In cases when two motor/drive combinations would work, Carrier recommended the lower horsepower option.
5. For information on the electrical properties of Carrier motors, please see the Electrical information section of this book.
6. For more information on the performance limits of Carrier motors, see the application data section of this book.
7. The EPACT (Energy Policy Act of 1992) regulates energy requirements for specific types of indoor fan motors. Motors regulated by EPACT include any general purpose, T-frame (three-digit, 143 and larger), single-speed, foot mounted, polyphase, squirrel cage induction motors of NEMA (National Electrical Manufacturers Association) design A and B, manufactured for use in the United States. Ranging from 1 to 200 Hp, these continuous-duty motors operate on 230 and 460 volt, 60 Hz power. If a motor does not fit into these specifications, the motor does not have to be replaced by an EPACT compliant energy-efficient motor. Variable-speed motors are exempt from EPACT compliance requirements.

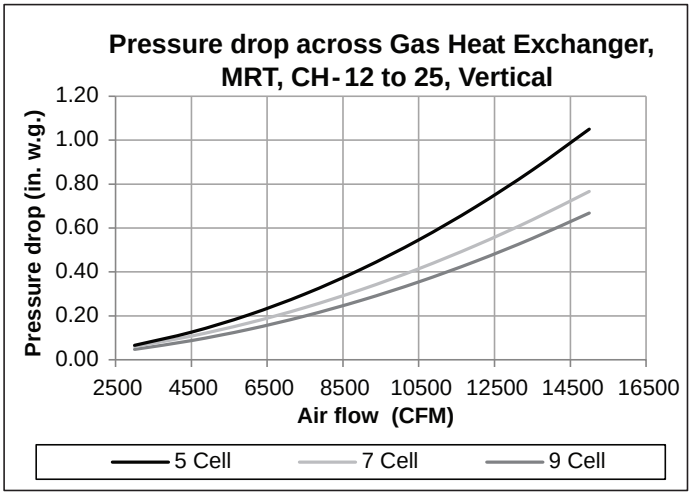
Performance data (cont)

ACCESSORY PRESSURE DROPS, BAROMETRIC RELIEF AND POWER EXHAUST PERFORMANCE (EXCLUDES EnergyX® SYSTEMS)

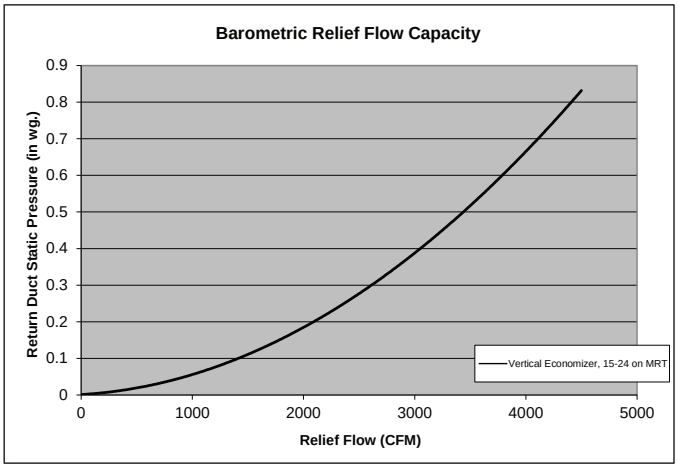
OUTSIDE AIR PRESSURE DROP



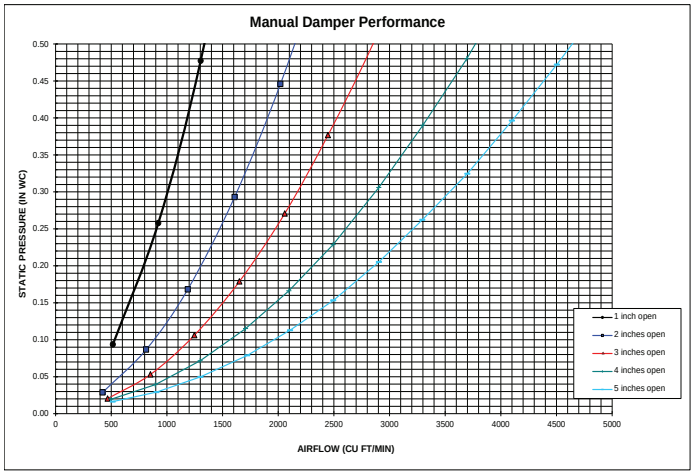
GAS HEAT EXCHANGER, CH-12 TO 25, VERTICAL SUPPLY PRESSURE DROP



BAROMETRIC RELIEF FLOW CAPACITY

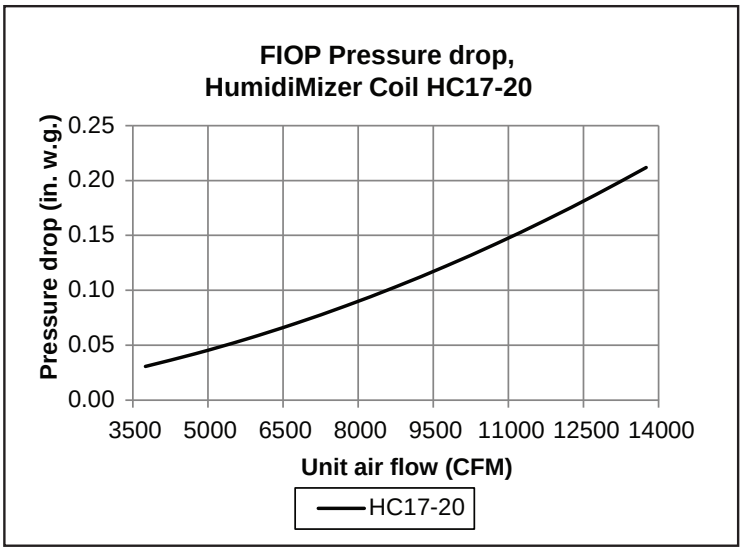


MANUAL DAMPER PERFORMANCE



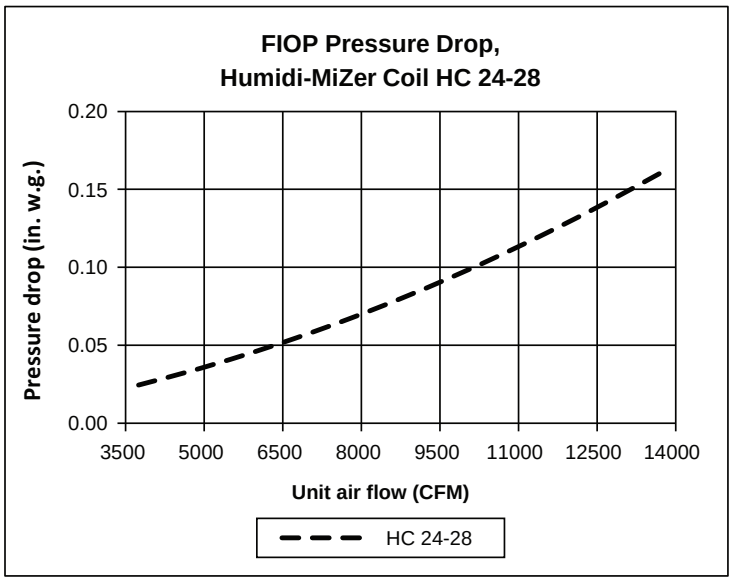
ACCESSORY PRESSURE DROPS, BAROMETRIC RELIEF AND POWER EXHAUST PERFORMANCE (EXCLUDES EnergyX® SYSTEMS) (cont)

PRESSURE DROP FOR HUMIDI-MIZER® COIL, SIZES 17, 20



15, 17.5 TONS											
CFM	3750	4750	5750	6750	7750	8750	9750	10750	11750	12750	13750
PRESSURE DROP (in. wg)	0.03	0.04	0.06	0.07	0.08	0.10	0.12	0.14	0.16	0.19	0.21

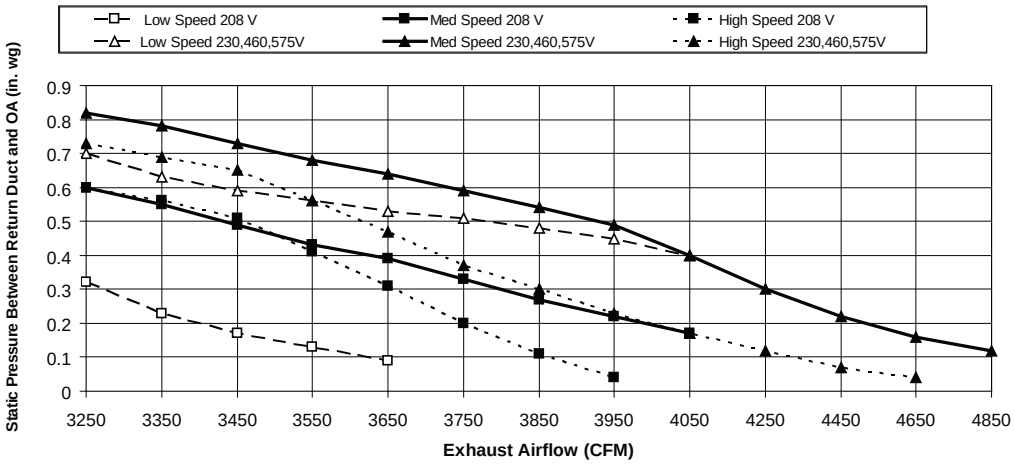
PRESSURE DROP FOR HUMIDI-MIZER COIL, SIZES 24, 28



20, 25 TONS											
CFM	3750	4750	5750	6750	7750	8750	9750	10750	11750	12750	13750
PRESSURE DROP (in. wg)	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.13	0.14	0.16

ACCESSORY PRESSURE DROPS, BAROMETRIC RELIEF AND POWER EXHAUST PERFORMANCE (EXCLUDES EnergyX SYSTEMS) (cont)

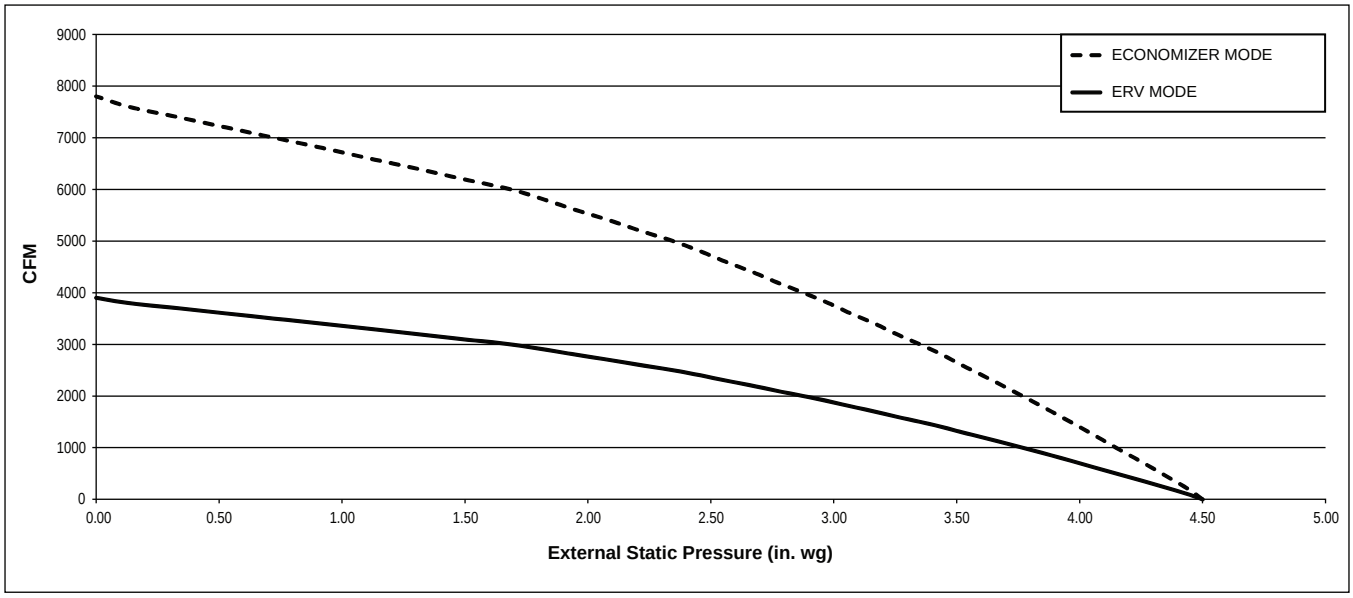
POWER EXHAUST FAN PERFORMANCE



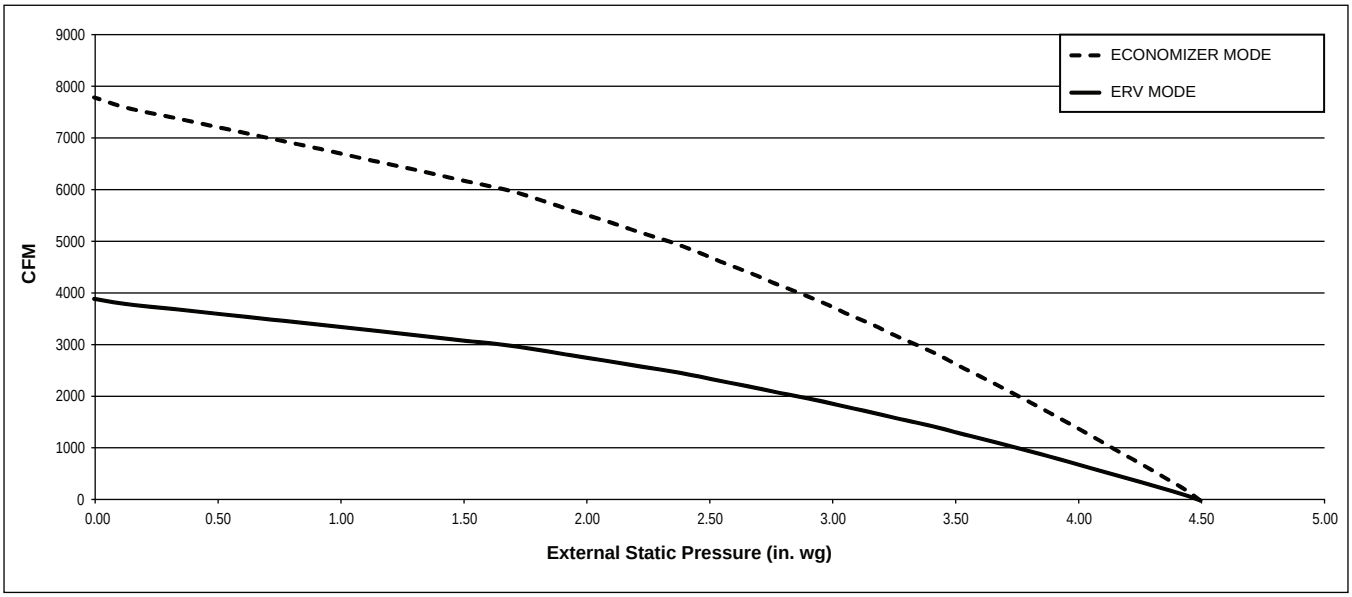
FAN PERFORMANCE — POWER EXHAUST

AIRFLOW	208V		230V/460V/575V	
	ESP	BHP	ESP	BHP
3,850	0.600	1.845	0.730	1.99
3,950	0.560	1.870	0.690	2.01
4,050	0.510	1.890	0.650	2.04
4,250	0.410	1.915	0.560	2.06
4,450	0.310	1.965	0.470	2.12
4,650	0.200	2.035	0.370	2.19
4,850	0.110	2.085	0.300	2.24
5,050	0.040	2.125	0.230	2.28
5,250	—	—	0.170	2.33
5,450	—	—	0.120	2.38
5,650	—	—	0.070	2.40
5,850	—	—	0.040	2.42

48HC UNITS WITH EnergyX SYSTEM — POWER EXHAUST PERFORMANCE

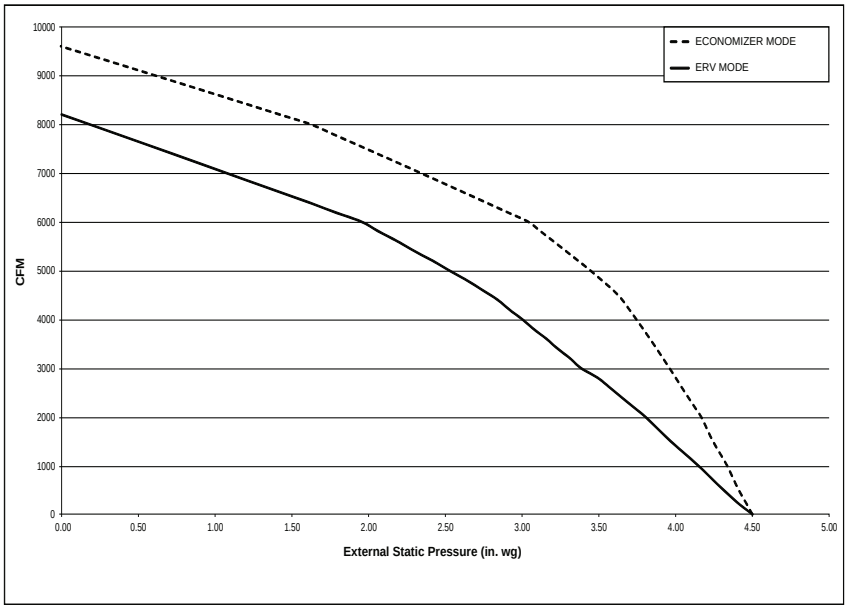


48HC17 SUPPLY AND EXHAUST FAN PERFORMANCE CURVES**

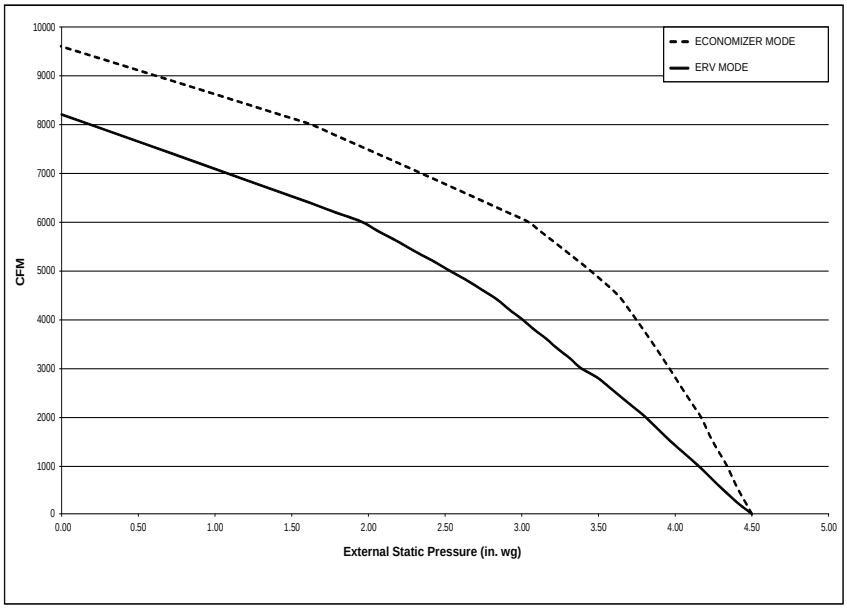


48HC20 SUPPLY AND EXHAUST FAN PERFORMANCE CURVES**

48HC UNITS WITH EnergyX SYSTEM — POWER EXHAUST PERFORMANCE (cont)



48HC24 SUPPLY AND EXHAUST FAN PERFORMANCE CURVES**



48HC28 SUPPLY AND EXHAUST FAN PERFORMANCE CURVES**

48HC**17, 15 TON, VERTICAL SUPPLY/RETURN WITHOUT EnergyX® — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	**494**	**0.77**	583	1.09	662	1.43	732	1.80	796	2.19
4900	522	0.93	605	1.27	681	1.64	750	2.03	813	2.44
5250	547	1.10	626	1.45	700	1.84	766	2.24	828	2.67
5650	577	1.32	651	1.68	721	2.09	786	2.51	846	2.96
6000	603	1.53	674	1.91	741	2.33	804	2.78	863	3.24
6400	634	1.81	701	2.20	765	2.64	826	3.10	883	3.59
6750	662	2.07	725	2.49	787	2.94	846	3.42	902	3.92
7150	694	2.42	754	2.85	813	3.31	869	3.81	923	4.33
7500	722	2.74	779	3.19	836	3.67	890	4.19	943	4.72

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	856	2.60	911	3.02	963	3.46	*1012*	*3.92*	*1059*	*4.39*
4900	871	2.86	926	3.30	977	3.76	*1026*	*4.23*	*1072*	*4.72*
5250	885	3.11	939	3.57	990	4.05	*1038*	*4.54*	—	—
5650	903	3.43	956	3.91	1006	4.40	—	—	—	—
6000	918	3.72	971	4.22	*1020*	*4.73*	—	—	—	—
6400	937	4.09	988	4.61	—	—	—	—	—	—
6750	954	4.44	—	—	—	—	—	—	—	—
7150	975	4.87	—	—	—	—	—	—	—	—
7500	—	—	—	—	—	—	—	—	—	—

NOTES:
1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.

Standard static 514-680 RPM, 2.9 BHP, max
Medium static 679-863 RPM, 3.7 BHP max
High static 826-1009 RPM, 4.9 BHP max

48HC**17, 15 TON, HORIZONTAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	508	1.25	582	1.76	647	2.31	705	2.89	758	3.51
4900	540	1.51	610	2.05	672	2.64	729	3.26	781	3.91
5250	568	1.78	635	2.35	695	2.96	750	3.61	801	4.29
5650	600	2.13	664	2.73	723	3.37	776	4.05	825	4.76
6000	629	2.47	691	3.10	747	3.77	799	4.48	—	—
6400	663	2.91	721	3.57	776	4.28	—	—	—	—
6750	693	3.34	749	4.03	801	4.76	—	—	—	—
7150	727	3.88	781	4.61	—	—	—	—	—	—
7500	757	4.40	—	—	—	—	—	—	—	—

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	807	4.16	852	4.83	—	—	—	—	—	—
4900	829	4.58	—	—	—	—	—	—	—	—
5250	—	—	—	—	—	—	—	—	—	—
5650	—	—	—	—	—	—	—	—	—	—
6000	—	—	—	—	—	—	—	—	—	—
6400	—	—	—	—	—	—	—	—	—	—
6750	—	—	—	—	—	—	—	—	—	—
7150	—	—	—	—	—	—	—	—	—	—
7500	—	—	—	—	—	—	—	—	—	—

NOTES:
1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.

Standard static 514-680 RPM, 2.9 BHP, max
Medium static 614-780 RPM, 3.7 BHP max
High static 746-912 RPM, 4.9 BHP max

Performance data (cont)

48HC**20, 17.5 TON, VERTICAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	**547**	**1.10**	626	1.45	700	1.84	766	2.24	828	2.67
5700	**581**	**1.35**	655	1.72	724	2.12	789	2.55	849	3.00
6150	**615**	**1.63**	684	2.02	750	2.44	812	2.90	871	3.37
6550	646	1.92	711	2.32	774	2.77	834	3.24	891	3.73
7000	682	2.28	743	2.71	803	3.17	860	3.66	915	4.17
7450	718	2.70	775	3.14	832	3.62	887	4.13	940	4.67
7900	755	3.16	809	3.62	863	4.12	915	4.65	966	5.21
8300	787	3.62	839	4.09	891	4.61	941	5.16	990	5.73
8750	825	4.18	874	4.68	923	5.22	971	5.78	1018	6.38

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	885	3.11	939	3.57	990	4.05	1038	4.54	1084	5.04
5700	905	3.47	958	3.95	1008	4.45	1055	4.96	1100	5.48
6150	925	3.86	977	4.36	1026	4.88	1073	5.42	1118	5.96
6550	945	4.24	995	4.76	1043	5.30	1090	5.86	1134	6.42
7000	967	4.71	1017	5.26	1064	5.82	1109	6.39	—	—
7450	991	5.22	1039	5.79	1085	6.38	—	—	—	—
7900	1015	5.78	1062	6.38	—	—	—	—	—	—
8300	1038	6.33	—	—	—	—	—	—	—	—
8750	—	—	—	—	—	—	—	—	—	—

NOTES:

1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.

Standard static 622-822 RPM, 3.7 BHP, max

Medium static 713-879 RPM, 4.9 BHP max

High static 882-1078 RPM, 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575V (8.3 Max BHP)

Operation point covered by high static drive. Confirm Max BHP coverage based on unit voltage selected.

48HC**20, 17.5 TON, HORIZONTAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	568	1.78	635	2.35	695	2.96	750	3.61	801	4.29
5700	604	2.17	668	2.78	726	3.43	779	4.11	829	4.82
6150	642	2.63	702	3.27	758	3.95	809	4.67	857	5.42
6550	676	3.09	733	3.76	786	4.48	836	5.23	883	6.01
7000	714	3.67	769	4.38	820	5.14	868	5.92	913	6.74
7450	753	4.33	805	5.08	854	5.87	900	6.69	944	7.54
7900	792	5.06	841	5.85	888	6.68	933	7.54	—	—
8300	827	5.78	874	6.61	920	7.47	—	—	—	—
8750	867	6.69	912	7.55	—	—	—	—	—	—

CFM	Available External Static PressuAVAILABLE EXTERNAL STATIC PRESSURE (in. wg)re (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	848	4.99	893	5.72	934	6.47	974	7.25	1012	8.05
5700	875	5.56	918	6.33	959	7.12	998	7.93	—	—
6150	902	6.20	944	7.00	985	7.83	—	—	—	—
6550	927	6.82	968	7.65	—	—	—	—	—	—
7000	955	7.58	—	—	—	—	—	—	—	—
7450	—	—	—	—	—	—	—	—	—	—
7900	—	—	—	—	—	—	—	—	—	—
8300	—	—	—	—	—	—	—	—	—	—
8750	—	—	—	—	—	—	—	—	—	—

NOTES:

1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.

Standard static 622-822 RPM, 3.7 BHP, max

Medium static 713-879 RPM, 4.9 BHP max

High static 835-1021 RPM, 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575V (8.3 Max BHP)

Operation point covered by high static drive. Confirm Max BHP coverage based on unit voltage selected.

48HC**24, 20 TON, VERTICAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	**615**	**1.25**	690	1.56	757	1.89	819	2.22	875	2.57
6,500	**653**	**1.52**	725	1.87	789	2.21	848	2.57	903	2.94
7,000	692	1.85	760	2.21	822	2.58	879	2.96	932	3.35
7,500	731	2.21	796	2.60	856	3.00	911	3.40	963	3.81
8,000	771	2.63	833	3.04	890	3.47	944	3.89	994	4.33
8,500	812	3.10	871	3.54	926	3.98	977	4.43	1026	4.89
9,000	852	3.62	909	4.09	961	4.55	1011	5.03	1059	5.51
9,500	893	4.20	947	4.69	998	5.19	1046	5.69	1092	6.19
10,000	934	4.85	986	5.36	1035	5.88	1082	6.40	1126	6.93

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	928	2.92	978	3.28	1025	3.65	1071	4.03	1114	4.42
6,500	955	3.31	1003	3.69	1050	4.09	1094	4.49	1137	4.89
7,000	983	3.75	1030	4.15	1075	4.56	1119	4.98	1161	5.41
7,500	1011	4.23	1058	4.66	1102	5.09	1145	5.53	*1186*	*5.98*
8,000	1041	4.77	1087	5.21	1130	5.67	1171	6.13	—	—
8,500	1072	5.35	1116	5.82	1158	6.30	—	—	—	—
9,000	1104	6.00	1147	6.49	*1188*	*6.99*	—	—	—	—
9,500	1136	6.70	*1178*	*7.22*	—	—	—	—	—	—
10,000	1169	7.47	—	—	—	—	—	—	—	—

NOTES:

1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.

Standard static 690-863 RPM; 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

Medium static 835-1021 RPM; 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

High static 941-1176 RPM; 208V (10.5 Max BHP) / 230V (11.9 Max BHP) / 460V (11.9 Max BHP) / 575 V (11.0 Max BHP)

48HC**24, 20 TON, HORIZONTAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	**633**	**1.92**	700	2.44	759	2.98	812	3.53	861	4.10
6,500	**674**	**2.34**	738	2.90	795	3.48	847	4.07	894	4.67
7,000	715	2.83	776	3.43	831	4.05	882	4.67	928	5.31
7,500	757	3.39	816	4.03	869	4.68	917	5.35	963	6.03
8,000	800	4.02	856	4.70	907	5.39	954	6.10	998	6.81
8,500	843	4.73	896	5.45	945	6.18	991	6.93	1034	7.68
9,000	886	5.52	937	6.28	984	7.06	1029	7.84	1071	8.63
9,500	929	6.40	978	7.21	1024	8.02	1067	8.84	—	—
10,000	973	7.38	1020	8.22	1064	9.08	—	—	—	—

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	907	4.68	949	5.27	990	5.88	1028	6.50	1064	7.13
6,500	939	5.29	981	5.92	1020	6.56	1058	7.21	1094	7.88
7,000	972	5.97	1013	6.63	1052	7.31	1089	8.00	—	—
7,500	1005	6.72	1046	7.42	1084	8.13	—	—	—	—
8,000	1040	7.54	1079	8.28	—	—	—	—	—	—
8,500	1075	8.45	—	—	—	—	—	—	—	—
9,000	—	—	—	—	—	—	—	—	—	—
9,500	—	—	—	—	—	—	—	—	—	—
10,000	—	—	—	—	—	—	—	—	—	—

NOTES:

1. Boldface indicates field-supplied drive is required.
2. Italics requires high static drive package with different motor pulley.
3. UNDERSCORE: Operation point covered by mid static drive; Confirm Max BHP coverage based on the unit voltage selected.

Standard static 690-863 RPM; 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

Medium static 835-1021 RPM; 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

High static 941-1100 RPM; 208V (10.5 Max BHP) / 230V (11.9 Max BHP) / 460V (11.9 Max BHP) / 575 V (11.0 Max BHP)

Performance data (cont)

48HC**28, 25 TON, VERTICAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	731	2.21	796	2.60	856	3.00	911	3.40	963	3.81
8,150	783	2.76	844	3.19	901	3.61	954	4.05	1003	4.49
8,750	832	3.35	890	3.80	943	4.26	994	4.73	1042	5.19
9,400	885	4.08	940	4.57	991	5.06	1039	5.55	1085	6.05
10,000	934	4.85	986	5.36	1035	5.88	1082	6.40	1126	6.93
10,650	988	5.78	1038	6.33	1084	6.88	1129	7.44	1172	8.00
11,250	1038	6.74	1086	7.32	1130	7.91	1173	8.49	—	—
11,900	1093	7.91	1138	8.52	1181	9.14	—	—	—	—
12,500	1144	9.10	1187	9.74	—	—	—	—	—	—

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	1011	4.23	1058	4.66	1102	5.09	1145	5.53	*1186*	*5.98*
8,150	1050	4.94	1095	5.39	1138	5.85	*1180*	*6.32*	—	—
8,750	1088	5.67	1131	6.15	1173	6.64	—	—	—	—
9,400	1129	6.56	1172	7.07	—	—	—	—	—	—
10,000	1169	7.47	—	—	—	—	—	—	—	—
10,650	—	—	—	—	—	—	—	—	—	—
11,250	—	—	—	—	—	—	—	—	—	—
11,900	—	—	—	—	—	—	—	—	—	—
12,500	—	—	—	—	—	—	—	—	—	—

NOTES:

1. Italics requires high static drive package with different motor pulley.
2. UNDERSCORE: Operation point covered by mid static drive; Confirm Max BHP coverage based on the unit voltage selected.

Standard static 717-911 RPM, 4.9 BHP, max

Medium static 913-1116 RPM, 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

High static 941-1176 RPM, 208V (10.5 Max BHP) / 230V (11.9 Max BHP) / 460V (11.9 Max BHP) / 575 V (11.0 Max BHP)

48HC**28, 25 TON, HORIZONTAL SUPPLY/RETURN WITHOUT EnergyX — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	**757**	**3.39**	816	4.03	869	4.68	917	5.35	963	6.03
8,000	800	4.02	856	4.70	907	5.39	954	6.10	998	6.81
8,500	843	4.73	896	5.45	945	6.18	991	6.93	1034	7.68
9,000	886	5.52	937	6.28	984	7.06	1029	7.84	1071	8.63
9,500	929	6.40	978	7.21	1024	8.02	1067	8.84	—	—
10,000	973	7.38	1020	8.22	1064	9.08	—	—	—	—
10,500	1017	8.45	1062	9.33	—	—	—	—	—	—
11,000	1061	9.63	—	—	—	—	—	—	—	—
11,500	—	—	—	—	—	—	—	—	—	—

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	1005	6.72	1046	7.42	1084	8.13	—	—	—	—
8,000	1040	7.54	1079	8.28	—	—	—	—	—	—
8,500	1075	8.45	—	—	—	—	—	—	—	—
9,000	—	—	—	—	—	—	—	—	—	—
9,500	—	—	—	—	—	—	—	—	—	—
10,000	—	—	—	—	—	—	—	—	—	—
10,500	—	—	—	—	—	—	—	—	—	—
11,000	—	—	—	—	—	—	—	—	—	—
11,500	—	—	—	—	—	—	—	—	—	—

NOTES: Boldface indicates field-supplied drive is required.

Standard static 717-911 RPM, 4.9 BHP, max

Medium static 913-1116 RPM, 208V (6.5 Max BHP) / 230V (6.9 Max BHP) / 460V (7.0 Max BHP) / 575 V (8.3 Max BHP)

High static 941-1176 RPM, 208V (10.5 Max BHP) / 230V (11.9 Max BHP) / 460V (11.9 Max BHP) / 575 V (11.0 Max BHP)

48HC*D17, 15 TON WITH EnergyX, VERTICAL SUPPLY/RETURN — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	**490**	**0.76**	575	1.07	653	1.41	724	1.79	791	2.19
4900	517	0.92	597	1.24	671	1.60	740	1.99	804	2.41
5250	541	1.08	618	1.42	688	1.79	754	2.19	817	2.62
5600	566	1.26	639	1.61	707	2.00	770	2.42	831	2.86
6000	595	1.49	664	1.86	729	2.27	790	2.70	848	3.15
6400	624	1.75	690	2.14	751	2.56	810	3.01	866	3.48
6750	650	2.00	713	2.41	772	2.84	829	3.30	883	3.79
7100	**676**	**2.27**	736	2.70	793	3.15	848	3.63	901	4.13
7500	706	2.62	763	3.06	**819**	**3.54**	871	4.03	922	4.55

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	854	2.63	913	3.09	970	3.57	**1024**	**4.09**	**1077**	**4.62**
4900	**865**	**2.86**	923	3.33	978	3.83	**1031**	**4.35**	**1082**	**4.89**
5250	876	3.08	932	3.56	986	4.07	**1038**	**4.60**	—	—
5600	888	3.33	943	3.82	995	4.34	**1046**	**4.88**	—	—
6000	903	3.64	956	4.14	1008	4.67	—	—	—	—
6400	920	3.98	971	4.50	—	—	—	—	—	—
6750	935	4.30	986	4.83	—	—	—	—	—	—
7100	952	4.65	—	—	—	—	—	—	—	—
7500	—	—	—	—	—	—	—	—	—	—

NOTES: Boldface indicates field-supplied drive is required.

Standard static 514 — 680 RPM, 2.2 Max BHP
Medium static 679 — 863 RPM, 3.3 Max BHP
High static 826 — 1009 RPM, 4.9 Max BHP

48HCF*20, 17.5 TON WITH EnergyX, VERTICAL SUPPLY/RETURN — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	**541**	**1.08**	**618**	**1.42**	688	1.79	754	2.19	817	2.62
5700	**573**	**1.31**	645	1.67	712	2.06	775	2.48	835	2.93
6100	**602**	**1.55**	670	1.93	734	2.34	795	2.77	852	3.23
6500	631	1.81	696	2.21	757	2.64	815	3.09	871	3.57
7000	668	2.19	729	2.61	787	3.06	843	3.53	896	4.03
7500	706	2.62	763	3.06	819	3.54	871	4.03	922	4.55
7900	736	3.00	791	3.47	844	3.96	895	4.47	944	5.00
8300	767	3.42	819	3.90	870	4.41	919	4.94	967	5.49
8750	801	3.94	852	4.44	900	4.97	948	5.52	993	6.09

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	876	3.08	932	3.56	986	4.07	1038	4.60	**1088**	**5.15**
5700	892	3.40	946	3.90	998	4.42	1049	4.96	**1097**	**5.52**
6100	907	3.72	960	4.23	1011	4.76	1060	5.31	**1107**	**5.89**
6500	924	4.07	975	4.59	1025	5.13	1072	5.70	**1119**	**6.28**
7000	947	4.55	996	5.09	1044	5.65	**1090**	**6.23**	—	—
7500	971	5.08	1019	5.64	1064	6.22	—	—	—	—
7900	992	5.55	1038	6.13	—	—	—	—	—	—
8300	1013	6.06	—	—	—	—	—	—	—	—
8750	—	—	—	—	—	—	—	—	—	—

NOTES: Boldface indicates field-supplied drive is required.

Standard static 622 — 822 RPM, 3.3 Max BHP
Medium static 713 — 879 RPM, 4.9 Max BHP
High static 882 — 1078 RPM, 6.5 Max BHP

Performance data (cont)

48HC*D24, 20 TON WITH EnergyX, VERTICAL SUPPLY/RETURN — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	**605**	**1.48**	**674**	**1.77**	738	2.08	798	2.41	854	2.74
6,500	**644**	**1.82**	709	2.14	770	2.47	827	2.81	881	3.17
7,000	**683**	**2.22**	744	2.56	802	2.91	857	3.28	908	3.65
7,500	722	2.68	781	3.04	836	3.41	888	3.80	938	4.19
8,000	762	3.20	818	3.58	870	3.97	920	4.38	968	4.79
8,500	803	3.78	855	4.19	905	4.60	953	5.02	999	5.46
9,000	843	4.43	893	4.86	941	5.30	987	5.74	1032	6.19
9,500	884	5.15	932	5.61	978	6.06	1022	6.53	1065	7.01
10,000	925	5.95	970	6.43	1015	6.91	1057	7.40	1098	7.89

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6,000	907	3.10	958	3.46	1006	3.84	1052	4.23	1097	4.63
6,500	932	3.54	981	3.92	1027	4.31	1073	4.72	1116	5.14
7,000	958	4.04	1005	4.43	1051	4.84	1094	5.27	1137	5.70
7,500	985	4.59	1031	5.01	1075	5.44	1118	5.87	1159	6.32
8,000	1014	5.21	1058	5.65	1101	6.09	1142	6.55	—	—
8,500	1044	5.90	1087	6.35	1128	6.82	1168	7.29	—	—
9,000	1075	6.66	1116	7.13	1156	7.61	—	—	—	—
9,500	1106	7.49	1146	7.98	—	—	—	—	—	—
10,000	1139	8.40	—	—	—	—	—	—	—	—

NOTE: Boldface indicates field-supplied drive is required.

Standard static 690 — 863 RPM, 4.9 Max BHP
Medium static 835 — 1021 RPM, 6.5 Max BHP
High static 941 — 1176 RPM, 8.7 Max BHP

48HC*D28 25 TON, WITH EnergyX, VERTICAL SUPPLY/RETURN — FAN PERFORMANCE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	**713**	**2.25**	778	2.61	838	2.97	894	3.36	946	3.76
8,000	752	2.68	814	3.06	871	3.44	925	3.85	976	4.26
8,500	791	3.17	850	3.56	905	3.97	957	4.39	1006	4.83
9,000	831	3.71	887	4.12	939	4.55	989	4.99	1037	5.45
9,500	870	4.31	924	4.75	974	5.19	1023	5.66	1069	6.13
10,000	910	4.83	961	5.43	1010	5.90	1057	6.38	1102	6.87
10,500	950	5.70	999	6.18	1046	6.67	1091	7.17	1135	7.69
11,000	990	6.50	1037	7.01	1083	7.52	1126	8.04	1168	8.57
11,500	1030	7.38	1076	7.90	1119	8.43	—	—	—	—
12,000	1070	8.33	—	—	—	—	—	—	—	—
12,500	—	—	—	—	—	—	—	—	—	—

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7,500	996	4.17	1044	4.60	1089	5.05	1133	5.51	1175	5.98
8,000	1024	4.70	1071	5.14	1115	5.60	1158	6.07	—	—
8,500	1053	5.27	1098	5.74	1141	6.21	—	—	—	—
9,000	1083	5.91	1127	6.39	1169	6.88	—	—	—	—
9,500	1113	6.61	1156	7.11	—	—	—	—	—	—
10,000	1145	7.38	—	—	—	—	—	—	—	—
10,500	—	—	—	—	—	—	—	—	—	—
11,000	—	—	—	—	—	—	—	—	—	—
11,500	—	—	—	—	—	—	—	—	—	—
12,000	—	—	—	—	—	—	—	—	—	—
12,500	—	—	—	—	—	—	—	—	—	—

NOTE: Boldface indicates field-supplied drive is required.

Standard static 717 — 911 RPM, 4.9 Max BHP 2.2
Medium static 913 — 1116 RPM, 6.5 Max BHP
High static 941 — 1176 RPM, 8.7 Max BHP

PULLEY ADJUSTMENT, VERTICAL

48HC UNIT		MOTOR/DRIVE COMBO	MOTOR PULLEY TURNS OPEN										
			0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
17	3 phase	Standard Static	680	663	647	630	614	597	580	564	547	531	514
		Medium Static	863	845	826	808	789	771	753	734	716	697	679
		High Static	1009	991	972	954	936	918	899	881	863	844	826
20	3 phase	Standard Static	822	802	782	762	742	722	702	682	662	642	622
		Medium Static	879	862	846	829	813	796	779	763	746	730	713
		High Static	1078	1058	1039	1019	1000	980	960	941	921	902	882
24	3 phase	Standard Static	863	846	828	811	794	777	759	742	725	707	690
		Medium Static	1021	1002	984	965	947	928	909	891	872	854	835
		High Static	1176	1153	1129	1106	1082	1059	1035	1012	988	965	941
28	3 phase	Standard Static	911	892	872	853	833	814	795	775	756	736	717
		Medium Static	1116	1096	1075	1055	1035	1015	994	974	954	933	913
		High Static	1176	1153	1129	1106	1082	1059	1035	1012	988	965	941

Factory setting

PULLEY ADJUSTMENT, HORIZONTAL

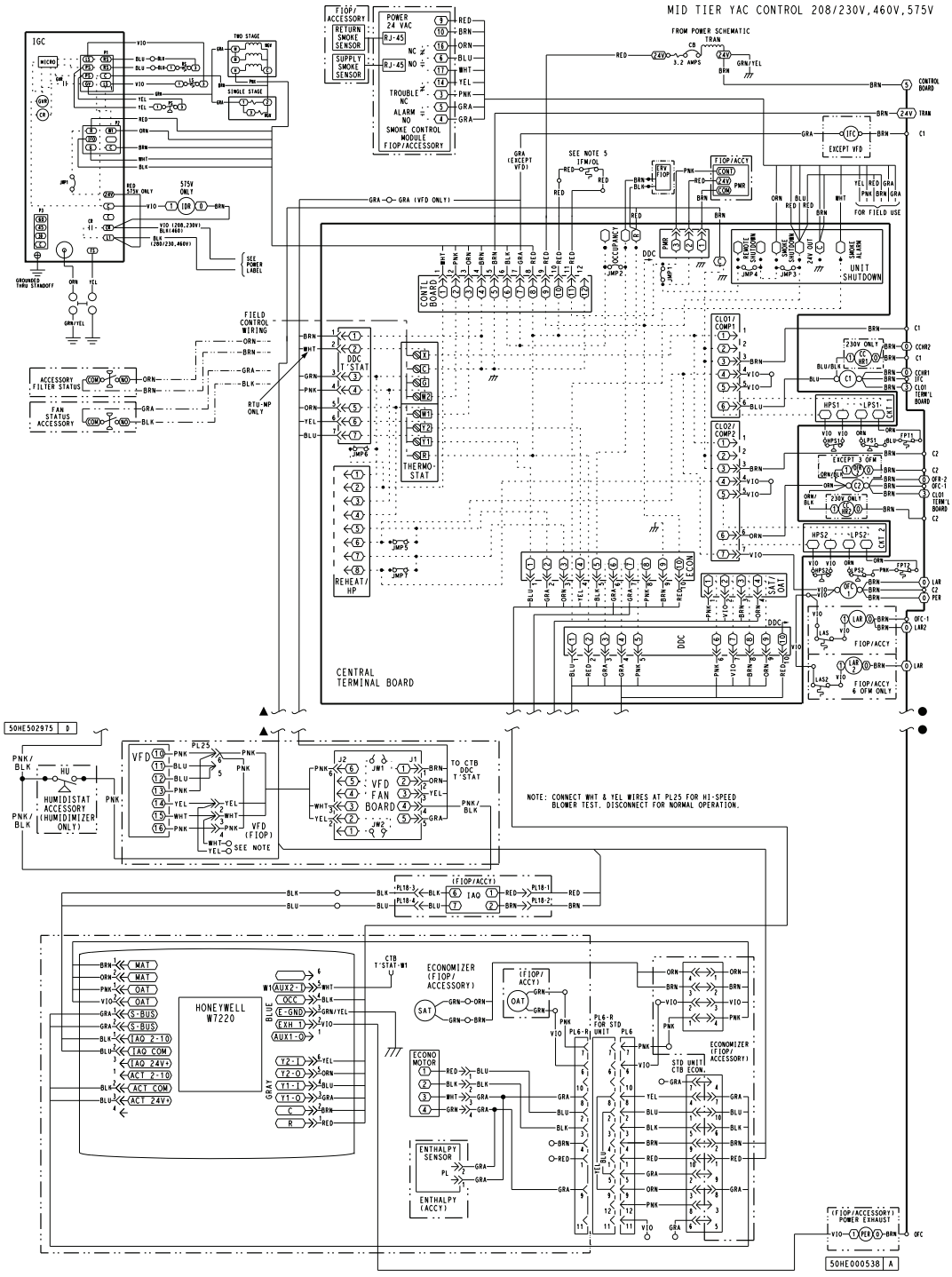
48HC UNIT		MOTOR/DRIVE COMBO	MOTOR PULLEY TURNS OPEN										
			0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
17	3 phase	Standard Static	680	663	647	630	614	597	580	564	547	531	514
		Medium Static	780	763	747	730	714	697	680	664	647	631	614
		High Static	912	895	879	862	846	829	812	796	779	763	746
20	3 phase	Standard Static	822	802	782	762	742	722	702	682	662	642	622
		Medium Static	879	862	846	829	813	796	779	763	746	730	713
		High Static	1021	1002	984	965	947	928	909	891	872	854	835
24	3 phase	Standard Static	863	846	828	811	794	777	759	742	725	707	690
		Medium Static	1021	1002	984	965	947	928	909	891	872	854	835
		High Static	1176	1153	1129	1106	1082	1059	1035	1012	988	965	941
28	3 phase	*Standard Static	791	777	762	748	733	719	705	690	676	661	647
		Medium Static	923	906	889	873	856	839	822	805	789	772	755
		High Static	1107	1087	1067	1047	1027	1007	986	966	946	926	906

* Standard Static drive is only for 50 series, for 48 series use a field-supplied drive.

Factory setting

Typical wiring diagram

48HC 17-24 ELECTRO-MECHANICAL CONTROL WIRING DIAGRAMS

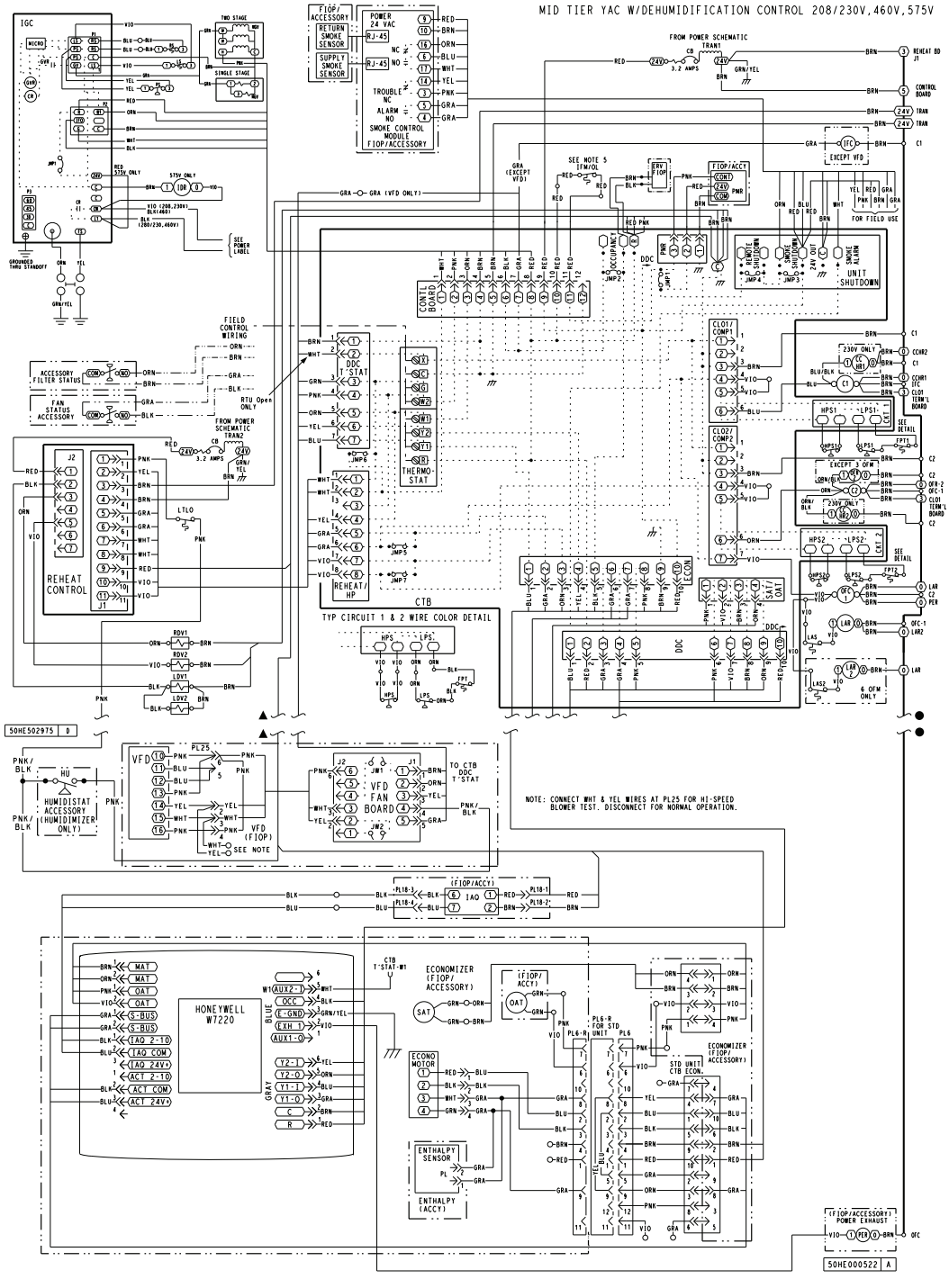


C	CONTACTOR,COMPRESSOR
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CCH	CRANKCASE HEATER
CCHR	CRANKCASE HEATER RELAY
CCN	CARRIER COMFORT NETWORK
CMP SAFE	COMPRESSOR SAFFETY
COFS	CONDENSATE OVERFLOW SWITCH
COMP	COMPRESSOR MOTOR
CTB	CENTRAL TERMINAL BOARD
DDC	DIRECT DIGITAL CONTROL
ERV	ENERGY RECOVERY VENTILATOR
FIOP	FACTORY INSTALLED OPTION
FSD	FIRE SHUT DOWN
FU	FUSE
GND	GROUND
GVR	GAS VALVE RELAY
HPS	HIGH PRESSURE SWITCH
HS	HALL EFFECT SENSOR
I	IGNITOR
IAQ	INDOOR AIR QUALITY SENSORS
IDM	INDUCED DRAFT MOTOR
IDR	INDUCED DRAFT RELAY
IFC	INDOOR FAN CONTACTOR
IFM	INDOOR FAN MOTOR
IGC	INTEGRATED GAS CONTROL
IRH	INDOOR RELATIVE HUMIDITY
LA	LOW AMBIENT LOCKOUT
LAR	LOW AMBIENT RELAY
LAS	LOW AMBIENT SWITCH
LOOP PWR	CURRENT LOOP POWER
LPS	LOW PRESSURE SWITCH
LSM	LIMIT SWITCH (MANUAL RESET)
MGV	MAIN GAS VALVE
OAQ	OUTDOOR AIR QUALITY
OAT	OUTDOOR AIR TEMP. SENSOR
OFC	OUTDOOR FAN CONTACTOR
OFM	OUTDOOR FAN MOTOR
OFR	OUTDOOR FAN RELAY
OFTB	OUTDOOR FAN TERMINAL BLOCK
OLR	OVERLOAD RELAY
PER	POWER EXHAUST RELAY
PL	PLUG ASSEMBLY
POT	POTENTIOMETER
PMR	PHASE MONITOR RELAY
QT	QUADRUPLE TERMINAL
R	RELAY
RAT	RETURN AIR TEMP. SEN
RMT OCC	REMOTE OCCUPANCY
RS	ROLLOUT SWITCH
RTPF	ROUND TUBE PLATE FIN CONDENSER COIL
SAT	SUPPLY AIR TEMP. SENSOR
SEN	SENSOR
SET	SET POINT OFFSET
SFS	SUPPLY FAN STATUS
TDR	TIME DELAY RELAY
TRAN	TRANSFORMER
VFD	VARIABLE FREQUENCY DRIVE

NOTES

1. IF ANY OF THE ORIGINAL WIRE FURNISHED MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 90 C WIRE OR ITS EQUIVALENT.
2. COMPRESSOR AND FAN MOTORS ARE THERMALLY PROTECTED. THREE PHASE MOTORS ARE PROTECTED AGAINST PRIMARY SINGLE PHASING CONDITIONS.
3. 208/230V UNIT TRAN IS WIRED FOR 230V UNIT. IF UNIT IS TO BE RUN WITH 208V POWER SUPPLY DISCONNECT BLK WIRE FROM 230V TAP AND CONNECT TO 200V TAP.
4. USE COPPER CONDUCTOR ONLY.
5. IFM OL IS NOT USED ON ALL MODELS, IF NOT USED, THEN RED LEADS ARE CONNECTED TOGETHER.

48HC 17-24 ELECTRO-MECHANICAL CONTROL WIRING DIAGRAM WITH OPTIONAL HUMIDI-MIZER® SYSTEM



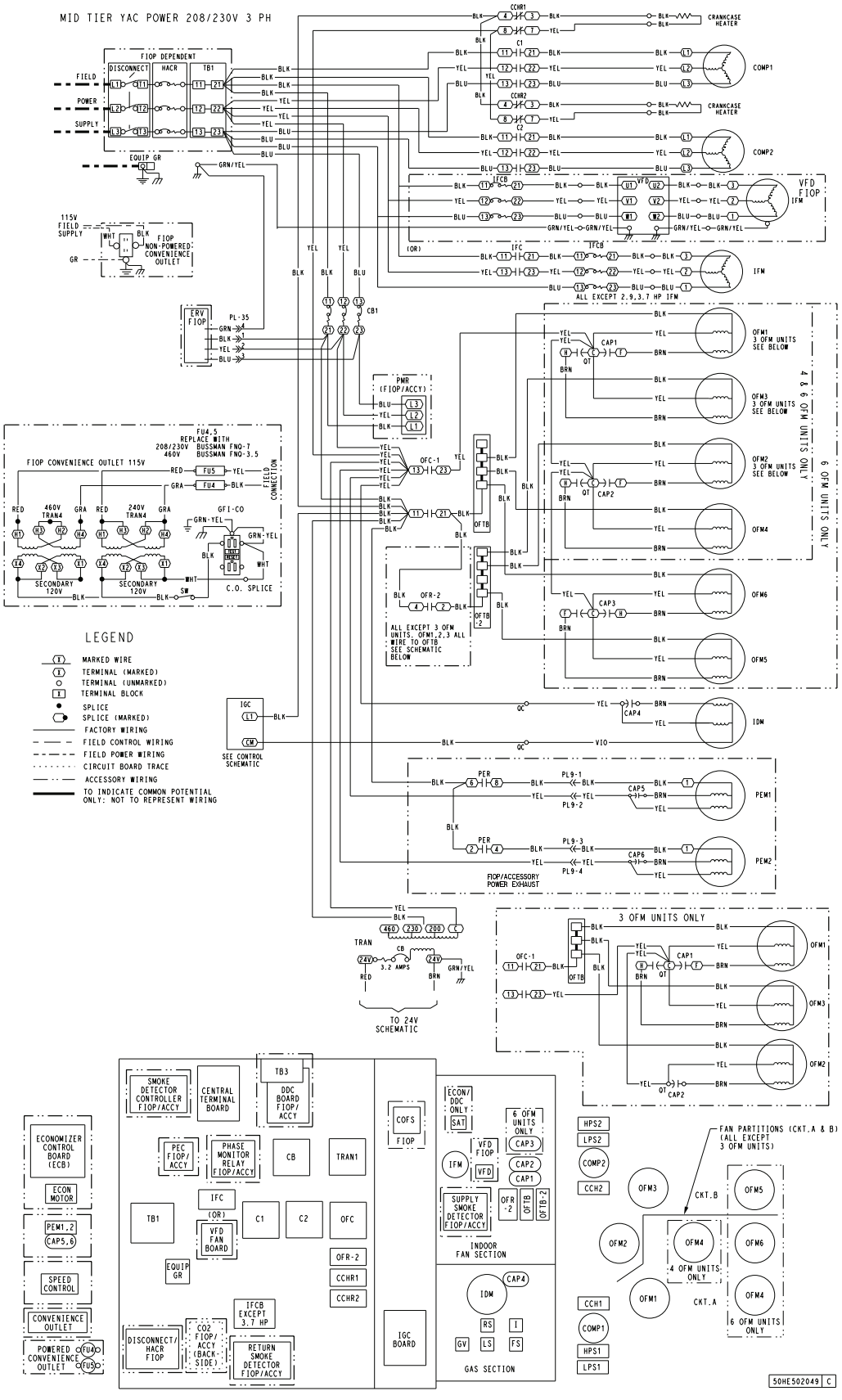
C	CONTACTOR,COMPRESSOR
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CCH	CRANKCASE HEATER
CCHR	CRANKCASE HEATER RELAY
CCN	CARRIER COMFORT NETWORK
CMP SAFE	COMPRESSOR SAFFETY
COFS	CONDENSATE OVERFLOW SWITCH
COMP	COMPRESSOR MOTOR
CTB	CENTRAL TERMINAL BOARD
DDC	DIRECT DIGITAL CONTROL
ERV	ENERGY RECOVERY VENTILATOR
FIOP	FACTORY INSTALLED OPTION
FPT	FREEZE PROTECTION THERMOSTAT
FSD	FIRE SHUT DOWN
FU	FUSE
GND	GROUND
GVR	GAS VALVE RELAY
HPS	HIGH PRESSURE SWITCH
HS	HALL-EFFECT SENSOR
I	IGNITOR
IAQ	INDOOR AIR QUALITY SENSORS
IDM	INDUCED DRAFT MOTOR
IDR	INDUCED DRAFT RELAY
IFC	INDOOR FAN CONTACTOR
IFM	INDOOR FAN MOTOR
IGC	INTEGRATED GAS CONTROL
IRH	INDOOR RELATIVE HUMIDITY
LA	LOW AMBIENT LOCKOUT
LAR	LOW AMBIENT RELAY
LAS	LOW AMBIENT SWITCH
LDV	LIQUID DIVERTER VALVE (3-WAY)
LOOP PWR	CURRENT LOOP POWER
LPS	LOW PRESSURE SWITCH
LSM	LIMIT SWITCH (MANUAL RESET)
MGV	MAIN GAS VALVE
OAQ	OUTDOOR AIR QUALITY
OAT	OUTDOOR AIR TEMP. SENSOR
OFC	OUTDOOR FAN CONTACTOR
OFM	OUTDOOR FAN MOTOR
OFR	OUTDOOR FAN RELAY
OFTB	OUTDOOR FAN TERMINAL BLOCK
OLR	OVERLOAD RELAY
PER	POWER EXHAUST RELAY
PL	PLUG ASSEMBLY
POT	POTENTIOMETER
PWR	PHASE MONITOR RELAY
QT	QUADRUPLE TERMINAL
R	RELAY
RAT	RETURN AIR TEMP. SEN
RDV	REHEAT DISCHARGE VALVE
RMT OCC	REMOTE OCCUPANCY
RS	ROLLOUT SWITCH
RTPF	ROUND TUBE PLATE FIN CONDENSER COIL
SAT	SUPPLY AIR TEMP. SENSOR
SEN	SENSOR
SET	SET POINT OFFSET
SFS	SUPPLY FAN STATUS
TDR	TIME DELAY RELAY
TRAN	TRANSFORMER
VFD	VARIABLE FREQUENCY DRIVE

NOTES

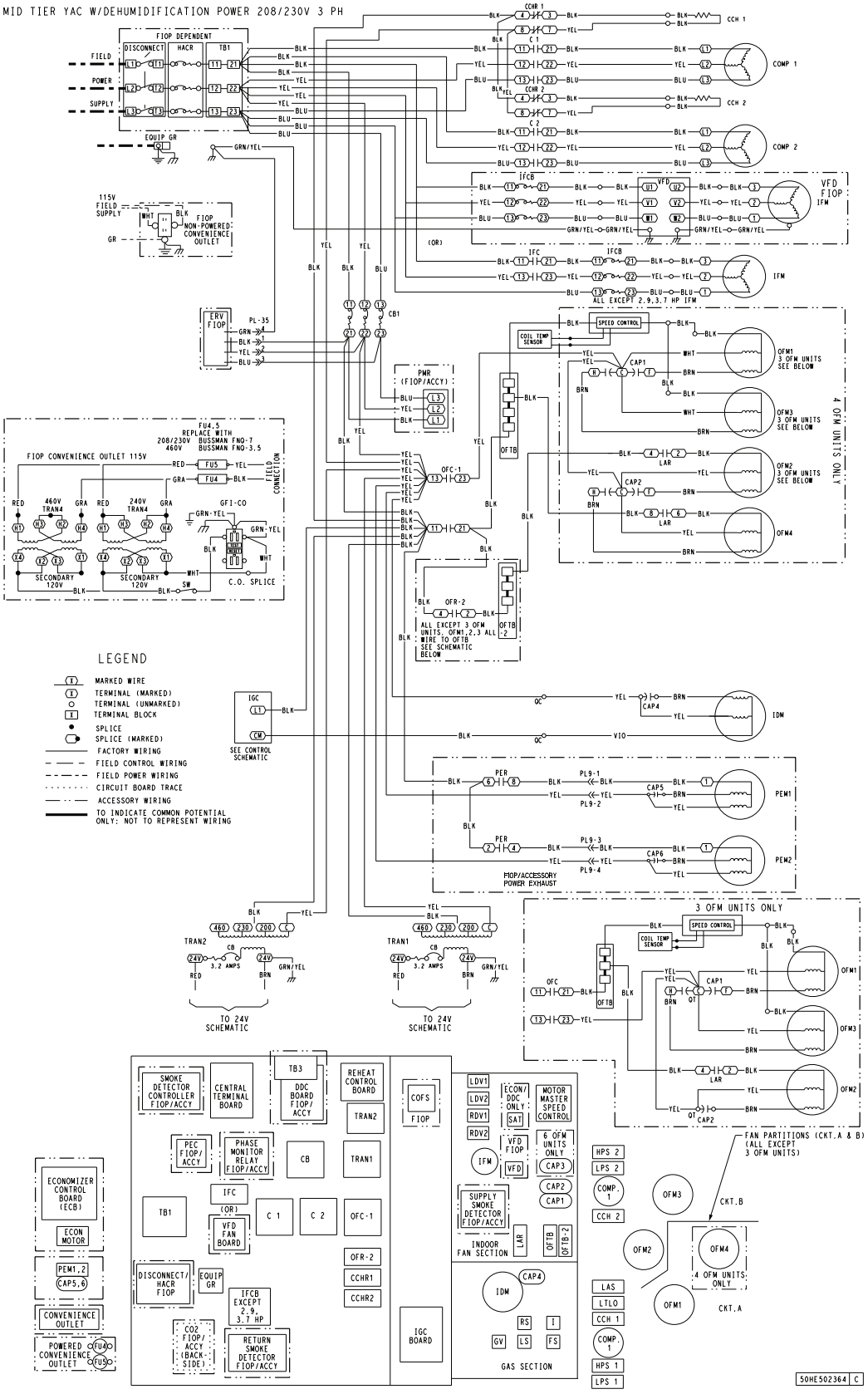
1. IF ANY OF THE ORIGINAL WIRE FURNISHED MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 90 C WIRE OR ITS EQUIVALENT.
2. COMPRESSOR AND FAN MOTORS ARE THERMALLY PROTECTED. THREE PHASE MOTORS ARE PROTECTED AGAINST PRIMARY SINGLE PHASING CONDITIONS.
3. 208/230V UNIT TRAN IS WIRED FOR 230V UNIT. IF UNIT IS TO BE RUN WITH 208V POWER SUPPLY DISCONNECT BLK WIRE FROM 230V TAP AND CONNECT TO 200V TAP.
4. USE COPPER CONDUCTOR ONLY.
5. IFM OL IS NOT USED ON ALL MODELS. WHEN NOT USED, RED LEADS ARE CONNECTED TOGETHER.

Typical wiring diagram (cont)

48HC 17-24 TYPICAL POWER WIRING DIAGRAM, 208/230V SHOWN

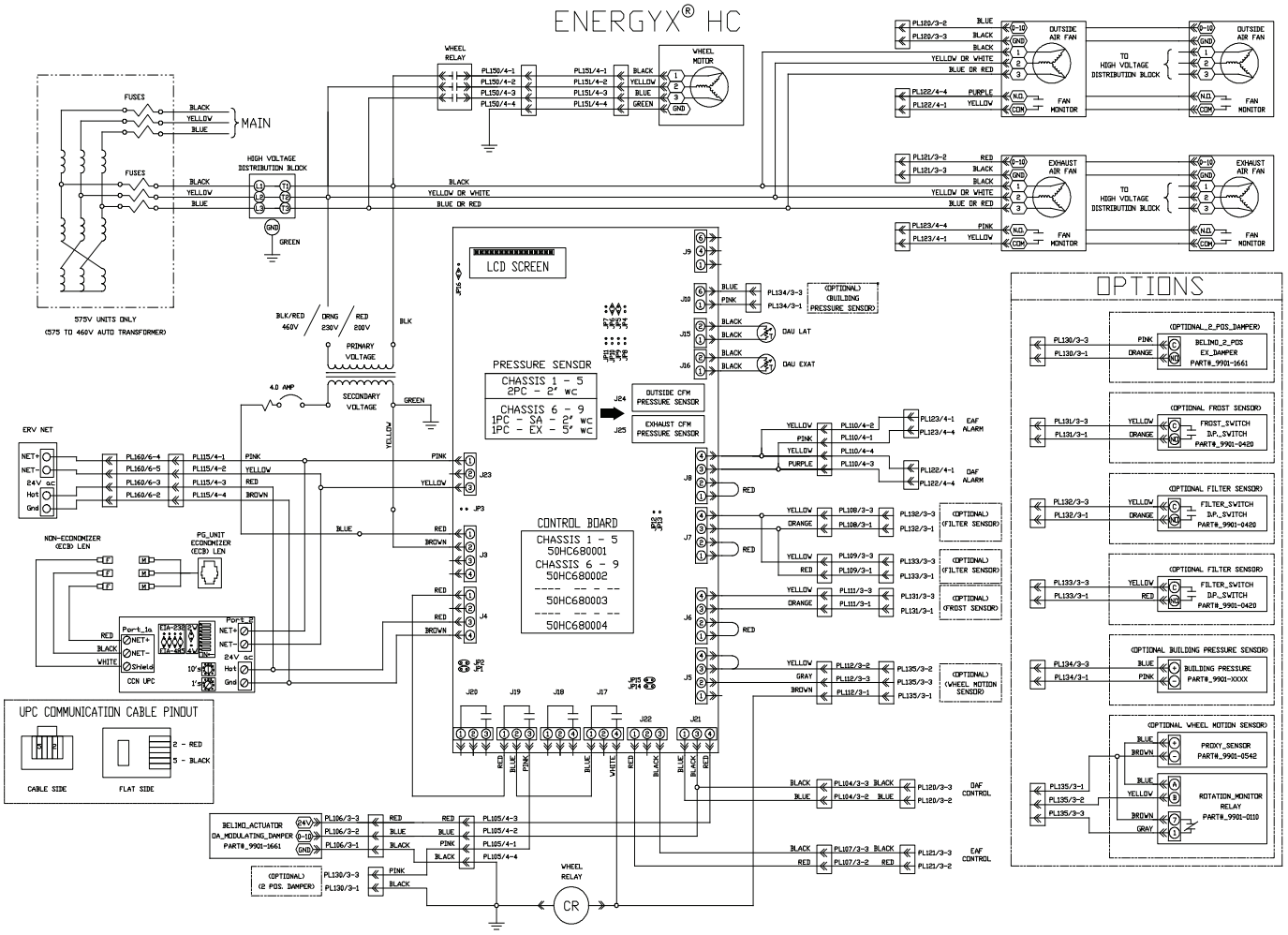


48HC 17-24 TYPICAL POWER WIRING DIAGRAM WITH OPTIONAL HUMIDI-MIZER® SYSTEM, 208/230V SHOWN



Typical wiring diagram (cont)

48HC MODULATING ERV WIRING SCHEMATIC



Electrical data

48HC**17-28 COOLING ELECTRICAL DATA — WITHOUT EnergyX®

48HC UNIT SIZE	V-Ph-Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (EA)		IFM			COMBUSTION FAN MOTOR	POWER EXHAUST	
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFFCY AT FULL LOAD	FLA	FLA	KIT QTY	FLA (EA KIT)
17	208-3-60	187	253	25.0	164	25.0	164	350	1.5	STD	81.3%	7.5	0.52	2	5.9
										MED	87.0%	10.6			
										HIGH	82.9%	13.6			
	230-3-60	187	253	25.0	164	25.0	164	350	1.5	STD	81.3%	7.5	0.52	2	5.9
										MED	87.0%	10.6			
										HIGH	82.9%	12.7			
	460-3-60	414	506	12.8	100	12.8	100	277	0.9	STD	81.3%	3.4	0.3	2	3.1
										MED	87.0%	5.3			
										HIGH	82.9%	6.4			
	575-3-60	518	633	9.6	78	9.6	48	397	0.6	STD	81.1%	2.8	0.24	2	2.4
										MED	81.1%	2.8			
										HIGH	83.6%	5.6			
20	208-3-60	187	253	27.6	191	25.0	164	350	1.5	STD	83.8%	10.2	0.52	2	5.9
										MED	82.9%	13.6			
										HIGH-HE	89.5%	17.1			
	230-3-60	187	253	27.6	191	25.0	164	350	1.5	STD	83.8%	10.2	0.52	2	5.9
										MED	82.9%	12.7			
										HIGH-HE	89.5%	17.1			
	460-3-60	414	506	12.8	100	12.2	100	277	0.9	STD	83.8%	4.8	0.3	2	3.1
										MED	82.9%	6.4			
										HIGH-HE	89.5%	8.6			
	575-3-60	518	633	9.6	78	9.0	78	397	0.6	STD	81.1%	2.8	0.24	2	2.4
										MED	83.6%	5.6			
										HIGH-HE	89.5%	7.6			
24	208-3-60	187	253	28.2	239	28.2	239	350	1.5	STD	89.5%	17.1	0.52	2	5.9
										MED-HE	89.5%	17.1			
										HIGH-HE	91.7%	28.5			
	230-3-60	187	253	28.2	239	28.2	239	350	1.5	STD	89.5%	17.1	0.52	2	5.9
										MED-HE	89.5%	17.1			
										HIGH-HE	91.7%	28.5			
	460-3-60	414	506	14.7	130	14.7	130	277	0.9	STD	89.5%	8.6	0.3	2	3.1
										MED-HE	89.5%	8.6			
										HIGH-HE	91.7%	14.3			
	575-3-60	518	633	11.3	94	11.3	94	397	0.6	STD	83.6%	5.6	0.24	2	2.4
										MED-HE	89.5%	7.6			
										HIGH-HE	91.7%	9.5			
28	208-3-60	187	253	48.1	245	33.9	240	350	1.5	STD	82.9%	13.6	0.52	2	5.9
										MED-HE	89.5%	17.1			
										HIGH-HE	91.7%	28.5			
	230-3-60	187	253	48.1	245	33.9	240	350	1.5	STD	82.9%	12.7	0.52	2	5.9
										MED-HE	89.5%	17.1			
										HIGH-HE	91.7%	28.5			
	460-3-60	414	506	18.6	125	16.0	140	277	0.9	STD	82.9%	6.4	0.3	2	3.1
										MED-HE	89.5%	8.6			
										HIGH-HE	91.7%	14.3			
	575-3-60	518	633	14.7	100	12.9	108	397	0.6	STD	83.6%	5.6	0.24	2	2.4
										MED-HE	89.5%	7.6			
										HIGH-HE	91.7%	9.5			

LEGEND

EA — Entering Air
FLA — Full Load Amps
HIGH-HE — High-High Efficiency
IFM — Indoor (Evaporator) Fan Motor
LRA — Locked Rotor Amps
MED-HE — Medium-High Efficiency
OFM — Outdoor Fan Motor
RLA — Rated Load Amps

NOTE: Refer to Packaged Rooftop Builder (Selection Software) for additional electrical data specific to EnergyX units.

Electrical data (cont)

48HC**17-28 WITH TWO-SPEED BLOWER COOLING ELECTRICAL DATA — WITHOUT EnergyX

48HC UNIT SIZE	V-Ph-Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (EA)		IFM			COMBUSTION FAN MOTOR	POWER EXHAUST	
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	EFFCY AT FULL LOAD	FLA	FLA	KIT QTY	FLA (EA KIT)
17	208-3-60	187	253	25.0	164	25.0	164	350	1.5	STD	85.0%	8.6	0.52	2	5.9
										MED	81.5%	10.8			
										HIGH	83.6%	13.6			
	230-3-60	187	253	25.0	164	25.0	164	350	1.5	STD	85.0%	7.8	0.52	2	5.9
										MED	81.5%	9.8			
										HIGH	83.6%	12.7			
	460-3-60	414	506	12.8	100	12.8	100	277	0.9	STD	85.0%	3.8	0.3	2	3.1
										MED	81.5%	4.9			
										HIGH	83.6%	6.4			
	575-3-60	518	633	9.6	78	9.6	78	397	0.6	STD	81.1%	4.5	0.24	2	2.4
										MED	81.1%	4.5			
										HIGH	83.6%	6.2			
20	208-3-60	187	253	27.6	191	25.0	164	350	1.5	STD	81.5%	10.8	0.52	2	5.9
										MED	83.6%	13.6			
										HIGH	89.5%	17.1			
	230-3-60	187	253	27.6	191	25.0	164	350	1.5	STD	81.5%	9.8	0.52	2	5.9
										MED	83.6%	12.7			
										HIGH	89.5%	17.1			
	460-3-60	414	506	12.8	100	12.2	100	277	0.9	STD	81.5%	4.9	0.3	2	3.1
										MED	83.6%	6.4			
										HIGH	89.5%	8.6			
	575-3-60	518	633	9.6	78	9.0	78	397	0.6	STD	81.1%	4.5	0.24	2	2.4
										MED	83.6%	6.2			
										HIGH	89.5%	7.6			
24	208-3-60	187	253	28.2	239	28.2	239	350	1.5	STD	83.6%	13.6	0.52	2	5.9
										MED	89.5%	17.1			
										HIGH	91.7%	28.5			
	230-3-60	187	253	28.2	239	28.2	239	350	1.5	STD	83.6%	12.7	0.52	2	5.9
										MED	89.5%	17.1			
										HIGH	91.7%	28.5			
	460-3-60	414	506	14.7	130	14.7	130	277	0.9	STD	83.6%	6.4	0.3	2	3.1
										MED	89.5%	8.6			
										HIGH	91.7%	14.3			
	575-3-60	518	633	11.3	94	11.3	94	397	0.6	STD	83.6%	6.2	0.24	2	2.4
										MED	89.5%	7.6			
										HIGH	91.7%	9.5			
28	208-3-60	187	253	48.1	245	33.9	240	350	1.5	STD	83.6%	13.6	0.52	2	5.9
										MED	89.5%	17.1			
										HIGH	91.7%	28.5			
	230-3-60	187	253	48.1	245	33.9	240	350	1.5	STD	83.6%	12.7	0.52	2	5.9
										MED	89.5%	17.1			
										HIGH	91.7%	28.5			
	460-3-60	414	506	18.6	125	16.0	140	277	0.9	STD	83.6%	6.4	0.3	2	3.1
										MED	89.5%	8.6			
										HIGH	91.7%	14.3			
	575-3-60	518	633	14.7	100	12.9	108	397	0.6	STD	83.6%	6.2	0.24	2	2.4
										MED	89.5%	7.6			
										HIGH	91.7%	9.5			

LEGEND

EA — Entering Air
FLA — Full Load Amps
HIGH-HE — High-High Efficiency
IFM — Indoor (Evaporator) Fan Motor
LRA — Locked Rotor Amps
MED-HE — Medium-High Efficiency
OFM — Outdoor Fan Motor
RLA — Rated Load Amps

NOTE: Refer to Packaged Rooftop Builder (Selection Software) for additional electrical data specific to EnergyX units.

48HC**17-28 MCA MOCP ELECTRICAL DATA — WITHOUT EnergyX

48HC UNIT TYPE	NOM. V-Ph-Hz	IFM TYPE	NO CONVENIENCE OUTLET OR UNPOWERED CONVENIENCE OUTLET								WITH POWERED CONVENIENCE OUTLET							
			NO POWERED EXHAUST				WITH POWERED EXHAUST (POWERED FROM UNIT)				NO POWERED EXHAUST				WITH POWERED EXHAUST (POWERED FROM UNIT)			
			MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE		MCA	HACR BRKR	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
17	208/230-3-60	STD	68.3	90	71	393	80.1	100	85	413	73.1	90	77	398	84.9	100	90	68.3
		MED	71.4	90	75	423	83.2	100	88	443	76.2	100	80	428	88.0	100	94	71.4
		HIGH	74.4	90	78/77	425	86.2	100	92/91	445	79.2	100	84/83	430	91.0	100	97/96	74.4
	460-3-60	STD	34.9	45	36	234	41.1	50	44	246	37.1	45	39	236	43.3	50	46	34.9
		MED	36.8	45	39	249	43.0	50	46	261	39.0	50	41	251	45.2	50	48	36.8
		HIGH	37.9	50	40	250	44.1	50	47	262	40.1	50	42	252	46.3	50	50	37.9
	575-3-60	STD	26.2	30	27	184	31.0	40	33	192	27.9	35	29	186	32.7	40	35	26.2
		MED	26.2	30	27	184	31.0	40	33	192	27.9	35	29	186	32.7	40	35	26.2
		HIGH	29.0	35	31	198	33.8	40	36	206	30.7	40	33	200	35.5	45	38	29.0
20	208/230-3-60	STD	75.7	100	79	440	87.5	100	93	460	80.5	100	85	445	92.3	100	98	75.7
		MED	79.1	100	83/82	455	90.9	100	97/96	475	83.9	100	89/88	460	95.7	110	102/101	79.1
		HIGH-HE	82.6	100	87	451	94.4	110	101	471	87.4	100	93	456	99.2	125	106	82.6
	460-3-60	STD	36.6	45	38	245	42.8	50	46	257	38.8	50	41	247	45.0	50	48	36.6
		MED	38.2	50	40	252	44.4	50	47	264	40.4	50	43	254	46.6	50	50	38.2
		HIGH-HE	40.4	50	43	250	46.6	50	50	262	42.6	50	45	252	48.8	60	52	40.4
	575-3-60	STD	26.2	30	27	186	31.0	40	33	194	27.9	35	29	188	32.7	40	35	26.2
		MED	29.0	35	31	200	33.8	40	36	208	30.7	40	33	202	35.5	45	38	29.0
		HIGH-HE	31.0	40	33	198	35.8	45	38	206	32.7	40	35	200	37.5	45	40	31.0
24	208/230-3-60	STD	86.6	100	91	574	98.4	125	105	594	91.4	100	97	579	103.2	125	111	86.6
		MED-HE	86.6	100	91	574	98.4	125	105	594	91.4	100	97	579	103.2	125	111	86.6
		HIGH-HE	98.0	125	105	653	109.8	125	118	673	102.8	125	110	658	114.6	125	124	98.0
	460-3-60	STD	45.3	50	48	310	51.5	60	55	322	47.5	60	50	312	53.7	60	58	45.3
		MED-HE	45.3	50	48	310	51.5	60	55	322	47.5	60	50	312	53.7	60	58	45.3
		HIGH-HE	51.0	60	54	350	57.2	70	62	362	53.2	60	57	352	59.4	70	64	51.0
	575-3-60	STD	33.4	40	35	232	38.2	45	41	240	35.1	45	37	234	39.9	50	43	33.4
		MED-HE	35.4	45	37	230	40.2	50	43	238	37.1	45	39	232	41.9	50	45	35.4
		HIGH-HE	37.3	45	40	257	42.1	50	45	265	39.0	50	42	259	43.8	50	47	37.3
28	208/230-3-60	STD	116.6	150	120/119	591	128.4	175/175	134/133	611	121.4	150/150	126/125	596	133.2	175/175	139/138	116.6
		MED-HE	120.1	150	124	587	131.9	175	138	607	124.9	150	130	592	136.7	175	143	120.1
		HIGH-HE	131.5	175	137	666	143.3	175	151	686	136.3	175	143	671	148.1	175	157	131.5
	460-3-60	STD	51.1	60	53	321	57.3	70	60	333	53.3	60	56	323	59.5	70	63	51.1
		MED-HE	53.3	60	56	319	59.5	70	63	331	55.5	70	58	321	61.7	80	66	53.3
		HIGH-HE	59.0	70	62	359	65.2	80	70	371	61.2	70	65	361	67.4	80	72	59.0
	575-3-60	STD	40.5	50	42	256	45.3	50	48	264	42.2	50	44	258	47.0	60	50	40.5
		MED-HE	42.5	50	45	254	47.3	60	50	262	44.2	50	47	256	49.0	60	52	42.5
		HIGH-HE	44.4	50	47	281	49.2	60	52	289	46.1	60	49	283	50.9	60	54	44.4

LEGEND

BRKR — Circuit Breaker
DISC — Disconnect
FLA — Full Load Amps
HACR — Heating Air-conditioning And Refrigeration
IFM — Indoor Fan Motor
LRA — Locked Rotor Amps
MCA — Minimum Circuit Amps
RLA — Rated Load Amps

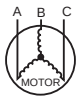
NOTES:

1. Refer to Packaged Rooftop Builder (Selection Software) for additional electrical data specific to EnergyX units.
2. In compliance with NEC requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker. Canadian units may be fuse or circuit breaker.
3. For 208/230 v units, where one value is shown it is the same for either 208 or 230 volts.
4. Unbalanced 3-Phase Supply Voltage

   Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

Example: Supply voltage is 230-3-60



AB = 224 v
BC = 231 v
AC = 226 v

$$\text{Average Voltage} = \frac{(224 + 231 + 226)}{3} = \frac{681}{3} = 227$$

Determine maximum deviation from average voltage.
(AB) 227-224 = 3 v
(BC) 231-227 = 4 v
(AC) 227-226 = 1 v
Maximum deviation is 4 v.
Determine percent of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{4}{227} = 1.78\%$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.

IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

General — The sequence below describes the sequence of operation for an electro-mechanical unit with and without a factory-installed EconoMi$er® IV and X (called "economizer" in this sequence). For information regarding a direct digital controller, see the start-up, operations, and troubleshooting manual for the applicable controller.

Electro• Mechanical Units with No Economizer

Cooling (Single Speed Indoor Fan Motor) — When the thermostat calls for cooling, terminals G and Y1 are energized. As a result, the indoor-fan contactor (IFC) and the compressor contactor (C1) are energized, causing the indoor-fan motor (IFM), compressor #1, and outdoor fan to start. If the unit has 2 stages of cooling, the thermostat will additionally energize Y2. The Y2 signal will energize compressor contactor #2 (C2), causing compressor #2 to start. Regardless of the number of stages, the outdoor-fan motor runs continuously while unit is cooling.

Cooling (2• speed indoor fan motor) — Per ASHRAE 90.1-2016 standards during the first stage of cooling operation the VFD will adjust the fan motor to provide 66% of the total cfm established for the unit. When a call for the second stage of cooling is required, the VFD will allow the total cfm established for the unit (100%).

Heating

NOTE: WeatherMaster® units have either 1 or 2 stages of gas heat.

When the thermostat calls for heating, power is sent to W on the Integrated Gas Controller (IGC) board. An LED (light-emitting diode) on the IGC board turns on and remains on during normal operation. A check is made to ensure that the roll-out switch and limit switch are closed. If the check was successful, the induced-draft motor is energized, and when its speed is satisfactory, as proven by the flue gas pressure switch, the ignition activation period begins. The burners will ignite within 5 seconds. If the burners do not light, there is a 22-second delay before another 5-second attempt. This sequence is repeated for 15 minutes or until the burners light. If, after the 15 minutes, the burners still have not lit, heating is locked out. To reset the control, break 24 V power to the thermostat.

When ignition occurs, the IGC board will continue to monitor the condition of the roll-out switch, the limit switches, the flue gas pressure switch, as well as the flame sensor. 45 seconds after ignition occurs, assuming the unit is controlled through a room thermostat set for fan auto, the indoor-fan motor will energize (and the outdoor-air dampers will open to their minimum position). If, for some reason, the over-temperature limit opens prior to the start of the indoor fan blower, the unit will shorten the 45-second delay to 5 seconds less than the time from initiation of heat to when the limit tripped. Gas will not be interrupted to the burners and heating will continue. Once the fan-on delay has been modified, it will not change back to 45 seconds until power is reset to the control. On units with 2 stages of heat, when additional heat is required, W2 closes and initiates power to the second stage of the main gas valve. When the thermostat is satisfied, W1 and W2 open and the gas valve closes, interrupting the flow of gas to the main burners. If the call for W1 lasted less than 1 minute, the heating cycle will not terminate until 1 minute after W1 became active. If the unit is controlled through a room thermostat set for fan auto, the indoor-fan motor will continue to operate for an additional 45 seconds then stop. If the over-temperature limit opens after the indoor motor is stopped, but within 10 minutes of W1 becoming inactive, on the next cycle the time will be extended by 15 seconds. The maximum delay is 3 minutes. Once modified, the fan off delay will not change back to 45 seconds unless power is reset to the control. An LED indicator is provided on the IGC to monitor operation.

Electro• mechanical Units with Factory-Installed Economi$er Cooling (Single Speed Indoor Fan Motor, Non-EnergyX units)

Cooling — When free cooling is not available, the compressors will be controlled by the zone thermostat. When free cooling is available, the outdoor-air damper is modulated by the EconoMi$er IV and X control to provide a 50°F (10°C) to 55°F (13°C) mixed-air temperature into the zone. As the mixed air temperature fluctuates above 55°F (13°C) or below 50°F (10°C) dampers will be modulated (open or close) to bring the mixed-air temperature back within control. If mechanical cooling is utilized with free cooling, the outdoor-air damper will maintain its current position at the time the compressor is started. If the increase in cooling capacity causes the mixed-air temperature to drop below 45°F (7°C), then the outdoor-air damper position will be decreased to the minimum position. If the mixed-air temperature continues to fall, the outdoor-air damper will close. Control returns to normal once the mixed-air temperature rises above 48°F (9°C). The power exhaust fans will be energized and de-energized, if installed, as the outdoor-air damper opens and closes

If field-installed accessory CO_2 sensors are connected to the EconoMi$er IV and X control, a demand controlled ventilation strategy will begin to operate. As the CO_2 level in the zone increases above the CO_2 set-point, the minimum position of the damper will be increased proportionally. As the CO_2 level decreases because of the increase in fresh air, the outdoor-air damper will be proportionally closed. For EconoMi$er IV and X operation, there must be a thermostat call for the fan (G). If the unit is occupied and the fan is on, the damper will operate at minimum position. Otherwise, the damper will be closed.

When the EconoMi$er IV and X control is in the occupied mode and a call for cooling exists (Y1 on the thermostat), the control will first check for indoor fan operation. If the fan is not on, then cooling will not be activated. If the fan is on, then the control will open the EconoMi$er IV and X damper to the minimum position.

On the initial power to the EconoMi$er IV and X control, it will take the damper up to 2 $^1/_2$ minutes before it begins to position itself. After the initial power-up, further changes in damper position can take up to 30 seconds to initiate. Damper movement from full closed to full open (or vice versa) will take between 1 $^1/_2$ and 2 $^1/_2$ minutes. If free cooling can be used as determined from the appropriate changeover command (switch, dry bulb, enthalpy curve, differential dry bulb, or differential enthalpy), then the control will modulate the dampers open to maintain the

mixed-air temperature set-point at 50°F (10°C) to 55°F (13°C). If there is a further demand for cooling (cooling second stage • Y2 is energized), then the control will bring on compressor stage 1 to maintain the mixed-air temperature set-point. The EconoMi$er IV and X damper will be open at maximum position.

2• Speed Note: When operating in ventilation mode only, the indoor fan motor will automatically adjust to 66% of the total cfm established.

Heating — The sequence of operation for the heating is the same as an electro-mechanical unit with no economizer. The only difference is how the economizer acts. The economizer will stay at the Economizer Minimum Position while the evaporator fan is operating. The outdoor-air damper is closed when the indoor fan is not operating. Refer to Service and Maintenance Manual for further details.

Optional Humidi-MiZer® Dehumidification System — Units with the factory equipped Humidi-MiZer system option are capable of providing multiple modes of improved dehumidification as a variation of the normal cooling cycle. The Humidi-MiZer system option includes additional valves in the liquid line and discharge line of each refrigerant circuit, a small reheat condenser coil downstream of the evaporator, and Motormaster® variable-speed control of some or all outdoor fans. Operation of the revised refrigerant circuit for each mode is described below.

The Humidi-MiZer system provides three sub-modes of operation: Cool, Reheat1, and Reheat2.

Cool mode — Provides a normal ratio of Sensible and Latent Cooling effect from the evaporator coil.

Reheat1 — Provides increased Latent Cooling while slightly reducing the Sensible Cooling effect.

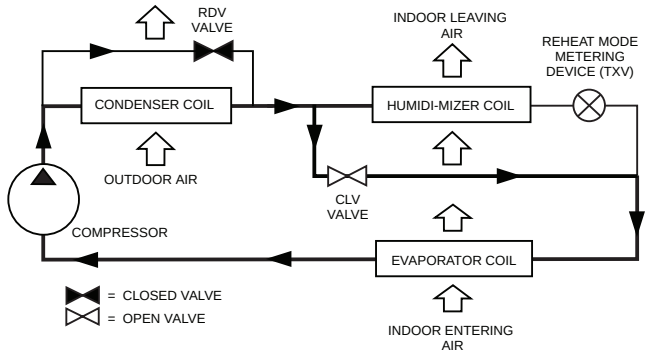
Reheat2 — Provides normal Latent Cooling but with null or minimum Sensible Cooling effect delivered to the space.

The Reheat1 and Reheat2 modes are available when the unit is not in a Heating mode and when the Low Ambient Lockout switch is closed.

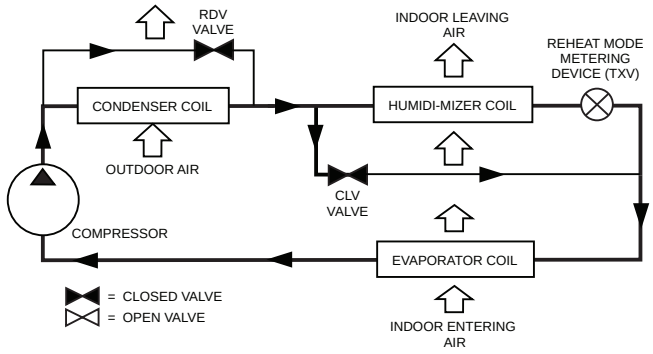
The figures on this page depict piping for single stage cooling units.

RTU Open Controller (Factory Option) — For details on operating 48HC units equipped with the factory-installed RTU Open controller option refer to Factory Installed RTU Open Multi-Protocol Controller Controls, Start-Up, Operation and Troubleshooting manual.

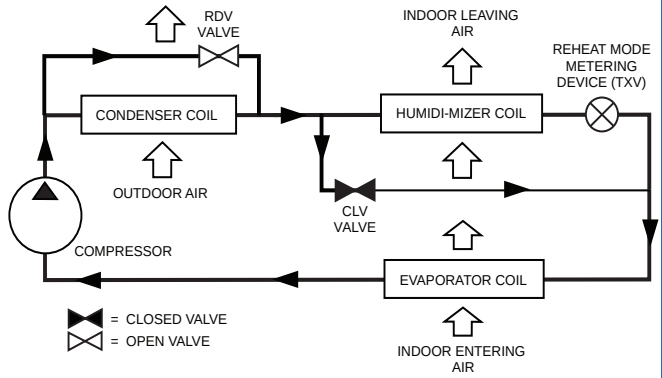
NORMAL COOLING MODE — HUMIDI-MIZER® SYSTEM WITH SINGLE STAGE COOLING



SUBCOOLING MODE (REHEAT 1) — HUMIDI-MIZER SYSTEM WITH SINGLE STAGE COOLING



HOT GAS REHEAT MODE (REHEAT2) — HUMIDI-MIZER SYSTEM WITH SINGLE STAGE COOLING



Application data

Minimum Operating Ambient Temperature (Cooling) — In mechanical cooling mode, your Carrier rooftop unit can safely operate down to an outdoor ambient temperature of 35°F (2°C). It is possible to provide cooling at lower outdoor ambient temperatures by using less outside air, economizers, and/or accessory low ambient kits.

Maximum Operating Ambient Temperature (Cooling) — The maximum operating ambient temperature for cooling mode is 125°F (52°C). While cooling operation above 125°F (52°C) may be possible, it could cause either a reduction in performance, reliability, or a protective action by the unit's internal safety devices.

Minimum Mixed Air Temperature (Heating) — Using the factory settings, the minimum temperatures for the mixed air (the combined temperature of the warm return air and the cold outdoor air) entering the dimpled, gas heat exchangers are shown in the table below.

MINIMUM MIXED AIR TEMPERATURE

ALUMINIZED	STAINLESS STEEL
50°F (10°C) Continuous	40°F (4°C) Continuous
45°F (7°C) Intermittent	35°F (2°C) Intermittent

Operating at lower mixed-air temperatures may be possible, if a field-supplied, outdoor air thermostat initiates both heat stages when the temperature is less than the minimum temperatures listed above. Please contact your local Carrier representative for assistance.

Minimum and Maximum Airflow (Heating and Cooling) — To maintain safe and reliable operation of your rooftop, operate within the heating airflow limits during heating mode and cooling airflow limits during cooling mode. Operating above the max may cause blow-off, undesired airflow noise, or airflow related problems with the rooftop unit. Operating below the min may cause problems with coil freeze-up and unsafe heating operation. Heating and cooling limitations differ when evaluating operating CFM, the minimum value is the HIGHER of the cooling and heating minimum CFM values published on page 5 and the maximum value is the LOWER of the cooling and heating minimum values published on page 5.

Heating-To-Cooling Changeover — Your unit will automatically change from heating to cooling mode when using a thermostat with an auto-changeover feature.

Airflow — All units are draw-though in cooling mode and blow-through in heating mode.

Outdoor Air Application Strategies — Economizers reduce operating expenses and compressor run time by providing a free source of cooling and a means of ventilation to match application changing needs. In fact, they should be considered for most applications. Also, consider the various economizer control methods and their benefits, as well as sensors required to accomplish your application goals. Please contact your local Carrier representative for assistance.

Motor Limits, Break Horsepower (BHP) — Due to internal design of Carrier units, the air path, and specially designed motors, the full horsepower (maximum continuous BHP) band, as listed in the Fan Performance tables, can be used with the utmost confidence. There is no need for extra safety factors, as Carrier motors are designed and rigorously tested to use the entire, listed BHP range without either nuisance tripping or premature motor failure.

Propane Heating — Propane has different physical qualities than natural gas. As a result, propane requires different fuel to air mixture. To optimize the fuel/air mixture for propane, Carrier sells different burner orifices in an easy to install accessory kit. To select the correct burner orifices or determine the heat capacity for a propane application, use either the selection software, or the unit's service manual.

High Altitude Heating — High altitudes have less oxygen, which affects the fuel/air mixture in heat exchangers. In order to maintain a proper fuel/air mixture, heat exchangers operating in altitudes above 2000 ft (610 m) require different orifices. To select the correct burner orifices or determine the heat capacity for a high altitude application, use either the selection software, or the unit's service manual.

High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion on altitudes above 2000 ft (610 m).

NOTE: Typical natural gas heating value ranges from 975 to 1050 Btu/ft^3 at sea level nationally. The heating value goes down approximately 1.7% per every thousand feet elevation. Standard factory orifices can typically be used up to 2000 ft (610 m) elevation without any operational issues.

The optional Carrier economizer can adequately cool your space by bringing in fresh, cool outside air. In fact, when so equipped, accessory low-ambient kit may not be necessary. In low ambient conditions, unless the outdoor air is excessively humid or contaminated, economizer-based "free cooling" is the preferred less costly and energy conscious method. In low ambient applications where outside air might not be desired (such as contaminated or excessively humid outdoor environments), your Carrier rooftop can operate to ambient temperatures down to –20°F (–29°C) using the recommended accessory Motormaster® low ambient controller.

Sizing a Rooftop — Bigger isn't necessarily better. While an air conditioner needs to have enough capacity to meet the design loads, it doesn't need excess capacity. In fact, excess capacity typically results in very poor part load performance and humidity control.

Using higher design temperatures than ASHRAE recommends for your location, adding "safety factors" to the calculated load, are all signs of oversizing air conditioners. Oversizing the air conditioner leads to poor humidity control, reduced efficiency, higher utility bills, larger indoor temperature swings, excessive noise, and increased wear and tear on the air conditioner.

Rather than oversizing an air conditioner, engineers should "right-size" or even slightly undersize air conditioners. Correctly sizing an air conditioner controls humidity better;

promotes efficiency; reduces utility bills; extends equipment life, and maintains even, comfortable temperatures. Please contact your local Carrier representative for assistance.

Low Ambient Applications — The optional Carrier economizer can adequately cool your space by bringing in fresh, cool outside air. In fact, when so equipped, accessory low-ambient kit may not be necessary. In low ambient conditions, unless the outdoor air is excessively humid or contaminated, economizer-based "free cooling" is the preferred less costly and energy conscious method. In low ambient applications where outside air might not be desired (such as contaminated or excessively humid outdoor environments), your Carrier rooftop can operate to ambient temperatures down to –20°F (–29°C) using the recommended accessory Motormaster® low ambient controller.

Staged Air Volume (SAV™) System with VFD Controller (2-Stage Cooling Models Only) — Carrier's staged air volume (SAV) system saves energy and installation time by utilizing a variable frequency drive (VFD) to automatically adjust the indoor fan motor speed in sequence with the units cooling operation. Per ASHRAE 90.1-2016 and IECC-2015, during the first stage of cooling operation the VFD will adjust the fan motor to provide two-thirds of the total cfm established for the unit. When a call for the second stage of cooling is required, the VFD will allow the total cfm for the unit established (100%). During the heating mode the VFD will allow total design cfm (100%) operation and during the ventilation mode the VFD will allow operation to two-thirds of total cfm.

Compared to single speed indoor fan motor systems, Carrier's SAV system can save substantial energy, 25%+, versus single speed indoor fan motor systems.

IMPORTANT: Data based on .10 ($/kWh) in an office application utilizing Carrier's HAP 4.6 simulation software program.

The VFD used in Carrier's SAV system has soft start capabilities to slowly ramp up the speeds, thus eliminating any high inrush air volume during initial start-up. It also has internal over current protection for the fan motor and a field installed display kit that allows adjustment and in depth diagnostics of the VFD.

This SAV system is available on models with 2-stage cooling operation.The SAV system is very flexible for initial fan performance set up and adjustment. The standard factory shipped VFD is pre-programmed to automatically stage the fan speed between the first and second stage of cooling. The unit fan performance static pressure and cfm can be easily adjusted using the traditional means of pulley adjustments. The other means to adjust the unit static and cfm performance is to utilize the field-installed display kit and adjust the frequency and voltage in the VFD to required performance requirements. In either case, once set up, the VFD will automatically adjust the speed between the cooling stage operations.

48HC STAGED AIR VOLUME (SAV) — VARIABLE FREQUENCY DRIVE (VFD) HP RATING

UNIT SIZE	STATIC OPTION	VOLTAGE	VFD HP
17	STD	208/230	3.0
		460	3.0
		575	5.0
	MED	208/230	3.0
		460	5.0
		575	5.0
	HIGH	208/230	7.5
		460	
		575	
20	STD	208/230	3.0
		460	5.0
		575	5.0
	MED	208/230	7.5
		460	
		575	
	HIGH	208/230	7.5
		460	
		575	
24	STD	208/230/460/575	7.5
	MED	208/230/460/575	7.5
	HIGH	208/230/460/575	7.5
28	STD	208/230/460/575	7.5
	MED	208/230/460/575	7.5
	HIGH	208/230/460/575	7.5

Optional EnergyX Energy Recovery Ventilator (ERV) Application Data

When selecting the WeatherMaster Series Unit and EnergyX system to use on a given application, it is strongly recommended that the Carrier Packaged RTU Builder (PRB) Selection Software be used. This is because there are a number of variables which become complex when manual calculations are performed, but can easily be accounted for in a computer operation. Most specifically, the AHRI certified ratings use Standard CFM values, but due to real world operation, variances in altitude and air density are very important. The Carrier PRB software uses altitude corrected airflows (ACFM).

See Carrier's Packaged Rooftop Builder selection software for automated calculation of unit selection and Combined Efficiency Factor (CEF) values.

Typical Energy Recovery unit selection involves the following steps:

1. Determine the zone cooling and heating requirements at the design conditions.
2. Select Energy Recovery unit based on desired outdoor airflow rate.

NOTE: It is recommended that the outdoor airflow and exhaust airflow rates be designed at the same or close to the same value. If the difference between the two airflows becomes large enough, the energy recovery unit's cooling capacity, heating capacity and overall efficiency will be negatively impacted.

3. Calculate the Energy Recovery unit's leaving air conditions and unit capacities based on the outside airflow rate, temperature (db and wb) and exhaust

airflow rate and temperatures (db and wb) at the design temperatures and maximum ventilation rate.

4. Subtract the Energy Recovery unit's cooling and heating capacities from the design zone requirements. The value that remains is the necessary design size of the rooftop unit.
5. Use the Energy Recovery unit's leaving air temperatures (db and wb) as the ventilation air temperatures entering the rooftop unit to be mixed with the return air before passing through the rooftop unit's evaporator.
6. After selecting the desired Energy Recovery unit and rooftop unit, use AHRI's Guideline V to calculate the Combine Efficiency Factor (system EER). Additional information on Energy Recovery capacity calculations and leaving air temperature calculations can be found in the two AHRI documents below:

AHRI Guideline V — Calculating the efficiency of energy recovery ventilation and its effect on efficiency and sizing of building HVAC systems

AHRI Standard 1060 — Performance rating of air-to-air heat exchangers for energy recovery ventilation equipment

AirXchange Energy Recovery Cassette — UL certified, AHRI listed, silica gel enthalpy desiccant, wheels greater than 25-in. diameter are segmented for easy cleaning, washable with detergent and water, 5 year standard limited warranty.

EnergyX Operation — Energy recovery wheels rotate between the incoming outdoor airstream and the building exhaust airstream. As the wheel rotates, it transfers heat and moisture from one airstream to the other. Result = outdoor air is pre-conditioned, significantly reducing the capacity and energy needed from the mechanical HVAC system.

EnergyX Factory Installed Accessories

Economizer option — Allows true modulating economizer capability when OA is suitable for free cooling

- operates as a true wheel bypass damper
- uses stop/jog operation for wheel
- required when using CO_2 sensor for DCV operation

Frost control option — Uses exhaust air to defrost the wheel when necessary.

EnergyX System ComfortLink V5 integrated controls — All ERV configuration, setup and troubleshooting is done via ComfortLink controls.

- Modulating OA ventilation damper
- New "Outside Air Unit" points table
- New control functions for accessory devices:
  Cold air tempering kit
  Exhaust fan building pressure control
  2-position exhaust damper

EnergyX Field-Installed Accessories

Horizontal Roofcurb Adapters — Used when horizontal supply and/or return is desired.

Motor Status Indicator Accessory — Monitors wheel, supply and exhaust motors and provides indication if not operating.

Filter Status Indicator Accessory — Monitors static pressure across supply and exhaust filters and provides indication when filters become clogged.

Motorized Exhaust Damper Accessory — Replaces the standard barometric exhaust damper blades with motorized (open/shut) damper.

Application/Selection Option — Selection software by Carrier saves time by performing many of the steps above. Contact your Carrier sales representative for assistance.

Guide specifications

"Masterformat" as published by the Construction Specification Institute. Please feel free to copy this specification directly into your building spec.

WeatherMaster® Gas Heat/Electric Cooling Packaged Rooftop

HVAC guide specifications

Size range: **15 to 25 Nominal Tons**

Carrier Model Number: **48HC*17-28**

Part 1 — (23 06 80) Schedules for decentralized HVAC equipment

1.01 (23 06 80.13) Decentralized Unitary HVAC Equipment Schedule

A. (23 06 80.13.A.) Rooftop unit (RTU) schedule

Schedule is per the project specification requirements.

Part 2 — (23 07 16) HVAC equipment insulation

2.01 (23 07 16.13) Decentralized, Rooftop Units:

A. (23 07 16.13.A.) Evaporator fan compartment:

1. Interior cabinet surfaces shall be insulated with a minimum $^1/_2$-in. thick, minimum 1 $^1/_2$-lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
3. Unit internal insulation linings shall be resistant to mold growth in accordance with "mold growth and humidity" test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the "Erosion Test" in UL 181, as part of ASTM C1071.

B. (23 07 16.13.B.) Gas heat compartment:

1. Aluminum foil-faced fiberglass insulation shall be used.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

Part 3 — (23 09 13) Instrumentation and control devices for HVAC

3.01 (23 09 13.23) Sensors and Transmitters

A. (23 09 13.23.A.) Thermostats

1. Thermostat must
   a. energize both "W" and "G" when calling for heat.
   b. have capability to energize 2 different stages of cooling, and 2 different stages of heating.
   c. include capability for occupancy scheduling.

Part 4 — (23 09 23) Direct-digital control system for HVAC

4.01 (23 09 23.13) Decentralized, Rooftop Units:

A. (23 09 23.13.A.) PremierLink™ controller

1. Shall be ASHRAE 62 compliant.
2. Shall accept 18-32 VAC input power.
3. Shall have an operating temperature range from –40°F (–40°C) to 158°F (70°C), 10% to 95% RH (non-condensing).
4. Shall include an integrated economizer controller to support an economizer with 4 to 20 mA actuator input and no microprocessor controller.
5. Controller shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, indoor relative humidity, compressor lock-out, fire shutdown, enthalpy, fan status, remote time clock/door switch.
6. Shall accept a CO_2 sensor in the conditioned space, and be Demand Controlled Ventilation (DCV) ready.
7. Shall provide the following outputs: economizer, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, heat stage 3/exhaust/ reversing valve/ dehumidify/ occupied.
8. Unit shall provide surge protection for the controller through a circuit breaker.
9. Shall be Internet capable, and communicate at a Baud rate of 38.4K or faster.
10. Shall have an LED display independently showing the status of activity on the communication bus, and processor operation.
11. Shall include an EIA-485 protocol communication port, an access port for connection of either a computer or a Carrier technician tool, an EIA-485 port for network communication to intelligent space sensors and displays, and a port to connect an optional LonWorks[1] plug-in communications card.
12. Shall have built-in Carrier Comfort Network® (CCN) protocol, and be compatible with other CCN devices, including *Comfort*Link and ComfortVIEW™ controllers.
13. Shall have built-in support for Carrier technician tool.
14. Software upgrades will be accomplished by local download. Software upgrades through chip replacements are not allowed.
15. Shall be shock resistant in all planes to 5G peak, 11ms during operation, and 100G peak, 11ms during storage.

1. LonWorks is a registered trademark of Echelon Corporation.

16. Shall be vibration resistant in all planes to 1.5G at 20-300 Hz.
17. Shall support a bus length of 4000 ft (1219 m) max, 60 devices per 1000 ft (305 m) section, and 1 RS-485 repeater per 1000 ft (305 m) sections.

B. (23 09 23.13.B.) RTU Open protocol, direct digital controller:
1. Shall be ASHRAE 62 compliant.
2. Shall accept 18-30VAC, 50-60Hz, and consume 15VA or less power.
3. Shall have an operating temperature range from –40°F (–40°C) to 130°F (54°C), 10% to 90% RH (non-condensing).
4. Shall include built-in protocol for BACnet[1] (MS/TP and PTP modes), Modbus[2] (RTU and ASCII), Johnson N2 and LonWorks. LonWorks Echelon processor required for all Lon applications shall be contained in separate communication board.
5. Shall allow access of up to 62 network variables (SNVT). Shall be compatible with all open controllers.
6. Baud rate Controller shall be selectable using a dip switch.
7. Shall have an LED display independently showing the status of serial communication, running, errors, power, all digital outputs, and all analog inputs.
8. Shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, compressor lock-out, fire shutdown, enthalpy switch, and fan status / filter status / humidity / remote occupancy.
9. Shall provide the following outputs: economizer, variable frequency drive, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, exhaust reversing valve/high fan speed.
10. Shall have built-in surge protection circuitry through solid-state polyswitches. Polyswitches shall be used on incoming power and network connections. Polyswitches will return to normal when the "trip" condition clears.
11. Shall have a battery backup capable of a minimum of 10,000 hours of data and time clock retention during power outages.
12. Shall have built-in support for Carrier technician tool.
13. Shall include an RS-485 protocol communication port, an access port for connection of either a computer or a Carrier technician tool, an RS-485 port for network communication to intelligent space sensors and displays, and a port to connect an optional LonWorks communications card.
14. Software upgrades will be accomplished by either local or remote download. No software upgrades through chip replacements are allowed.

C. (23 09 23.13.C.) ComfortLink Unit Controls shall contain:
1. Four button detailed English scrolling marquee display.
2. CCN (Carrier Comfort Network®) capable.
3. Unit control with standard suction pressure transducers and condensing temperature thermistors.
4. Shall provide a 5°F temperature difference between cooling and heating set points to meet ASHRAE 90.1-2016 Energy Standard.
5. Shall provide and display a current alarm list and an alarm history list.
6. Service run test capability.
7. Shall accept input from a CO_2 sensor (both indoor and outdoor).
8. Configurable alarm light shall be provided which activates when certain types of alarms occur.
9. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
10. Service diagnostic mode.
11. Economizer control (optional).
12. Control multiple capacity stages.
13. Unit shall be complete with self-contained low voltage control circuit.
14. Unit shall have 0°F low ambient cooling operation.

Part 5 — (23 09 33) Electric and electronic control system for HVAC

5.01 (23 09 33.13) Decentralized, rooftop units

A. (23 09 33.13.A) General:
1. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
2. Shall utilize color-coded wiring.
3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, economizer, thermostat, DDC control options, loss of charge, freeze switch, high pressure switches.
4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.

1. BACnet is a registered trademark of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers).
2. Modbus is a registered trademark of Schneider Electric.

See heat exchanger section of this specification.

5. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

B. (23 09 33.23.B) Safeties:

1. Compressor over-temperature, over-current.
2. Low-pressure switch.
   a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 loss of charge switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. Loss of charge switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and/or troubleshoot the rooftop unit.
3. High-pressure switch.
   a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. High-pressure switch shall use different color wire than the low-pressure switch. The purpose is to assist the installer and service technician to correctly wire and/or troubleshoot the rooftop unit.
4. Automatic reset, motor thermal overload protector.
5. Heating section shall be provided with the following minimum protections.
   a. High-temperature limit switches.
   b. Induced draft motor speed sensor.
   c. Flame rollout switch.
   d. Flame proving controls.

Part 6 — (23 09 93) Sequence of operations for HVAC controls

6.01 (23 09 93.13) Decentralized, Rooftop Units:

(23 09 93.13.A) INSERT SEQUENCE OF OPERATION

Part 7 — (23 40 13) Panel air filters

7.01 (23 40 13 13) Decentralized rooftop units:

A. (23 40 13 13.A) Standard filter section

1. Shall consist of factory-installed, low velocity, throwaway 2-in. thick fiberglass filters of commercially available sizes.
2. Unit shall use only one filter size. Multiple sizes are not acceptable.
3. Filters shall be accessible through a dedicated, weather tight access panel.
4. 4-in. filter capabilities shall be capable with pre-engineered and approved Carrier filter track field-installed accessory. This kit requires field furnished filters.

Part 8 — (23 81 19) Self-contained air conditioners

8.01 (23 81 19.13) Medium-Capacity Self-Contained Air Conditioners (48HC**17-28)

A. (23 81 19.13.A) General

1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2. Factory assembled, single piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
3. Unit shall use Puron® R-410A refrigerant.
4. Unit shall be installed in accordance with the manufacturer's instructions.
5. Unit must be selected and installed in compliance with local, state, and federal codes.

B. (23 81 19.13.B.) Quality Assurance

1. Unit meets ASHRAE 90.1-2016 and IECC[1]-2015 minimum efficiency requirements.
2. Units are ENERGY STAR[2] certified where sizes are required.
3. Unit shall be rated in accordance with AHRI Standard 340/360.
4. Unit shall be designed to conform to ASHRAE 15.
5. Unit shall be ETL-tested and certified in accordance with ANSI Z21.47 Standards and ETL-listed and certified under Canadian standards as a total package for safety requirements.
6. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
7. Unit internal insulation linings shall be resistant to mold growth in accordance with "mold growth and humidity" test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the "Erosion Test" in UL 181, as part of ASTM C1071.
8. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
9. Roof curb shall be designed to conform to NRCA Standards.
10. Unit shall be subjected to a completely automated run test on the assembly line. The data

1. IECC is a registered trademark of the International Code Council, Inc.
2. Energy Star is registered trademark of the United States Department of Energy.

for each unit will be stored at the factory, and must be available upon request.

11. Unit shall be designed in accordance with UL Standard 1995, ETL listed including tested to withstand rain.
12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
14. High-Efficiency Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

C. (23 81 19.13.C) Delivery, storage, and handling

1. Unit shall be stored and handled per manufacturer's recommendations.
2. Lifted by crane requires either shipping top panel or spreader bars.
3. Unit shall only be stored or positioned in the upright position.

D. (23 81 19.13.D) Project conditions

As specified in the contract.

E. (23 81 19.13.E) Operating characteristics

1. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 340/360 at ± 10% voltage.
2. Compressor with standard controls shall be capable of operation from 35°F (2°C), ambient outdoor temperatures. Accessory kits are necessary if mechanically cooling at ambient temperatures below 35°F (2°C).
3. Unit shall discharge supply air vertically as shown on contract drawings.
4. Unit shall be factory configured and ordered for vertical supply and return configurations.
5. Unit shall be factory furnished for either vertical or horizontal configuration without the use of special conversion kits. No field conversion is possible.

F. (23 81 19.13.F) Electrical Requirements

Main power supply voltage, phase, and frequency must match those required by the manufacturer.

G. (23 81 19.13.G) Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.
3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum $^1/_2$-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.
4. Unit internal insulation linings shall be resistant to mold growth in accordance with "mold growth and humidity" test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the "Erosion Test" in UL 181, as part of ASTM C1071.
5. Base of unit shall have a minimum of four locations for factory thru-the-base gas and electrical connections (factory-installed or field-installed) standard. Connections shall be internal to the cabinet to protect from environmental issues.
6. Base Rail
   a. Unit shall have base rails on a minimum of 2 sides.
   b. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
   c. Holes shall be provided in the base rail for moving the rooftop by fork truck.
   d. Base rail shall be a minimum of 16 gauge thickness.
7. Condensate pan and connections:
   a. Shall be a sloped condensate drain pan made of a non-corrosive material.
   b. Shall comply with ASHRAE Standard 62.
   c. Shall use a $^3/_4$-in. 14 NPT drain connection at the end of the drain pan. Connection shall be made per manufacturer's recommendations.
8. Top panel:

   Shall be a multi-piece top panel linked with water tight flanges and interlocking systems.
9. Gas Connections:
   a. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).
   b. Thru-the-base capability
      1) Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
      2) Optional, factory-approved, water-tight connection method must be used for thru-the-base gas connections.
      3) No basepan penetration, other than those authorized by the manufacturer, is permitted.

10. Electrical Connections
    a. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
    b. Thru-the-base capability
        1) Thru-the-base provisions/connections are available as standard with every unit. When bottom connections are required, field furnished couplings are required.
        2) No basepan penetration, other than those authorized by the manufacturer, is permitted.
11. Component access panels (standard)
    a. Cabinet panels shall be easily removable for servicing.
    b. Unit shall have one factory installed, toolless, removable, filter access panel.
    c. Panels covering control box and filters shall have molded composite handles while the blower access door shall have an integrated flange for easy removal.
    d. Handles shall be UV modified, composite, permanently attached, and recessed into the panel.
    e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
    f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

H. (23 81 19.13.H.) Gas Heat
1. General
    a. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
    b. Shall incorporate a direct-spark ignition system and redundant main gas valve.
    c. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
    a. IGC board shall notify users of fault using an LED (light-emitting diode).
    b. IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.
    c. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.
3. Standard Heat Exchanger construction
    a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.
    b. Burners shall be of the in-shot type constructed of aluminum-coated steel.
    c. Burners shall incorporate orifices for rated heat output up to 2000 ft (610 m) elevation. Additional accessory kits may be required for applications above 2000 ft (610 m) elevation, depending on local gas supply conditions.
    d. Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.
4. Optional Stainless Steel Heat Exchanger construction
    a. Use energy saving, direct-spark ignition system.
    b. Use a redundant main gas valve.
    c. Burners shall be of the in-shot type constructed of aluminum-coated steel.
    d. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
    e. The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.
    f. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
    g. Complete stainless steel heat exchanger allows for greater application flexibility.
5. Induced draft combustion motor and blower
    a. Shall be a direct-drive, single inlet, forward-curved centrifugal type.
    b. Shall be made from steel with a corrosion-resistant finish.
    c. Shall have permanently lubricated sealed bearings.
    d. Shall have inherent thermal overload protection.
    e. Shall have an automatic reset feature.

I. (23 81 19.13.I.) Coils
1. Standard Aluminum Fin/Copper Tube Coils:
    a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
    b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
    c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

2. Optional Pre-coated aluminum-fin condenser coils:
   a. Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments.
   b. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube.
   c. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.
   d. Corrosion durability of fin stock shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.
   e. Corrosion durability of fin stock shall be confirmed through testing to have no visible corrosion after 48 hour immersion in a room temperature solution of 5% salt, 1% acetic acid.
   f. Fin stock coating shall pass 2000 hours of the following: one week exposure in the prohesion chamber followed by one week of accelerated ultraviolet light testing. Prohesion chamber: the solution shall contain 3.5% sodium chloride and 0.35% ammonium sulfate. The exposure cycle is one hour of salt fog application at ambient followed by one hour drying at 95°F (35°C).
3. Optional Copper-fin evaporator and condenser coils:
   a. Shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets.
   b. Galvanized steel tube sheets shall not be acceptable.
   c. A polymer strip shall prevent coil assembly from contacting the sheet metal coil pan to minimize potential for galvanic corrosion between coil and pan.
4. Optional E-coated aluminum-fin evaporator and condenser coils:
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.
   b. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.
   c. Color shall be high gloss black with gloss per ASTM D523-89.
   d. Uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges.
   e. Superior hardness characteristics of 2H per ASTM D3363-92A and cross-hatch adhesion of 4B-5B per ASTM D3359-93.
   f. Impact resistance shall be up to 160 in.-lb (ASTM D2794-93).
   g. Humidity and water immersion resistance shall be up to minimum 1000 and 250 hours respectively (ASTM D224-92 and ASTM D870-92).
   h. Corrosion durability shall be confirmed through testing to be no less than 6000 hours salt spray per ASTM B117-90.
5. Optional E-coated aluminum-fin, aluminum tube condenser coils:
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil external surface areas without material bridging between fins or louvers.
   b. Coating process shall ensure complete coil encapsulation, including all exposed fin edges.
   c. E-coat thickness of 0.8 to 1.2 mil with top coat having a uniform dry film thickness from 1.0 to 2.0 mil on all external coil surface areas, including fin edges, shall be provided.
   d. Shall have superior hardness characteristics of 2H per ASTM D3363-00 and cross-hatch adhesion of 4B-5B per ASTM D3359-02.
   e. Shall have superior impact resistance with no cracking, chipping or peeling per NSF/ANSI 51-2002 Method 10.2.

J. (23 81 19.13.J) Refrigerant components
1. Refrigerant circuit shall include the following control, safety, and maintenance features:
   a. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
   b. Refrigerant filter drier.
   c. Service gauge connections on suction and discharge lines.
   d. Pressure gauge access through a specially designed access screen on the side of the unit.
2. Compressors
   a. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
   b. Models shall be available with 2 compressor/2-stage cooling.
   c. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
   d. Compressors shall be internally protected from high discharge temperature conditions.
   e. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.

f. Compressor shall be factory mounted on rubber grommets.

g. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.

h. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

K. (23 81 19.13.K) Filter section

1. Filters access is specified in the unit cabinet section of this specification.
2. Filters shall be held in place by a preformed slide out filter tray, facilitating easy removal and installation.
3. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
4. Filters shall be standard, commercially available sizes.
5. Only one size filter per unit is allowed.
6. 4-in. filter capability is possible with a field-installed pre-engineered slide out filter track accessory. 4-in. filters are field furnished.

L. (23 81 19.13.L) Evaporator fan and motor

1. Evaporator fan motor:
   a. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
   b. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
2. Belt-driven evaporator fan:
   a. Belt drive shall include an adjustable-pitch motor pulley and belt break protection system.
   b. Shall use rigid pillow block bearing system with lubricate fittings at are accessible or lubrication line.
   c. Blower fan shall be double-inlet type with forward-curved blades.
   d. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

M. (23 81 19.13.M) Condenser Fans and Motors

1. Condenser fan motors:
   a. Shall be a totally enclosed motor.
   b. Shall use permanently lubricated bearings.
   c. Shall have inherent thermal overload protection with an automatic reset feature.
   d. Shall use a shaft down design on all sizes.
2. Condenser fans:
   a. Shall be a direct driven propeller type fan.
   b. Shall have aluminum blades riveted to corrosion resistant steel spiders and shall be dynamically balanced.

8.02 (23 81 19.13.) Special Features Options and Accessories

A. EnergyX® and Economizer

1. System Description:
   a. One-piece EnergyX (Energy Recovery Ventilation) unit is an electrically controlled ventilation air pre-conditioner utilizing an AHRI 1060 certified Energy Recovery Cassette to reduce the cooling and heating loads placed on the primary HVAC unit by untreated outdoor air. Building exhaust air shall be introduced to the EnergyX unit through ductwork. Unit shall be designed as a factory-installed option to be used with WeatherMaster® 48HC units for use in vertical return applications only.
   b. Quality Assurance
      1) Unit shall be designed in accordance with UL Standard 1995
      2) Energy Recovery unit shall be ETL tested and certified.
      3) Rooftop unit and Energy Recovery unit shall be ETL certified as one single system.
      4) Roof curb or curb extension shall be designed to conform to NRCA Standards.
      5) Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
      6) Unit casing shall be capable of withstanding ASTM No. 141 (Method 6061) 500-hour salt spray test.
      7) Unit shall contain AHRI 1060 certified Energy Recovery Cassette.
      8) Unit shall leakage rates shall be capable of meeting ASHRAE Standard 62.1 requirements for use of class-2 exhaust with class-1 ventilation air.
2. Products
   Equipment (Standard): The EnergyX unit shall be a factory assembled, single piece unit. Contained within the unit enclosure shall be all factory wiring with a single, pre-determined point of power input and a single point of 24-volt control wiring.
3. Unit Cabinet
   a. Unit cabinet shall be constructed of galvanized steel coated with a pre-painted baked enamel finish.
   b. All models shall have hoods installed over outside air intake and exhaust openings. Outside air hood shall have aluminum water entrainment filters.
   c. All models have 1-in., 2 pound density fiberglass insulation.

d. Hinged access doors with compression latches shall be provided on all units for access to fans and filters. Hinged doors shall be provided with at least one handle capable of being locked.

e. Exhaust air stream shall have back-draft dampers to prevent air penetration during off cycles.

f. Holes shall be provided in the base rails for rigging shackles to facilitate overhead rigging.

4. Blowers

a. Blowers shall be direct drive with variable speed motors.

b. Blower wheel shall be made of steel with a corrosion resistant finish. It shall be dynamically balanced, double-inlet type with backward-curved blades.

c. Blower shall be mounted on neoprene vibration isolation pads.

d. Motor shall be high efficiency and have thermal overload protection.

5. Filter Section

Standard filter section shall accept commercially available, 2-in. pleated filter(s).

6. Controls and Safeties

The EnergyX unit shall operate in conjunction with rooftop unit fan.

7. Electrical Requirements

All unit power wiring shall enter unit cabinet at a single location.

8. Energy Recovery Cassette

a. The energy recovery media shall have a minimum of 70% effectiveness at nominal unit airflow.

b. Energy wheel performance shall be AHRI Standard 1060 Certified and bear the AHRI Certified Product Seal.

c. The energy recovery cassette shall be an UL Recognized component for electrical and fire safety.

d. The wheel shall be coated with silica gel desiccant, permanently bonded without the use of binders or adhesives.

e. Coated wheels shall be washable with detergent or alkaline coil cleaner and water.

f. The silica gel shall not dissolve or deliquesce in the presence of water or high humidity.

g. The substrate shall be made of a lightweight polymer and shall not degrade or require additional coatings for application in coastal environments.

h. The wheel polymer layers shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop.

i. The polymer layers shall be captured in a stainless steel wheel frame or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.

j. Energy recovery wheels greater than 19 inches in diameter shall be provided with removable wheel segments.

k. Wheel frame shall be a welded hub, spoke and rim assembly of stainless, plated, and or coated steel and shall be self supporting without the wheel segments in place.

l. Wheel segments shall be removable without the use of tools to facilitate maintenance and cleaning.

m. Wheel rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

n. Wheel bearings shall provide an L-10 life of 400,000 hours.

o. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

9. Supply and exhaust air frost control option

a. Factory-installed frost protection module shall sense pressure differential across the energy recovery cassette.

b. Supply blower shall be shut-off if the pressure differential across the energy recovery cassette exceeds an adjustable set point. Blower shall remain off for an adjustable time period.

c. Exhaust blower and wheel shall remain in operation in order to remove any frost build-up on the wheel.

10. EnergyX maintenance indicator package

A factory-installed switch shall monitor EnergyX blowers and wheel motor amp draw and send a signal to field-supplied 24-v indicator upon amperage surge that maintenance required.

11. Filter maintenance indicator

A factory-installed differential pressure switch shall measure pressure drop across the outside air filter and activate a field-supplied 24-v indicator when airflow is restricted. It shall not interrupt EnergyX operation. Switch set point shall be adjustable.

12. EnergyX free cooling with enthalpy and stop/jog control

a. An enthalpy sensor shall prevent the wheel from rotating if the outside air conditions are acceptable for free cooling. Both exhaust and supply blowers will remain on.

b. Stop-Jog-Control shall energize the wheel periodically during the free cooling

operation of the EnergyX to prevent dirt build-up on the wheel.

13. Economizer Option
    a. The economizer shall be integrated in the energy recovery module and shall allow air to bypass the energy recovery wheel for free cooling and fail safe operation. Tilting wheel mechanisms shall not be allowed.
    b. The economizer damper shall be motorized with factory installed, 24-volt Belimo actuator.
    c. The EnergyX shall be capable of using the economizer in a free cooling operation.
    d. The economizer shall utilize enthalpy sensor controls when in the economizer mode.
14. CO_2 Sensor
    a. The modulating airflow energy recovery unit shall be capable of incorporating a CO_2 sensor for use with Demand Controlled Ventilation.
    b. The CO_2 sensor shall connect to the base rooftop unit's digital controller.
    c. The modulating airflow energy recovery unit shall use at a minimum, a high and low CFM airflow set point when a CO_2 sensor is used.
15. Roof Curb Extension Accessory for use with EnergyX units
    a. The energy recovery module shall us the standard rooftop unit rooftop curb.
    b. Rooftop extensions, support rails or other devices that come in contact with the roof surface to support the energy recovery module shall not be allowed.
    c. A horizontal adapter curb shall be used to convert vertical return air applications into horizontal return air applications. The supply airflow shall be convertible via the base rooftop unit operation and restrictions.

B. Staged Air Volume System (SAV™) for 2• stage cooling models only:
    1. Evaporator fan motor:
        a. Shall have permanently lubricated bearings.
        b. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating.
        c. Shall be Variable Frequency duty and 2• speed control.
        d. Shall contain motor shaft grounding ring to prevent electrical bearing fluting damage by safely diverting harmful shaft voltages and bearing currents to ground.

C. Variable Frequency Drive (VFD). Only available on 2-speed indoor fan motor option (SAV):
    1. Factory-supplied VFDs qualify, through ABB for a 12• month warranty from date of commissioning or 18 months from date of sale, whichever occurs first.
    2. Shall be installed inside the unit cabinet, mounted, wired and tested.
    3. Shall contain Electromagnetic Interference (EMI) frequency protection.
    4. Insulated Gate Bi-Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform, allowing for quiet motor operation.
    5. Self diagnostics with fault and power code LED indicator. Field accessory Display Kit available for further diagnostics and special setup applications.
    6. RS485 capability standard.
    7. Electronic thermal overload protection.
    8. 5% swinging chokes for harmonic reduction and improved power factor.
    9. All printed circuit boards shall be conformal coated.

D. Integrated EconoMi$er® IV, EconoMi$er 2, and EconoMi$er X low leak rate models. (Factory-installed on 3-phase models only. Field installed on all 3 and 1-phase models):
    1. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
    2. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory-installed option.
    3. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
    4. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
    5. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
    6. Low leak rate models shall be equipped with dampers not to exceed 2% leakage at 1 in. wg pressure differential.
    7. Economizer controller on EconoMi$er IV models shall be Honeywell W7212 that provides:
        a. Combined minimum and DCV maximum damper position potentiometers with compressor staging relay.
        b. Functions with solid state analog enthalpy or dry bulb changeover control sensing.

c. LED indicators for: when free cooling is available, when module is in DCV mode, when exhaust fan contact is closed.

8. Economizer controller on EconoMi$er X models shall be the Honeywell W7220 that provides:
   a. 2-line LCD interface screen for setup, configuration and troubleshooting.
   b. On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, per California Title 24.
   c. Sensor failure loss of communication identification.
   d. Automatic sensor detection.
   e. Capabilities for use with multiple-speed indoor fan systems.
   f. Utilize digital sensors: Dry bulb and Enthalpy.
9. Economizer controller on EconoMi$er 2 models with PremierLink™ controller shall be 4-20mA design and controlled by the PremierLink controller. PremierLink does not comply with California Title 24 Fault Detection and Diagnostic (FDD) requirements.
10. Economizer controller on EconoMi$er 2 models with RTU Open controller shall be a 4-20mA design controlled directly by the RTU Open controller. RTU Open controller meets California Title 24 Fault Detection and Diagnostic (FDD) requirements.
11. Shall be capable of introducing up to 100% outdoor air.
12. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1-2016 and IECC-2015 requirements.
13. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
14. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory-installed only. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F (4 to 38°C). Additional sensor options shall be available as accessories.
15. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
16. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
17. Dampers shall be completely closed when the unit is in the unoccupied mode.
18. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
19. Compressor lockout temperature on W7220 is adjustable from –45°F to 80°F, set at a factory default of 32°F. Others shall open at 35°F (2°C) and close at 50°F (10°C).
20. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
21. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

E. Integrated EconoMi$er2, and EconoMi$er X Ultra Low Leak rate models. (Factory-installed on 3-phase models only. Field-installed on all 3 and 1-phase models):
   1. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
   2. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory-installed option.
   3. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
   4. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
   5. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
   6. Ultra Low Leak design meets California Title 24 section 140.4 and, ASHRAE 90.1-2016 and IECC-2015 requirements for 4 cfm per sq. ft. on the outside air dampers and 10 cfm per sq. ft. on the return dampers.
   7. Economizer controller on EconoMi$er X models shall be the Honeywell W7220 that provides:
      a. 2-line LCD interface screen for setup, configuration and troubleshooting
      b. On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, per California Title 24.
      c. Sensor failure loss of communication identification
      d. Automatic sensor detection
      e. Capabilities for use with multiple-speed indoor fan systems
      f. Utilize digital sensors: Dry bulb and Enthalpy

8. Economizer controller on EconoMi$er 2 models with RTU Open controller shall be a 4-20mA design controlled directly by the RTU Open controller. RTU Open controller meets California Title 24 Fault Detection and Diagnostic (FDD) requirements.
9. Shall be capable of introducing up to 100% outdoor air.
10. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1-2016 and IECC-2015 requirements.
11. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
12. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory-installed only. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F (4 to 38°C). Additional sensor options shall be available as accessories.
13. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
14. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
15. Dampers shall be completely closed when the unit is in the unoccupied mode.
16. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
17. Compressor lockout temperature on W7220 is adjustable from –45°F to 80°F, set at a factory default of 32°F. Others shall open at 35°F (2°C) and closes at 50°F (10°C).
18. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
19. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

F. Two-Position Damper
1. Damper shall be a Two-Position Damper. Damper travel shall be from the full closed position to the field adjustable %–open setpoint.
2. Damper shall include adjustable damper travel from 25% to 100% (full open).
3. Damper shall include single or dual blade, gear driven dampers and actuator motor.
4. Actuator shall be direct coupled to damper gear. No linkage arms or control rods shall be acceptable.
5. Damper will admit up to 100% outdoor air for applicable rooftop units.
6. Damper shall close upon indoor (evaporator) fan shutoff and/or loss of power.
7. The damper actuator shall plug into the rooftop unit's wiring harness plug. No hard wiring shall be required.
8. Outside air hood shall include aluminum water entrainment filter.
9. Not available with Staged Air Volume (SAV™) models.

G. Manual damper
1. Manual damper package shall consist of damper, air inlet screen, and rain hood which can be preset to admit up to 25% outdoor air for year round ventilation.
2. Not available with Staged Air Volume (SAV) models.

H. Humidi-MiZer® Adaptive Dehumidification System:
1. The Humidi-MiZer Adaptive Dehumidification System shall be factory-installed and shall provide greater dehumidification of the occupied space by two modes of dehumidification operations in addition to its normal design cooling mode:
   a. Subcooling mode further sub cools the hot liquid refrigerant leaving the condenser coil when both temperature and humidity in the space are not satisfied.
   b. Hot gas reheat mode shall mix a portion of the hot gas from the discharge of the compressor with the hot liquid refrigerant leaving the condenser coil to create a two-phase heat transfer in the system, resulting in a neutral leaving air temperature when only humidity in the space is not satisfied.
   c. Includes head pressure controller.

I. Head Pressure Control Package (Motormaster®)
1. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
2. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature at outdoor ambient temperatures between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to 0°F (–18°C).

J. Low Ambient Controller (Factory-installed only)
1. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
2. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to 0°F (–18°C).

Guide specifications (cont)

K. Propane Conversion Kit

Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit for use with liquefied propane. Kits shall be available for elevations from 0 up to 14,000 ft (4,276 m).

L. Condenser Coil Hail Guard Assembly:

1. Shall protect against damage from hail.
2. Shall be of louvered style.

M. Unit-Mounted, Non-Fused Disconnect Switch:

1. Switch shall be factory-installed, internally mounted.
2. National Electric Code (NEC) and UL or ETL approved non-fused switch shall provide unit power shutoff.
3. Shall be accessible from outside the unit.
4. Shall provide local shutdown and lockout capability.
5. Sized only for the unit as ordered from the factory. Does not accommodate field-installed devices.

N. HACR Breaker

1. These manual reset devices provide overload and short circuit protection for the unit. Factory wired and mounted with the units, with access cover to help provide environmental protection. On 575V applications, HACR breaker can only be used with WYE power distribution systems. Use on Delta power distribution systems is prohibited.
2. Sized only for the unit as ordered from the factory. Does not accommodate field-installed devices.

O. Convenience outlet:

1. Powered convenience outlet. (Not available on single phase models):
   a. Outlet shall be powered from main line power to the rooftop unit.
   b. Outlet shall be powered from line side or load side of disconnect by installing contractor, as required by code. If outlet is powered from load side of disconnect, unit electrical ratings shall be UL certified and rated for additional outlet amperage.
   c. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
   d. Outlet shall include 15 amp GFI receptacles with independent fuse protection.
   e. Voltage required to operate convenience outlet shall be provided by a factory-installed step down transformer.
   f. Outlet shall be accessible from outside the unit.
   g. Outlet shall include a field-installed “Wet in Use” cover.
2. Non-powered convenience outlet.
   a. Outlet shall be powered from a separate 115-120v power source.
   b. A transformer shall not be included.
   c. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
   d. Outlet shall include 15 amp GFI receptacles.
   e. Outlet shall be accessible from outside the unit.
   f. Outlet shall include a field-installed “Wet in Use” cover.

P. Flue Discharge Deflector:

1. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.
2. Deflector shall be defined as a “natural draft” device by the National Fuel and Gas (NFG) code.

Q. Fan/Filter Status Switch:

1. Switch shall provide status of indoor evaporator fan (ON/OFF) or filter (CLEAN/DIRTY).
2. Status shall be displayed either over communication bus (when used with direct digital controls) or with an indicator light at the thermostat.

R. Centrifugal Propeller Power Exhaust:

1. Power exhaust shall be used in conjunction with an integrated economizer.
2. Independent modules for vertical or horizontal return configurations shall be available.
3. Horizontal power exhaust is shall be mounted in return ductwork.
4. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0-100% adjustable setpoint on the economizer control.

S. Roof Curbs (Vertical):

1. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
3. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

T. Adapter Curb (Vertical):

1. Full perimeter – fully assembled and welded roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.

2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
3. Permits installation of new 48HC 17-28 models to past Carrier design curb models: DP, DR, HJ, TM, and TJ. (Not for 48TJE024-028 models.) Check with Carrier sales expert of further details and information.

U. High Altitude Gas Conversion Kit:

Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 3,000 to 10,000 ft (914 to 3048 m) elevation and 10,001 to 14,000 ft (3049 to 4267 m) elevation.

V. Outdoor Air Enthalpy Sensor:

The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.

W. Return Air Enthalpy Sensor:

The return air enthalpy sensor shall be used in conjunction with an outdoor air enthalpy sensor to provide differential enthalpy control.

X. Indoor Air Quality (CO_2) Sensor:

1. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
2. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.

Y. Smoke detectors:

1. Shall be a Four-Wire Controller and Detector.
2. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
3. Shall use magnet-activated test/reset sensor switches.
4. Shall have tool-less connection terminal access.
5. Shall have a recessed momentary switch for testing and resetting the detector.
6. Controller shall include:
   a. One set of normally open alarm initiation contacts for connection to an initiating device circuit on a fire alarm control panel.
   b. Two Form-C auxiliary alarm relays for interface with rooftop unit or other equipment.
   c. One Form-C supervision (trouble) relay to control the operation of the Trouble LED on a remote test/reset station.
   d. Capable of direct connection to two individual detector modules.
   e. Can be wired to up to 14 other duct smoke detectors for multiple fan shutdown applications

Z. Horn/Strobe Annunciator

1. Provides an audible/visual signaling device for use with factory-installed option or field-installed accessory smoke detectors.
   a. Requires installation of a field-supplied 24-v transformer suitable for 4.2 VA (AC) or 3.0 VA (DC) per horn/strobe accessory.
2. Requires field-supplied electrical box, North American 1-gang box, 2-in (51 mm) x 4-in (102 mm).
3. Shall have a clear colored lens.

AA. Winter start kit

1. Shall contain a bypass device around the low pressure switch.
2. Shall be required when mechanical cooling is required down to 25°F (–4°C).
3. Shall not be required to operate on an economizer when below an outdoor ambient of 40°F (4°C).

AB. Time Guard

1. Shall prevent compressor short cycling by providing a 5-minute delay (±2 minutes) before restarting a compressor after shutdown for any reason.
2. One device shall be required per compressor.

AC. Barometric Hood (Horizontal Economizer Applications)

Shall be required when a horizontal economizer and barometric relief are required. Barometric relief damper must be installed in the return air (horizontal) duct work. This hood provides weather protection.

AD. Display Kit for Variable Frequency Drive

1. Kit allows the ability to access the VFD controller programs to provide special setup capabilities and diagnostics.
2. Kit contains display module and communication cable.
3. Display Kit can be permanently installed in the unit or used on any SAV™ system VFD controller as needed.

AE. Condensate Overflow Switch:

1. This sensor and related controller monitors the condensate level in the drain pan and shuts down compression operation when overflow conditions occur. It includes:
   a. Indicator light - solid red (more than 10 seconds on water contact - compressors disabled), blinking red (sensor disconnected).

b. 10 second delay to break - eliminates nuisance trips from splashing or waves in pan (sensor needs 10 seconds of constant water contact before tripping).

c. Disables the compressor(s) operation when condensate plug is detected, but still allows fans to run for Economizer.

AF. Hinged Access Panels

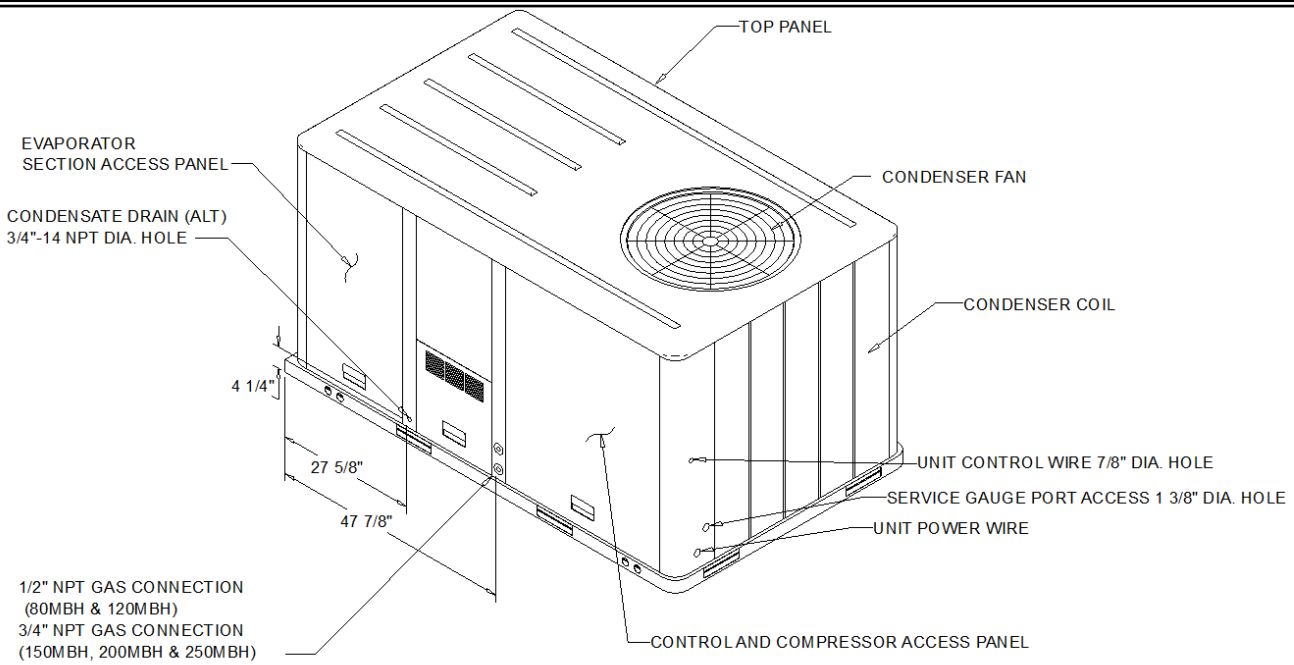
1. Shall provide easy access through integrated quarter turn latches.
2. Shall be on major panels of – filter, control box, fan motor and compressor.

AG. Foil faced insulation

Throughout unit cabinet air stream, non-fibrous and cleanable foil faced insulation is used.

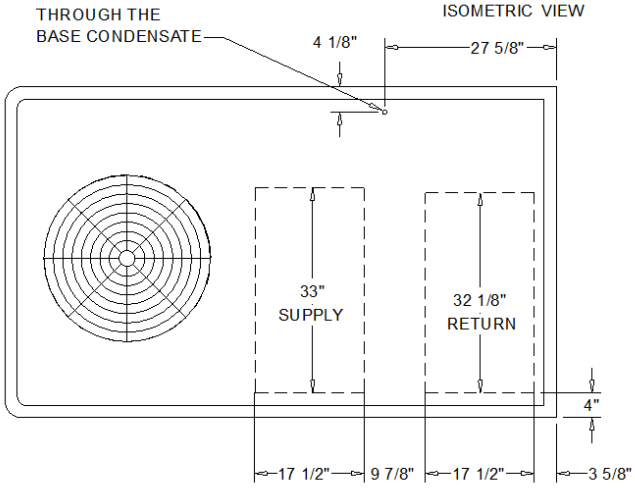
Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

Pg 92 Catalog No. 04-52480044-01 Printed in U.S.A. Form 48HC-17-28-03PD
Replaces: 48HC-17-28-02PD
48HC-13PD



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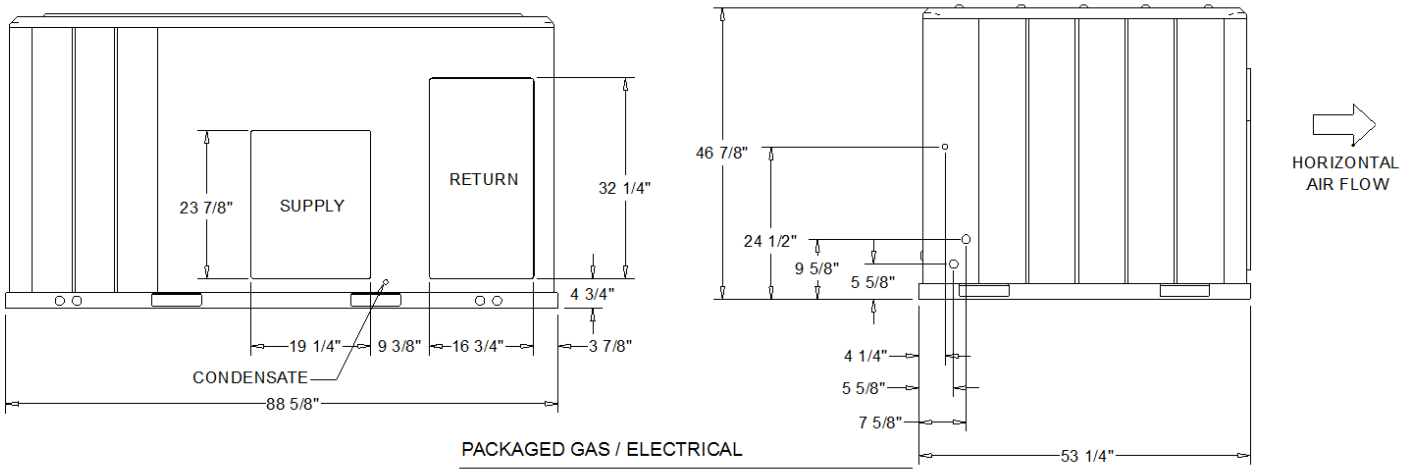
ISOMETRIC VIEW



NOTES:
1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.

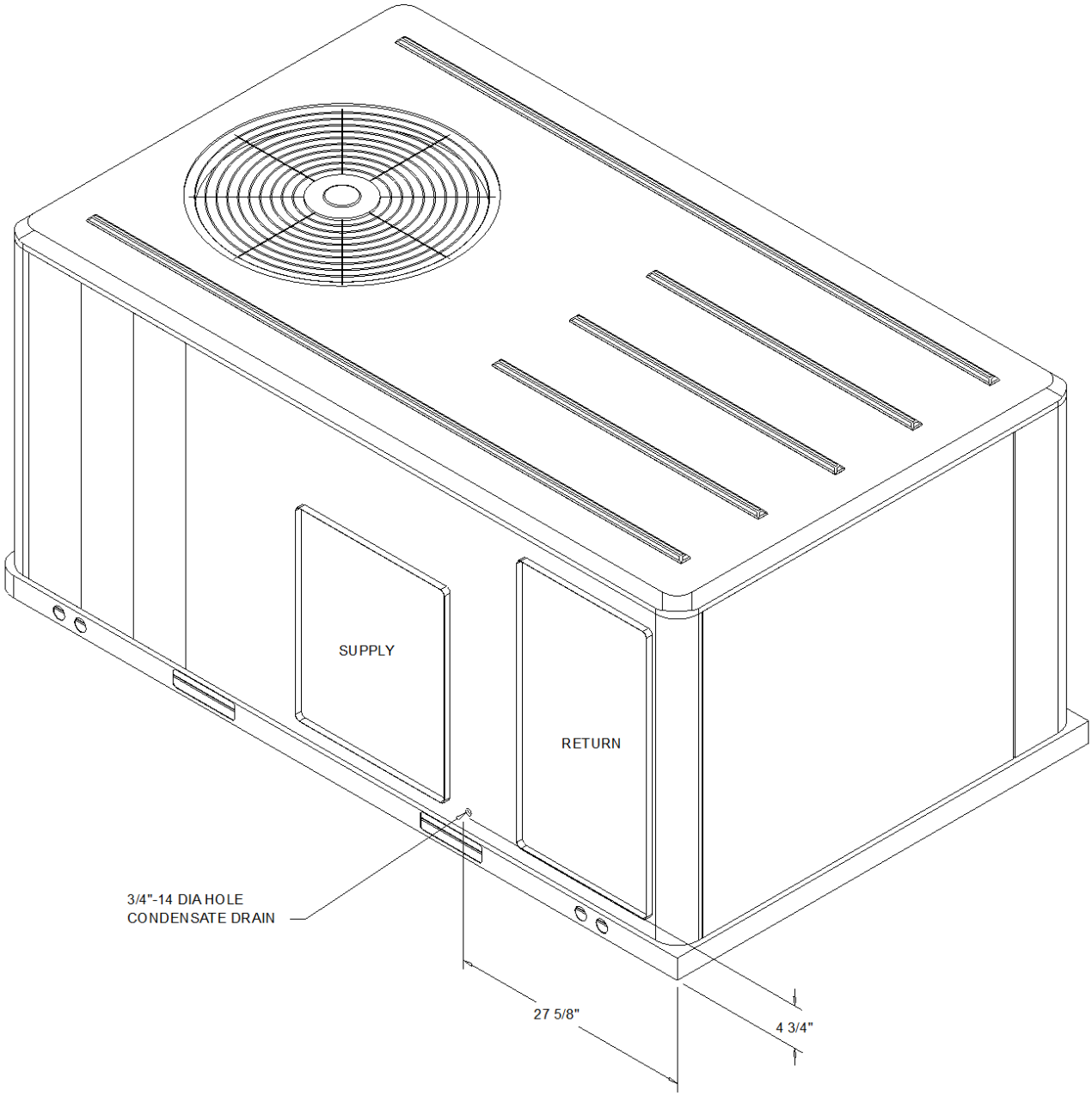
PLAN VIEW UNIT

DIMENSION DRAWING



PACKAGED GAS / ELECTRICAL

DIMENSION DRAWING



ISOMETRIC-PACKAGED COOLING

ELECTRICAL / GENERAL DATA

GENERAL (2)(4)(6)

		Oversized Motor
Model:	YZ*090F3	
Unit Operating Voltage:	187-253	MCA: N/A
Unit Primary Voltage:	208	MFS: N/A
Unit Secondary Voltage	230	MCB: N/A
Unit Hertz:	60	
Unit Phase:	3	
EER / SEER	12.8/22.4	

Standard Motor		Field Installed Oversized Motor
MCA:	40.0	MCA: N/A
MFS:	60.0	MFS: N/A
MCB:	60.0	MCB: N/A

HEATING PERFORMANCE

HEATING - GENERAL DATA

Heating Model:	Modulating
Heating Input (BTU):	200000
Heating Output (BTU):	162000
No. Burners:	5
No. Stages	2.5:1 Modulating

Gas Inlet Pressure

Natural Gas (Min/Max):	4.5/14.0
LP (Min/Max)	11.0/14.0
Gas Pipe Connection Size L/M/H/Mod:	1/2"/3/4"/3/4"

INDOOR MOTOR

Standard Motor		Oversized Motor		Field Installed Oversized Motor	
Number:	1	Number:	N/A	Number:	N/A
Horsepower:	2.75	Horsepower:	N/A	Horsepower:	N/A
Motor Speed (RPM):	Direct/Variable	Motor Speed (RPM):	N/A	Motor Speed (RPM):	N/A
Phase	3	Phase	N/A	Phase	N/A
Full Load Amps:	7.3	Full Load Amps:	N/A	Full Load Amps:	N/A
	-		N/A		N/A

COMPRESSOR Circuit 1/2

Number:	1
Motor Speed	-
Phase:	Variable Speed
VFD Input Amps:	3
	-
	21.5
	-

OUTDOOR MOTOR

Number:	1
Horsepower:	0.75
Motor Speed (RPM):	1200
Phase:	1
Full Load Amps:	5.7
	-

POWER EXHAUST ACCESSORY (3,7)

(Field Installed Power Exhaust)

Phase:	1
Horsepower:	0.87
Motor Speed (RPM):	1075
Full Load Amps:	5.7
Locked Rotor Amps:	13.6

FILTERS

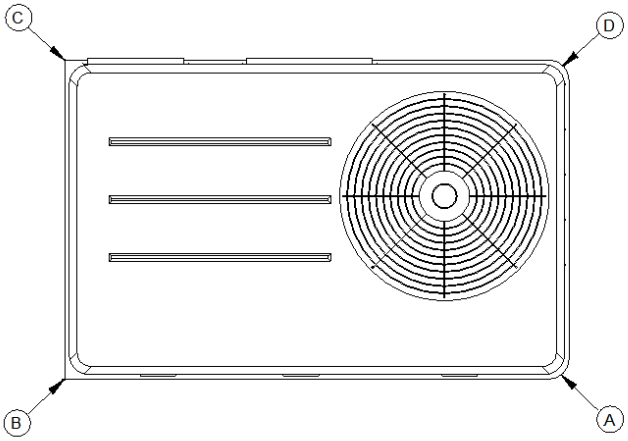
Type:	Throwaway
Furnished:	Yes
Number	4
Recommended	20"x25"x2"

REFRIGERANT (2)

Type	R-410A
Factory Charge	
Circuit #1	8.7 lb
Circuit #2	-

NOTES:

1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value does not include Power Exhaust Accessory.
4. Value includes oversized motor.
5. Value does not include Power Exhaust Accessory.
6. EER is rated at AHRI conditions and in accordance with DOE test procedures.
7. Installation of this power exhaust kit will affect unit level MCA and could affect MOP sizing having a direct impact on existing field wiring and unit protection devices. The change in MCA/MOP is the sole responsibility of the field installing party. Trane will not issue new nameplates as a result of this power exhaust accessory installation. FLA of the power exhaust kit option must be added to the MCA of the unit for building supply conductor sizing determination.



PACKAGED GAS / ELECTRICAL

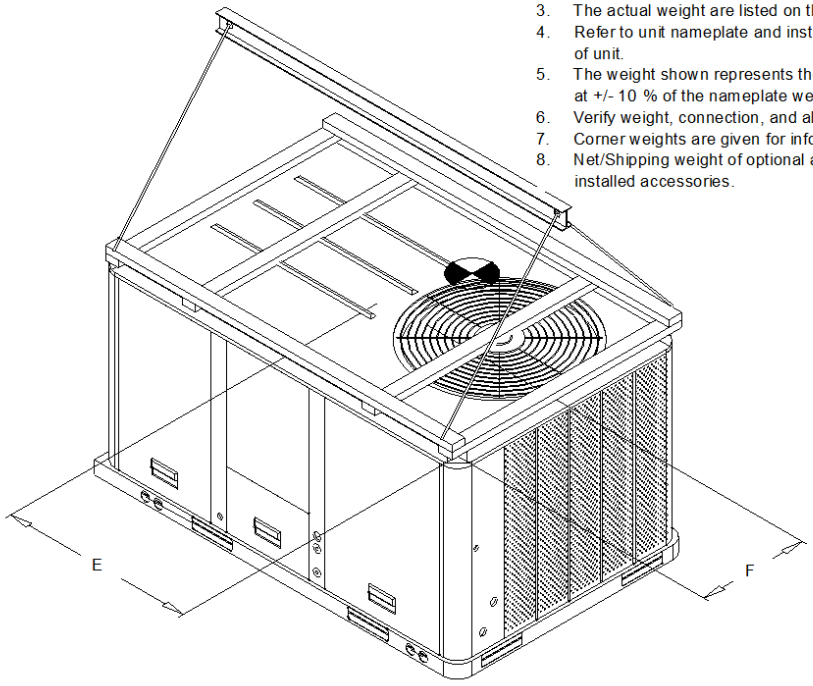
CORNER WEIGHT

INSTALLED ACCESSORIES NET WEIGHT DATA

ACCESSORY	WEIGHTS
ECONOMIZER	
MOTORIZED OUTSIDE AIR DAMPER	
MANUAL OUTSIDE AIR DAMPER	
BAROMETRIC RELIEF	
OVERSIZED MOTOR	
BELT DRIVE MOTOR	
POWER EXHAUST	80.0 lb
THROUGHT THE BASE ELECTRICAL/GAS (FIOPS)	18.0 lb
UNIT MOUNTED CIRCUIT BREAKER (FIOPS)	
UNIT MOUNTED DISCONNECT (FIOPS)	5.0 lb
POWERED CONVENIENCE OUTLET (FIOPS)	
HINGED DOORS (FIOPS)	
HAIL GUARD	
SMOKE DETECTOR, SUPPLY / RETURN	
NOVAR CONTROL	
STAINLESS STEEL HEAT EXCHANGER	
REHEAT	
ROOF CURB	

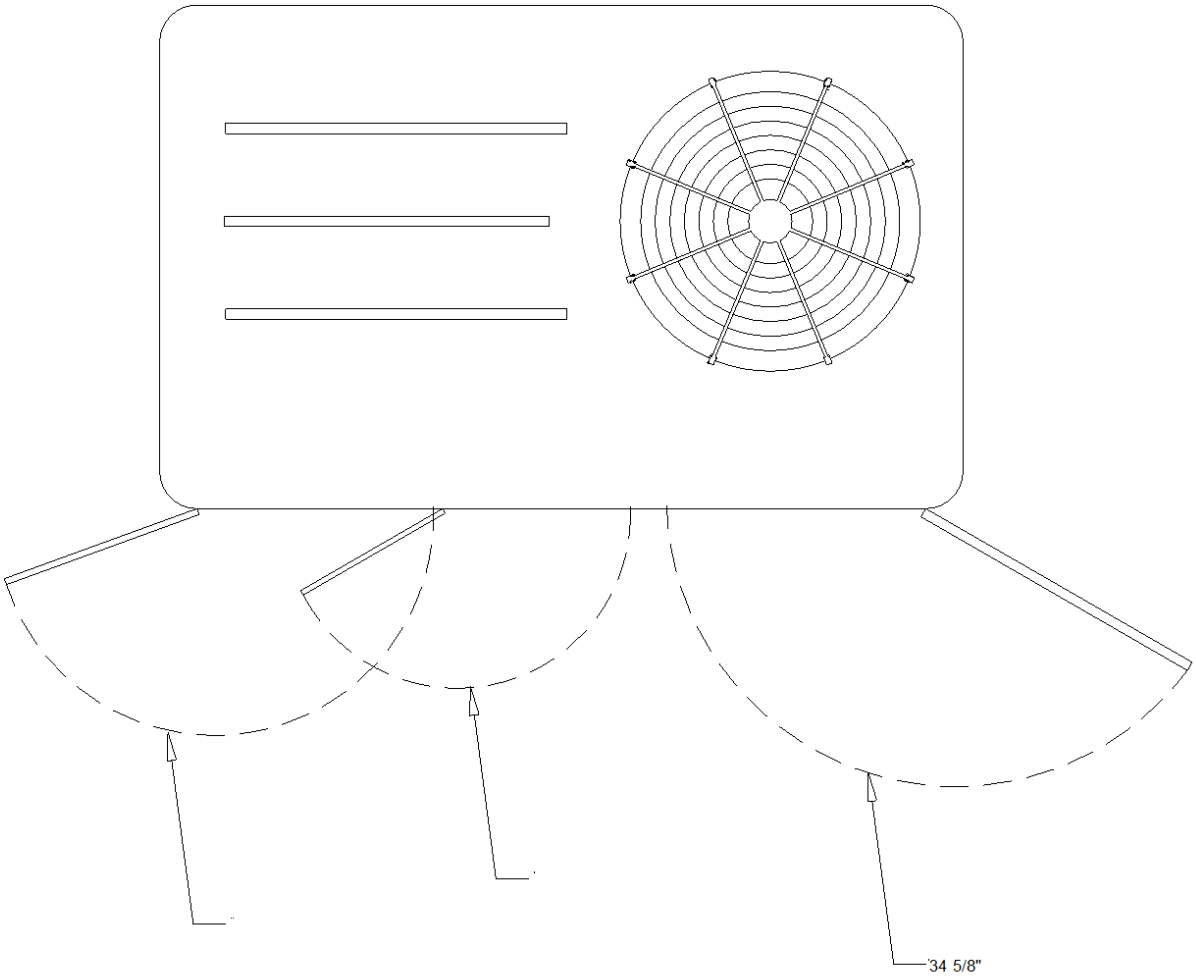
BASIC UNIT WEIGHTS		CORNER WEIGHTS				CENTER OF GRAVITIY	
SHIPPING	NET	(A)	248.0 lb	(C)	261.0 lb	(E) LENGHT	(F) WIDTH
1007.0 lb	909.0 lb	(B)	210.0 lb	(D)	190.0 lb	51"	26"

NOTE:
1. All weights are approximate.
2. Weights for options that are not list refer to Installation guide.
3. The actual weight are listed on the unit nameplate.
4. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
5. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
6. Verify weight, connection, and all dimension with installer documents before installation.
7. Corner weights are given for information only.
8. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.



PACKAGED GAS / ELECTRICAL

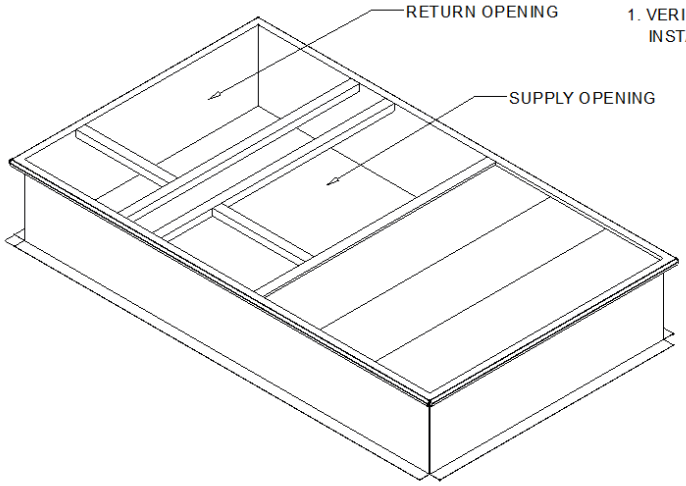
RIGGING AND CENTER OF GRAVITY

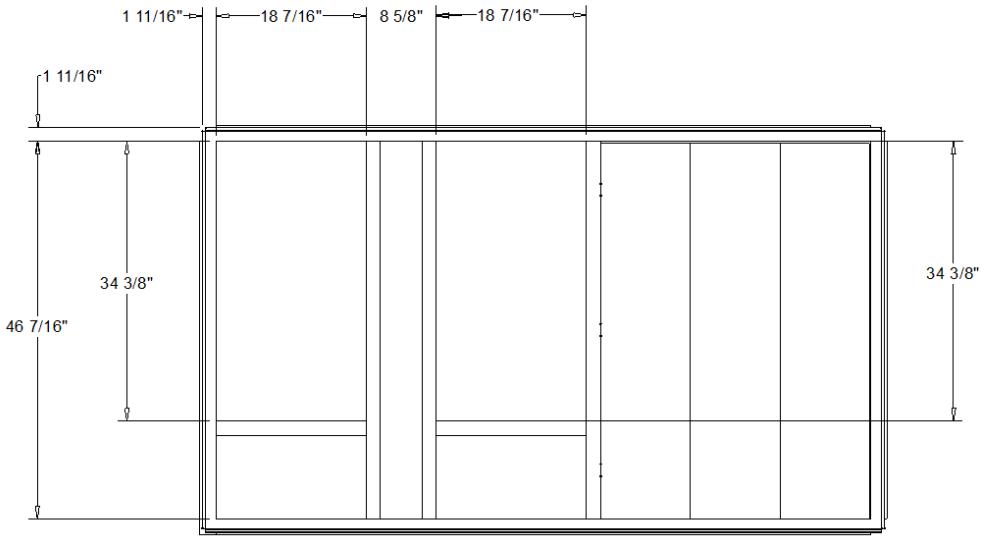


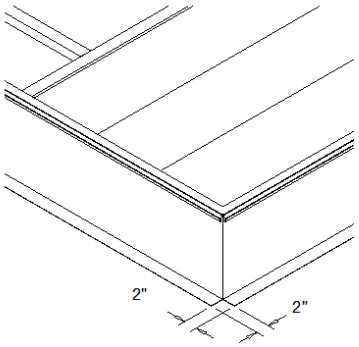
SWING DIAMETER - HINGED DOOR(S) OPTION

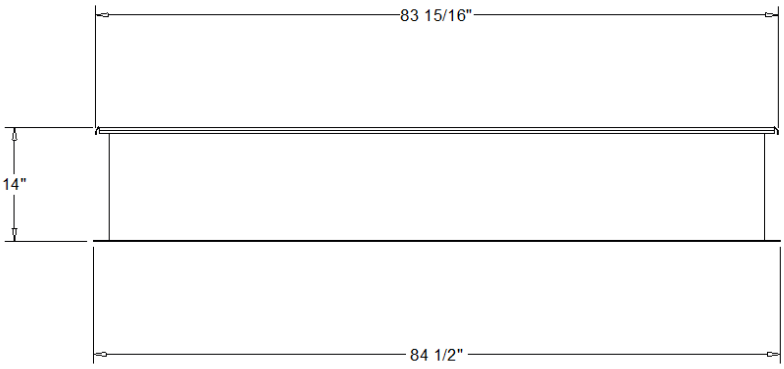
ACCESSORY

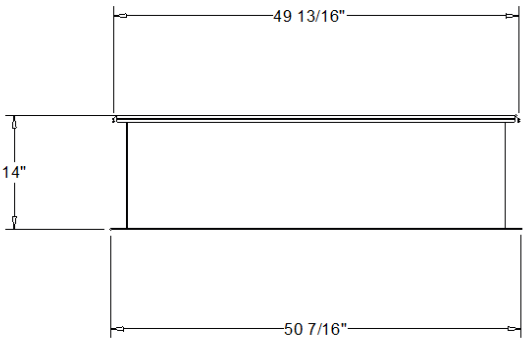
NOTES:
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION







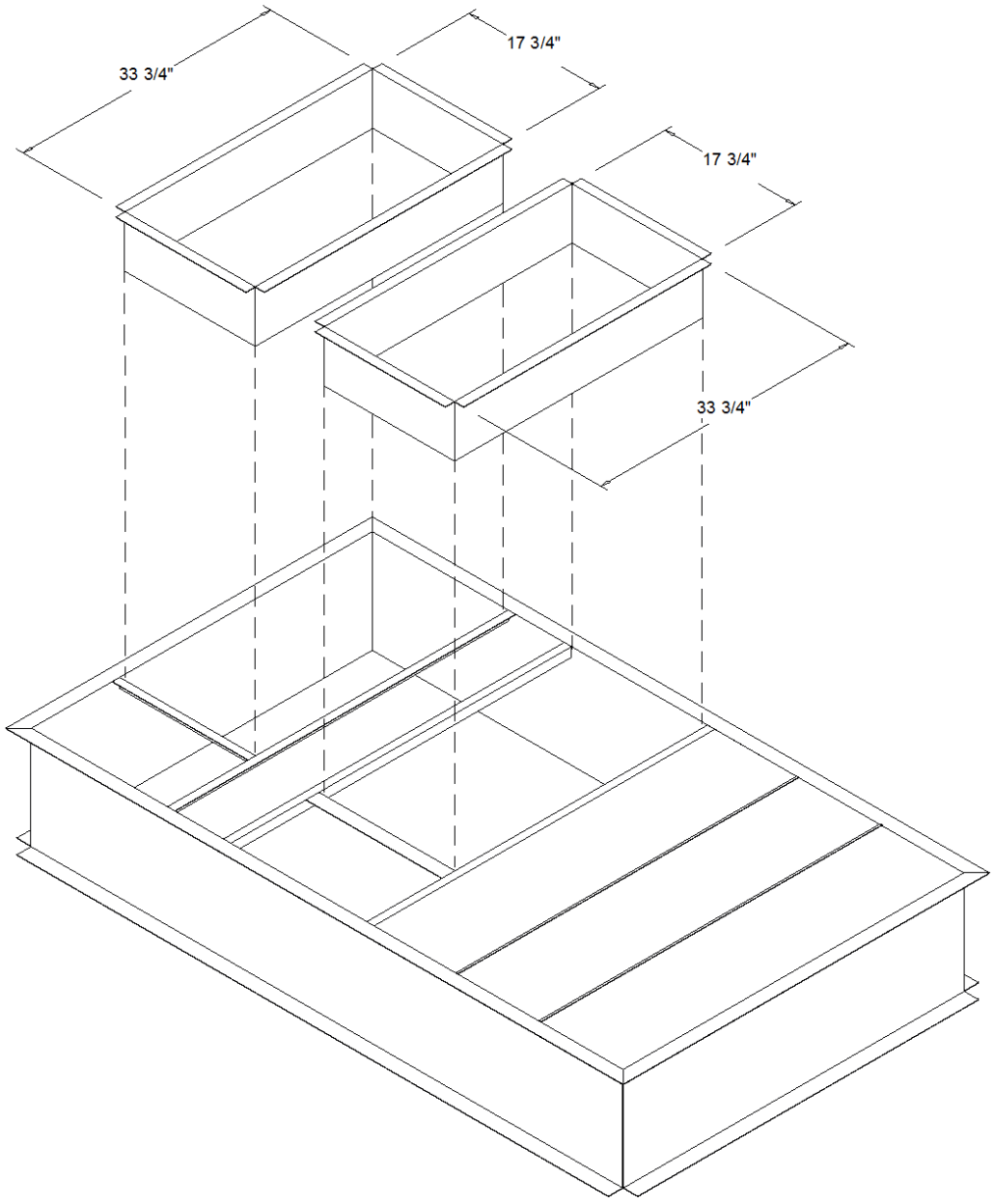




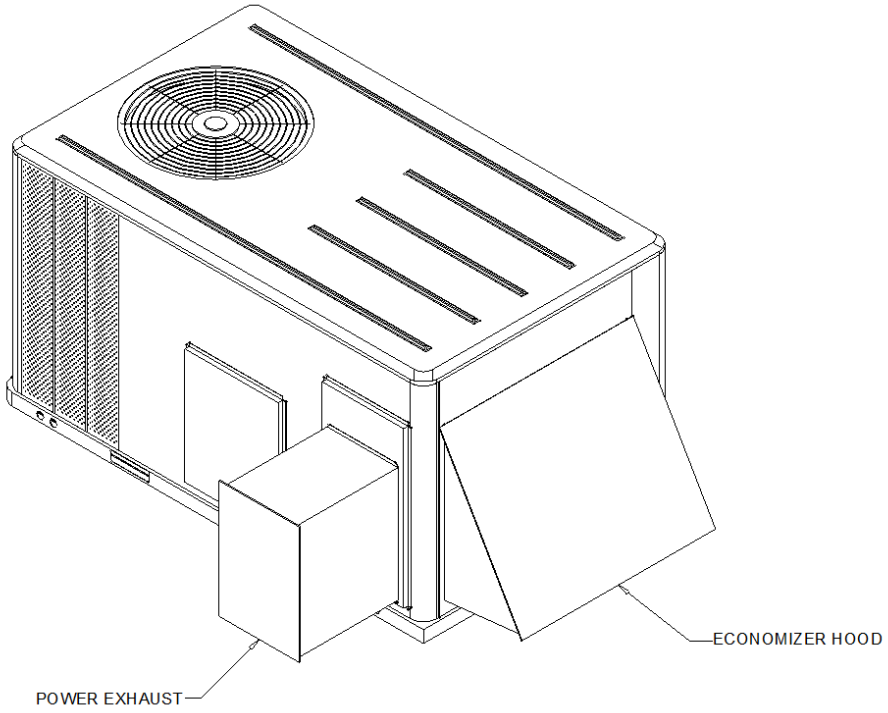
ROOF TOP CURB (BAYCURB043)

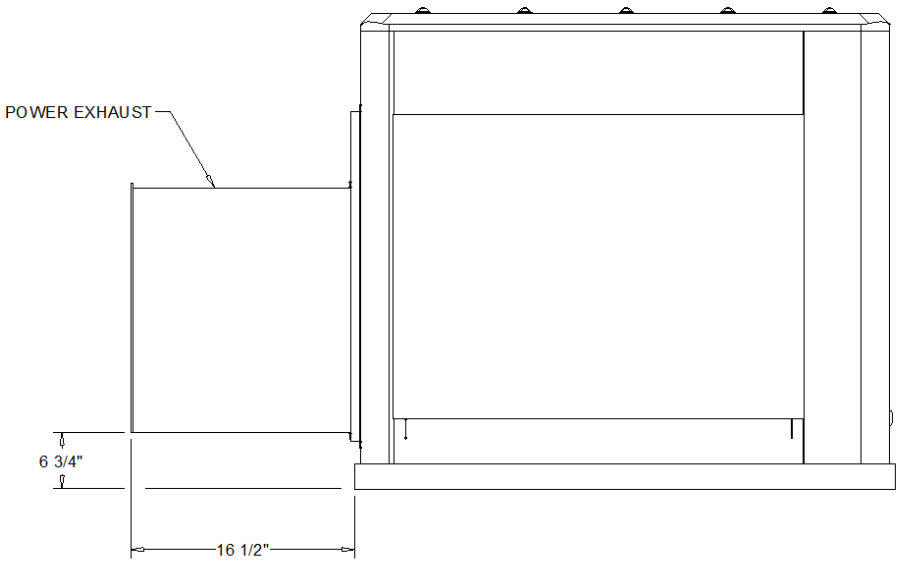
ACCESSORY

Downflow Duct Connections - Field Fabricated
All Flanges - 1 1/4"



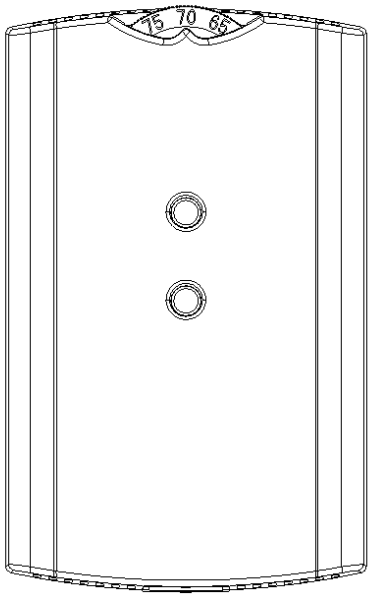
ACCESSORY - DUCT CONNECTIONS

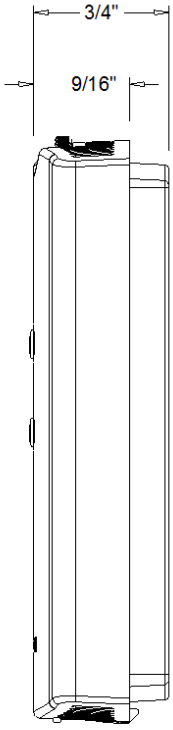


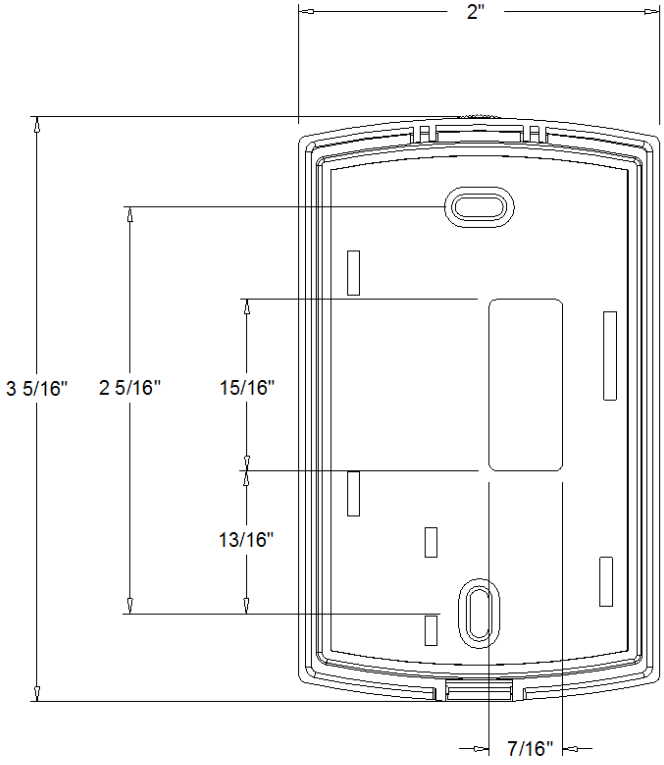


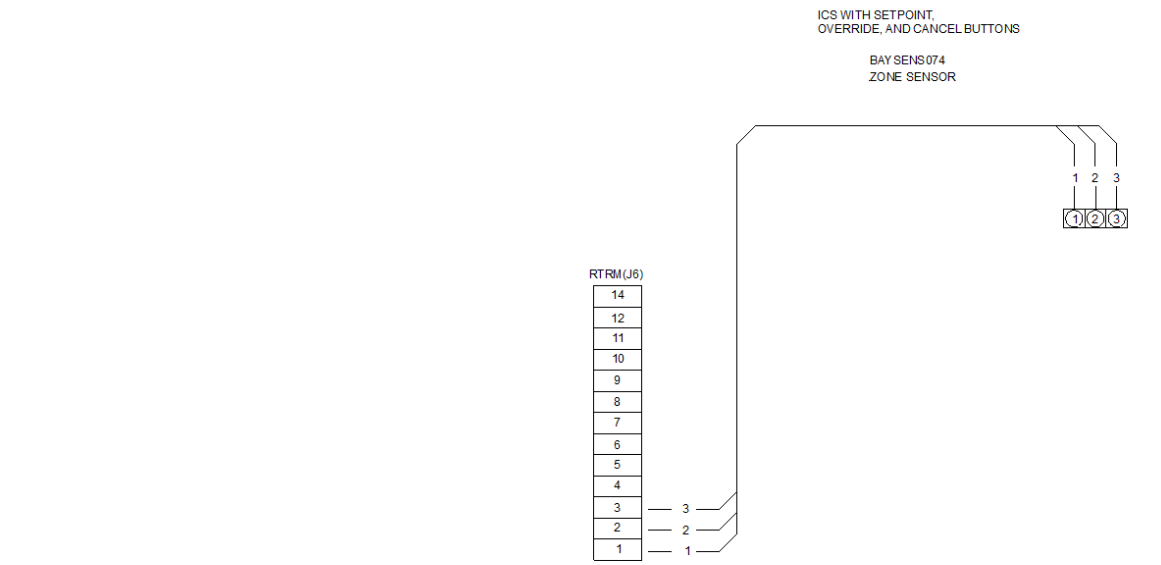
POWER EXHAUST AND HOOD

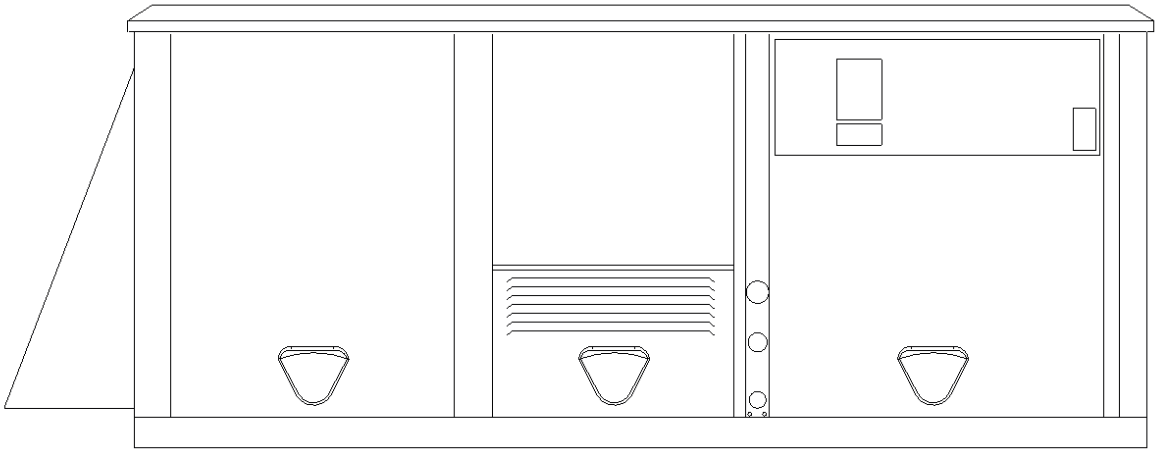
ACCESSORY


75 70 65


3/4"
9/16"


2"
3 5/16"
2 5/16"
15/16"
13/16"
7/16"



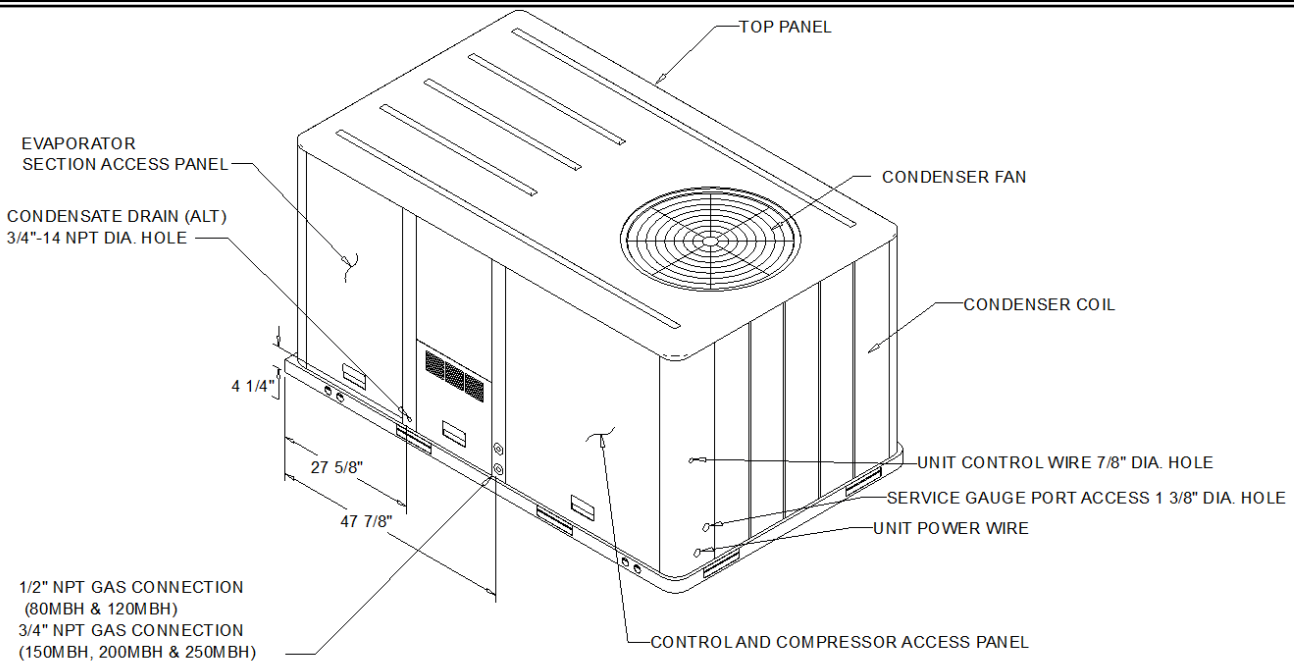


ZONE SENSOR WIRE TABLE

WIRE SIZE	MAXIMUM WIRE LENGTH
22 GAUGE	1800"
20 GAUGE	3000"
18 GAUGE	4500"
16 GAUGE	7200"
14 GAUGE	11700"

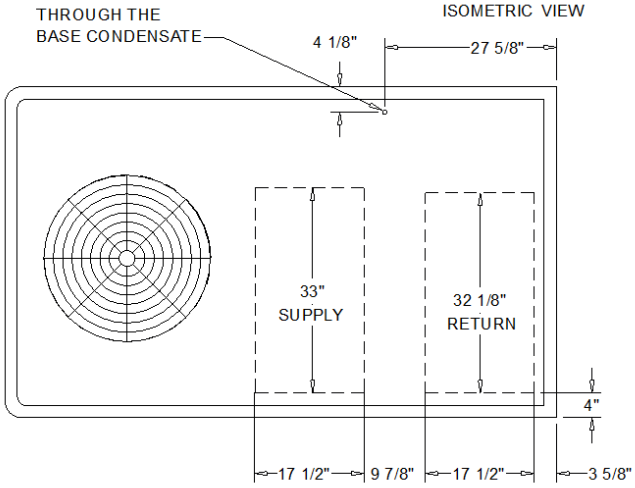
NOTE:

1. All wiring and devices shown dashed to be supplied and installed by the customer in accordance with national and local electrical codes.
2. Low voltage control wiring must not be run in conduit with power wiring.



PACKAGED GAS / ELECTRICAL

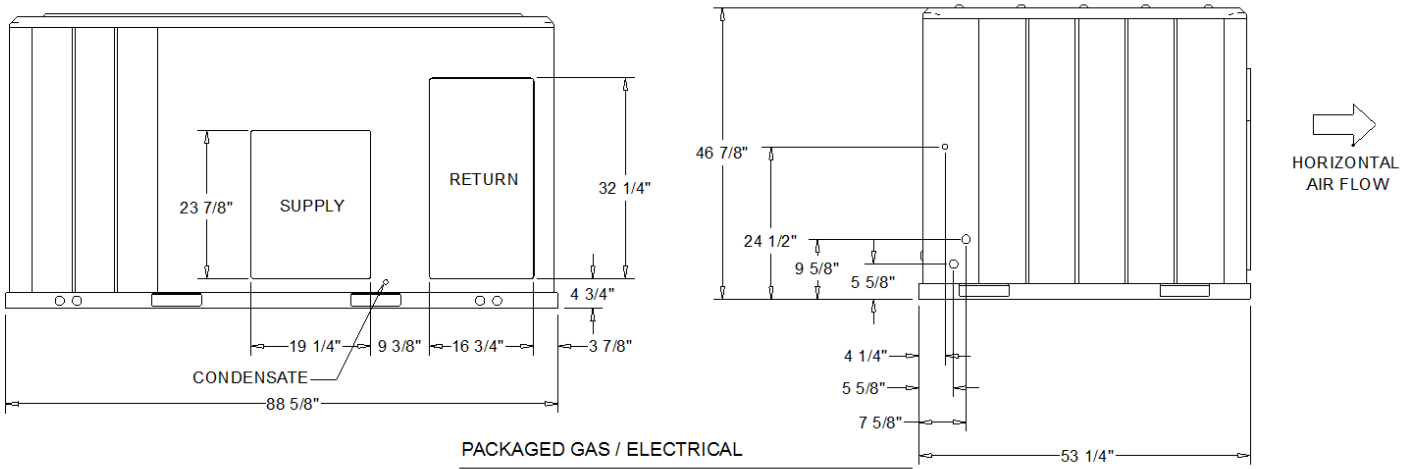
ISOMETRIC VIEW



NOTES:
1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.

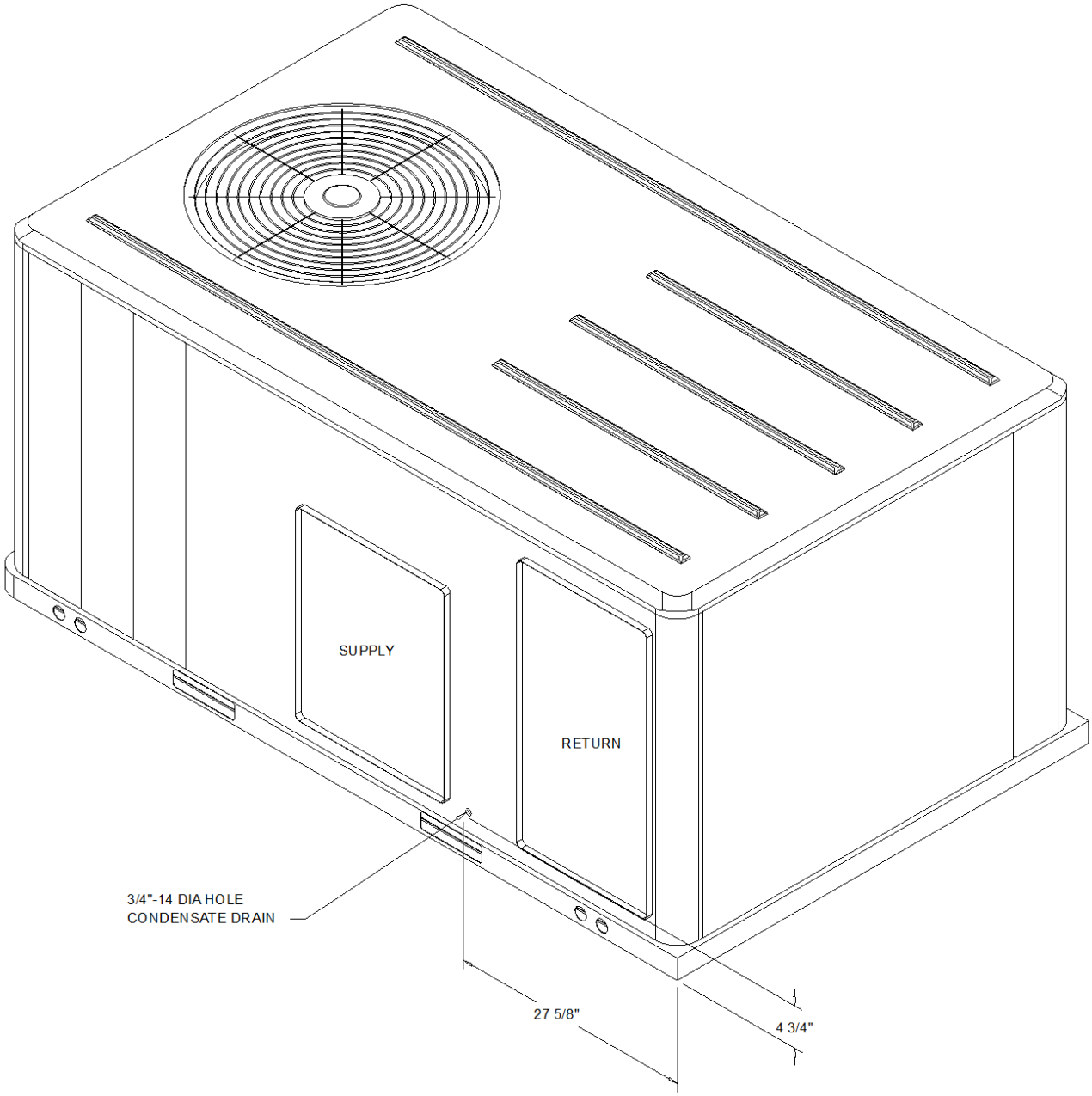
PLAN VIEW UNIT

DIMENSION DRAWING

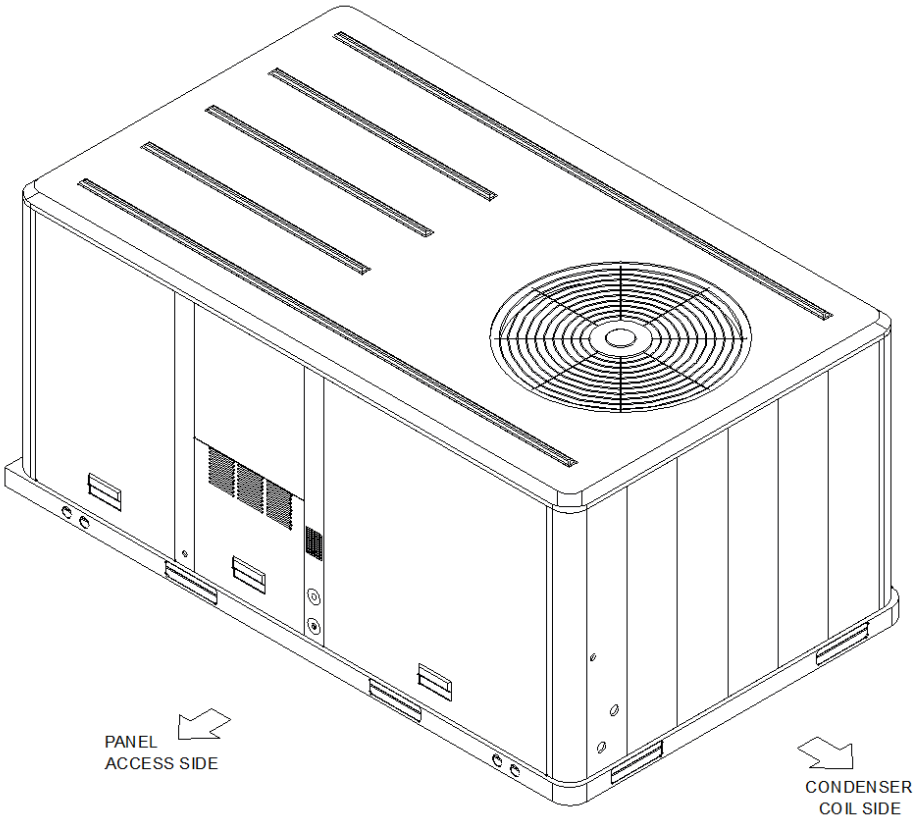


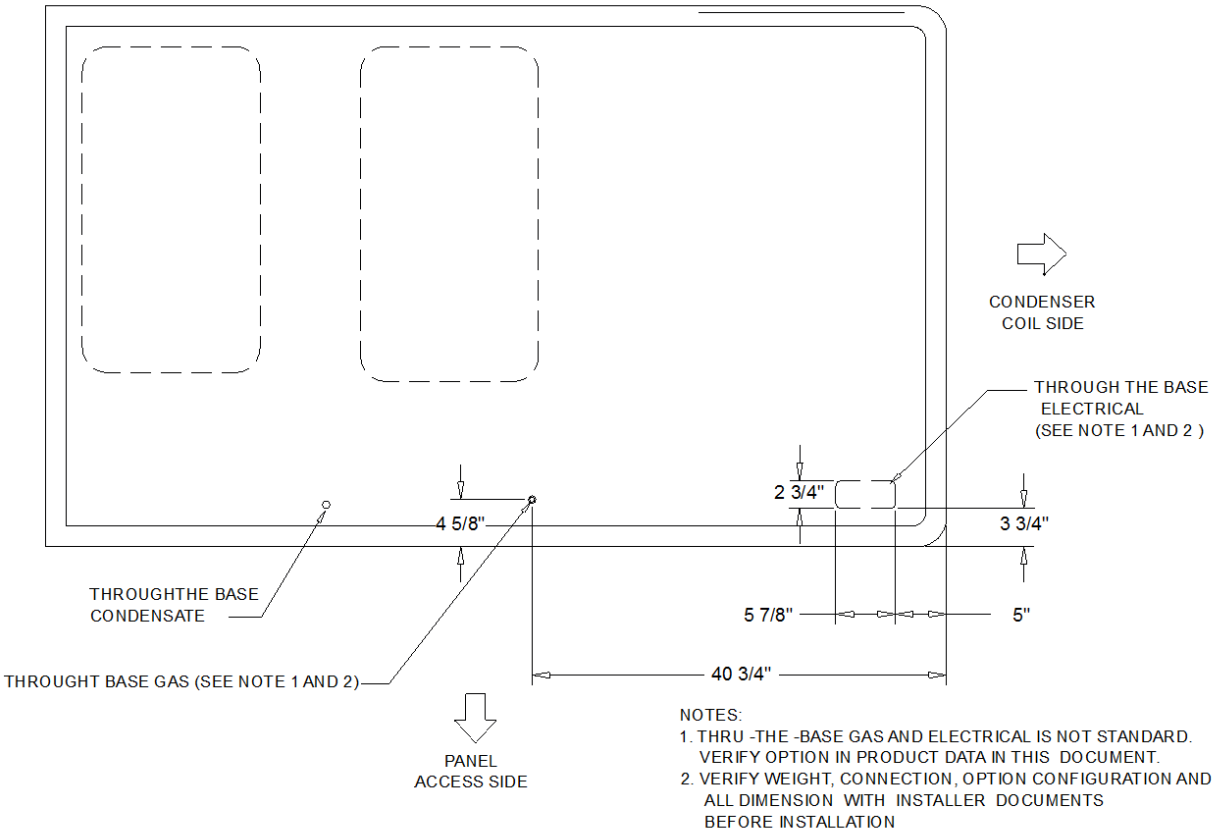
PACKAGED GAS / ELECTRICAL

DIMENSION DRAWING



ISOMETRIC-PACKAGED COOLING





NOTES:
1. THRU -THE -BASE GAS AND ELECTRICAL IS NOT STANDARD. VERIFY OPTION IN PRODUCT DATA IN THIS DOCUMENT.
2. VERIFY WEIGHT, CONNECTION, OPTION CONFIGURATION AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION

THRU THE BASE GAS / ELECTRICAL

PLAN / ISO VIEW DRAWING

ELECTRICAL / GENERAL DATA

GENERAL (2)(4)(6)

		Oversized Motor
Model:		
Unit Operating Voltage:	187-253	MCA: N/A
Unit Primary Voltage:	208	MFS: N/A
Unit Secondary Voltage	230	MCB: N/A
Unit Hertz:	60	
Unit Phase:	3	
EER / SEER	12.6/22.5	

Standard Motor		Field Installed Oversized Motor
MCA:	42.0	MCA: N/A
MFS:	60.0	MFS: N/A
MCB:	60.0	MCB: N/A

HEATING PERFORMANCE

HEATING - GENERAL DATA

Heating Model:	Modulating
Heating Input (BTU):	200000
Heating Output (BTU):	162000
No. Burners:	5
No. Stages	2.5:1 Modulating

Gas Inlet Pressure

Natural Gas (Min/Max):	4.5/14.0
LP (Min/Max)	11.0/14.0
Gas Pipe Connection Size L/M/H/Mod:	1/2"/3/4"/3/4"

INDOOR MOTOR

Standard Motor		Oversized Motor		Field Installed Oversized Motor	
Number:	1	Number:	N/A	Number:	N/A
Horsepower:	2.75	Horsepower:	N/A	Horsepower:	N/A
Motor Speed (RPM):	Direct/Variable	Motor Speed (RPM):	N/A	Motor Speed (RPM):	N/A
Phase	3	Phase	N/A	Phase	N/A
Full Load Amps:	7.3	Full Load Amps:	N/A	Full Load Amps:	N/A
	-		N/A		N/A

COMPRESSOR Circuit 1/2

Number:	1
Motor Speed	-
Phase:	Variable Speed
VFD Input Amps:	3
	-
	22.6
	--

OUTDOOR MOTOR

Number:	1
Horsepower:	0.75
Motor Speed (RPM):	1200
Phase:	1
Full Load Amps:	5.7
	-

POWER EXHAUST ACCESSORY (3,7)

(Field Installed Power Exhaust)

Phase:	1
Horsepower:	0.87
Motor Speed (RPM):	1075
Full Load Amps:	5.7
Locked Rotor Amps:	13.6

FILTERS

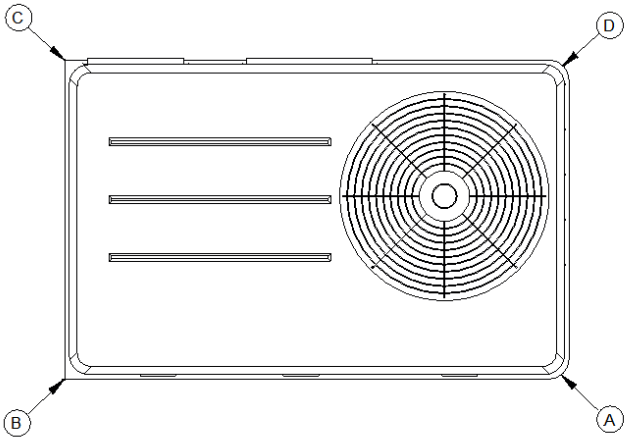
Type:	Throwaway
Furnished:	Yes
Number	4
Recommended	20"x25"x2"

REFRIGERANT (2)

Type	R-410A
Factory Charge	
Circuit #1	8.9 lb
Circuit #2	-

NOTES:

1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value does not include Power Exhaust Accessory.
4. Value includes oversized motor.
5. Value does not include Power Exhaust Accessory.
6. EER is rated at AHRI conditions and in accordance with DOE test procedures.
7. Installation of this power exhaust kit will affect unit level MCA and could affect MOP sizing having a direct impact on existing field wiring and unit protection devices. The change in MCA/MOP is the sole responsibility of the field installing party. Trane will not issue new nameplates as a result of this power exhaust accessory installation. FLA of the power exhaust kit option must be added to the MCA of the unit for building supply conductor sizing determination.



PACKAGED GAS / ELECTRICAL

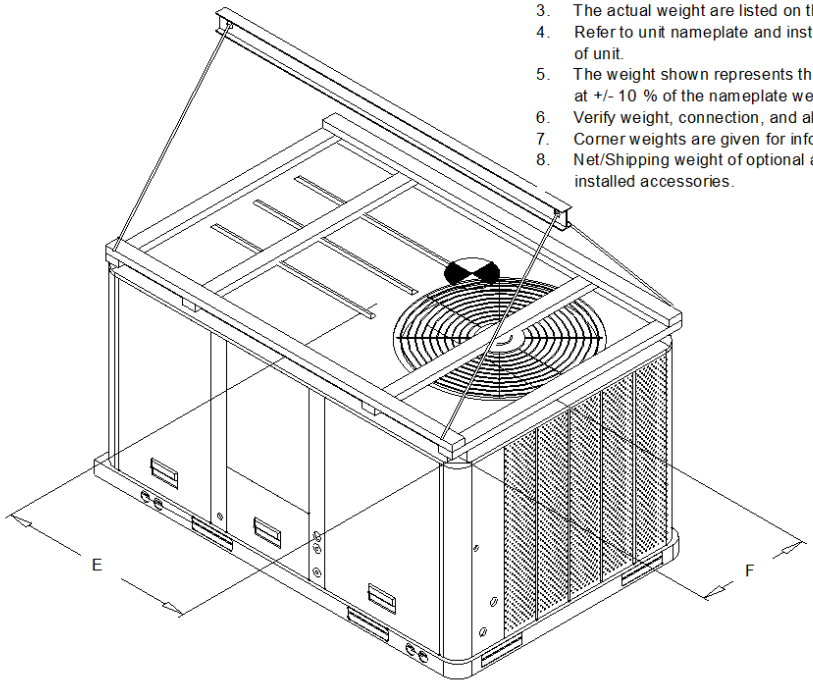
CORNER WEIGHT

INSTALLED ACCESSORIES NET WEIGHT DATA

ACCESSORY	WEIGHTS
ECONOMIZER	36.0 lb
MOTORIZED OUTSIDE AIR DAMPER	
MANUAL OUTSIDE AIR DAMPER	
BAROMETRIC RELIEF	
OVERSIZED MOTOR	
BELT DRIVE MOTOR	
POWER EXHAUST	80.0 lb
THROUGHT THE BASE ELECTRICAL/GAS (FIOPS)	18.0 lb
UNIT MOUNTED CIRCUIT BREAKER (FIOPS)	
UNIT MOUNTED DISCONNECT (FIOPS)	5.0 lb
POWERED CONVENIENCE OUTLET (FIOPS)	50.0 lb
HINGED DOORS (FIOPS)	12.0 lb
HAIL GUARD	30.0 lb
SMOKE DETECTOR, SUPPLY / RETURN	
NOVAR CONTROL	
STAINLESS STEEL HEAT EXCHANGER	
REHEAT	
ROOF CURB	78.0 lb

BASIC UNIT WEIGHTS		CORNER WEIGHTS				CENTER OF GRAVITIY	
SHIPPING	NET	(A)	248.0 lb	(C)	261.0 lb	(E) LENGHT	(F) WIDTH
1007.0 lb	909.0 lb	(B)	210.0 lb	(D)	190.0 lb	51"	26"

NOTE:
1. All weights are approximate.
2. Weights for options that are not list refer to Installation guide.
3. The actual weight are listed on the unit nameplate.
4. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
5. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
6. Verify weight, connection, and all dimension with installer documents before installation.
7. Corner weights are given for information only.
8. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.



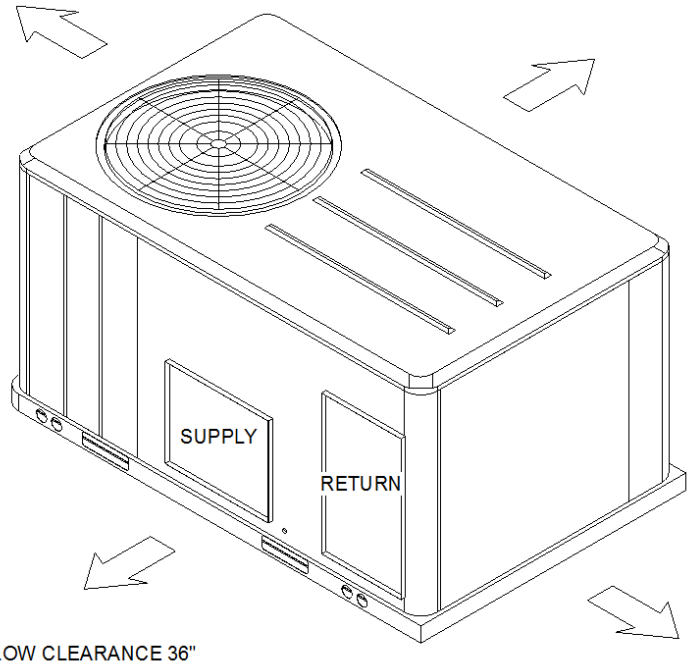
PACKAGED GAS / ELECTRICAL

RIGGING AND CENTER OF GRAVITY

CLEARANCE FROM TOP OF UNIT 72"

CLEARANCE 36"

CLEARANCE 48"



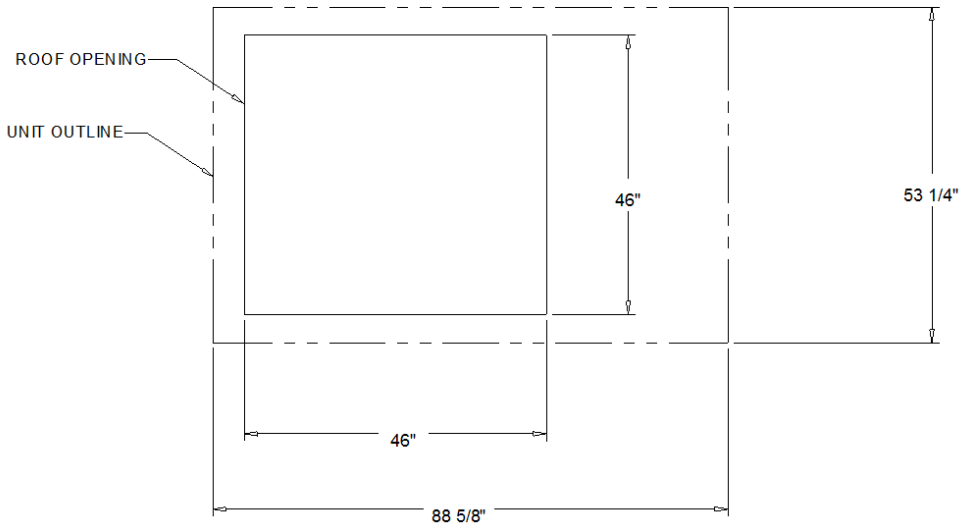
DOWNFLOW CLEARANCE 36"

HORIZONTAL CLEARANCE 18"

CLEARANCE 36"

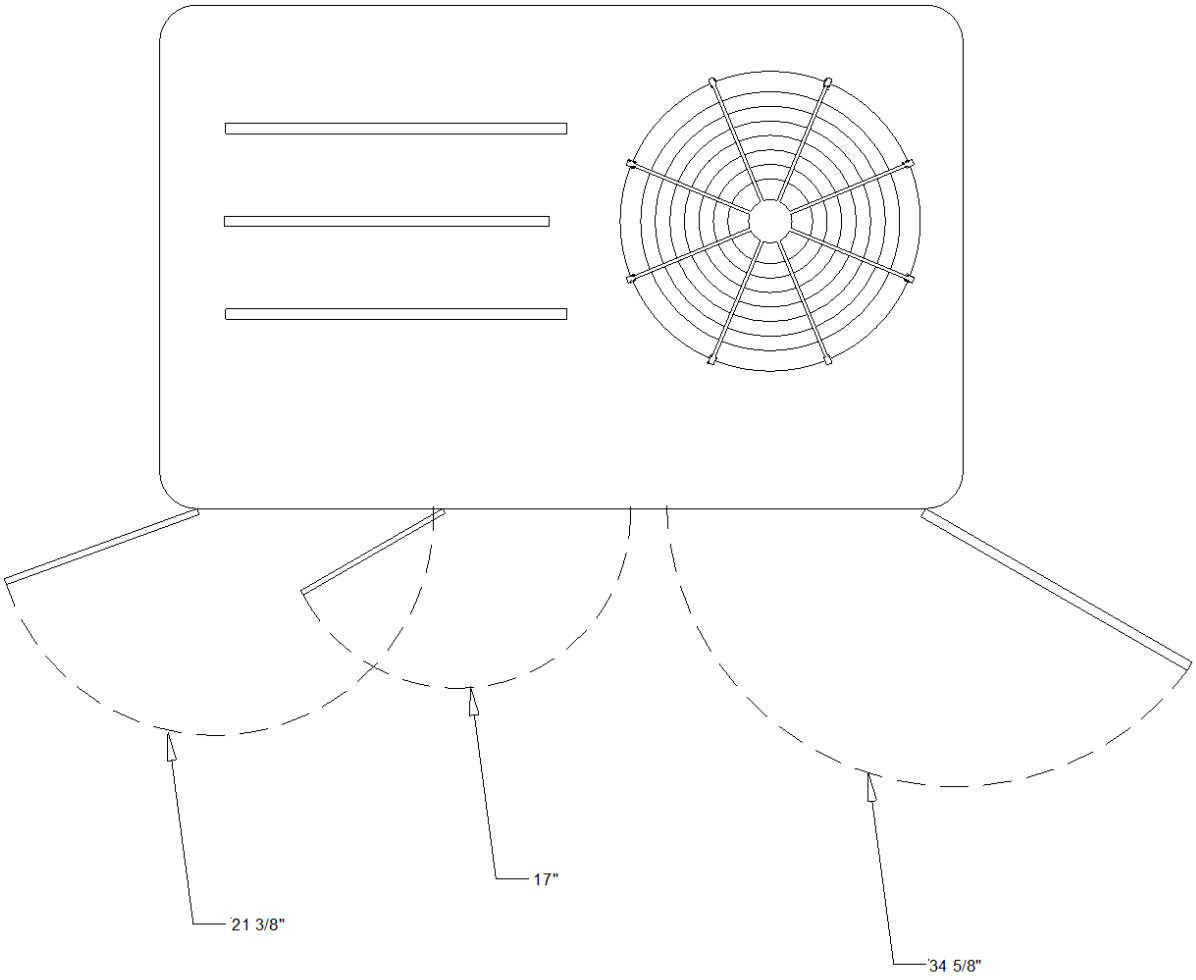
PACKAGED GAS / ELECTRIC

CLEARANCE



PACKAGED GAS / ELECTRIC

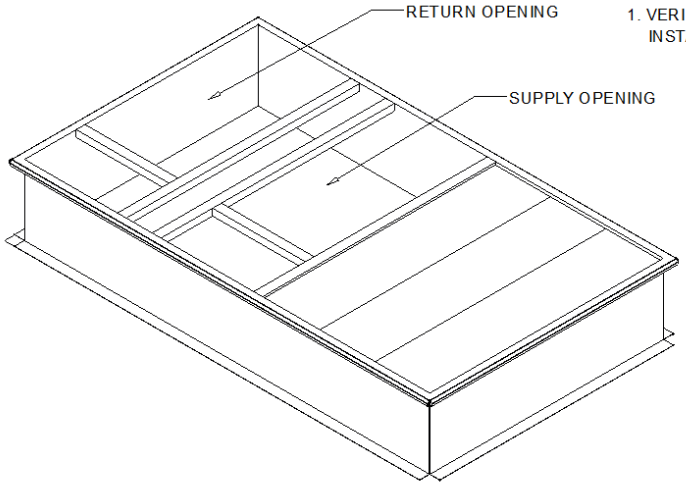
DOWNFLOW TYPICAL ROOF OPENING

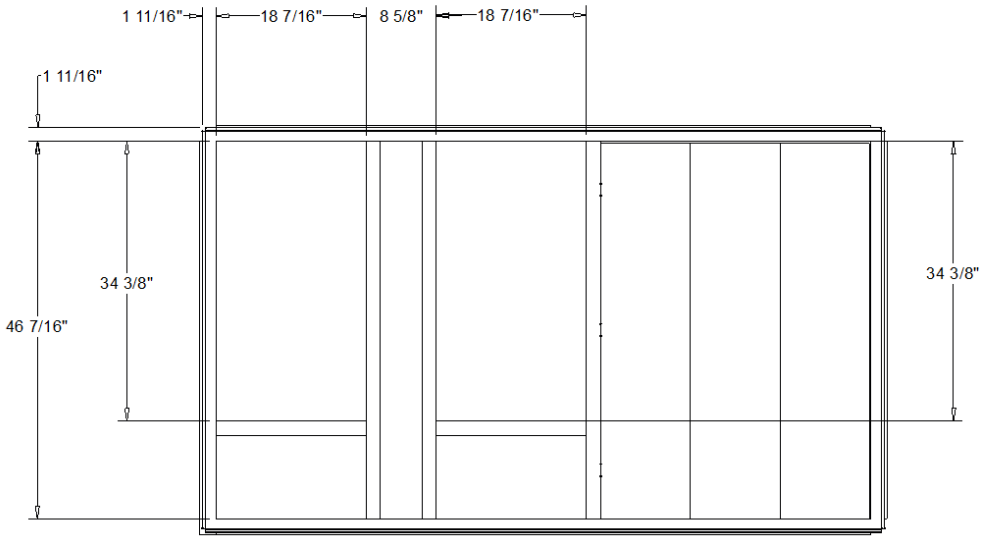


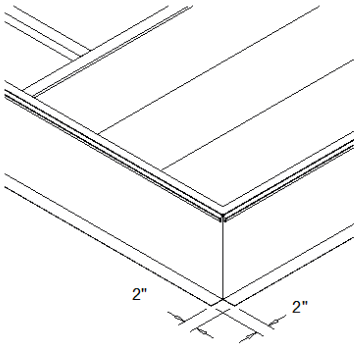
SWING DIAMETER - HINGED DOOR(S) OPTION

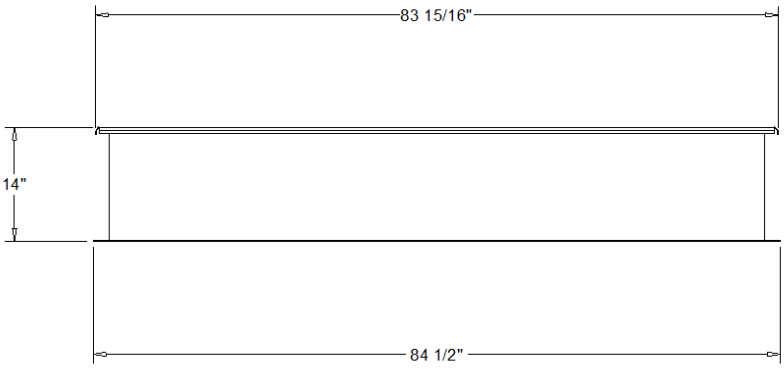
ACCESSORY

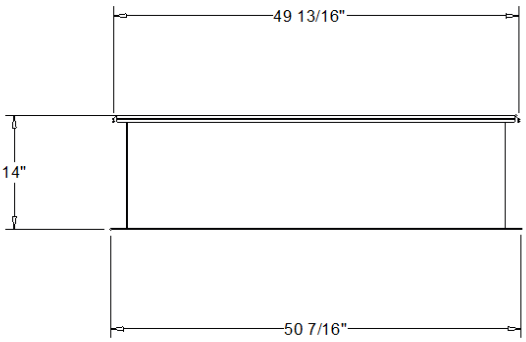
NOTES:
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION







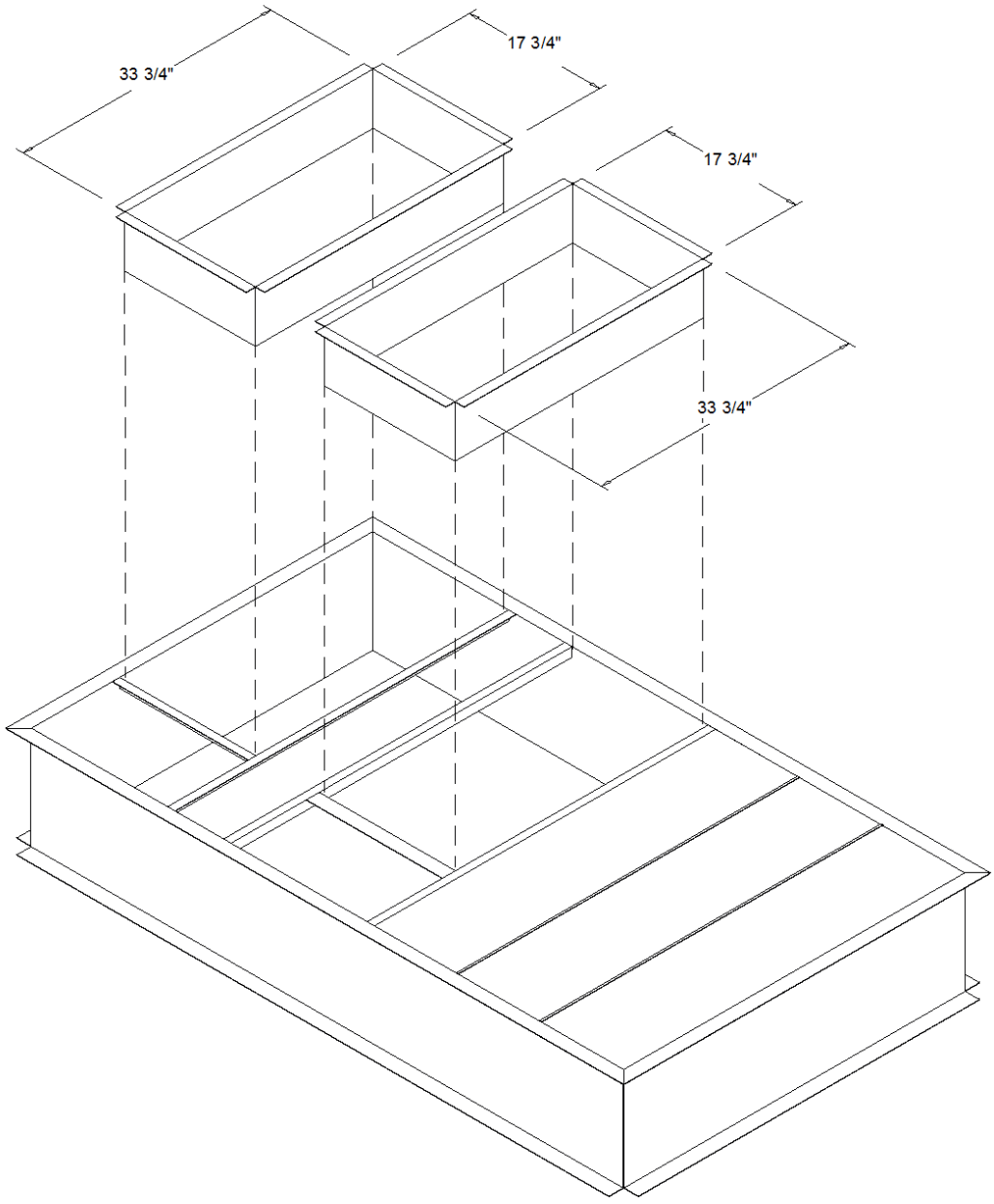




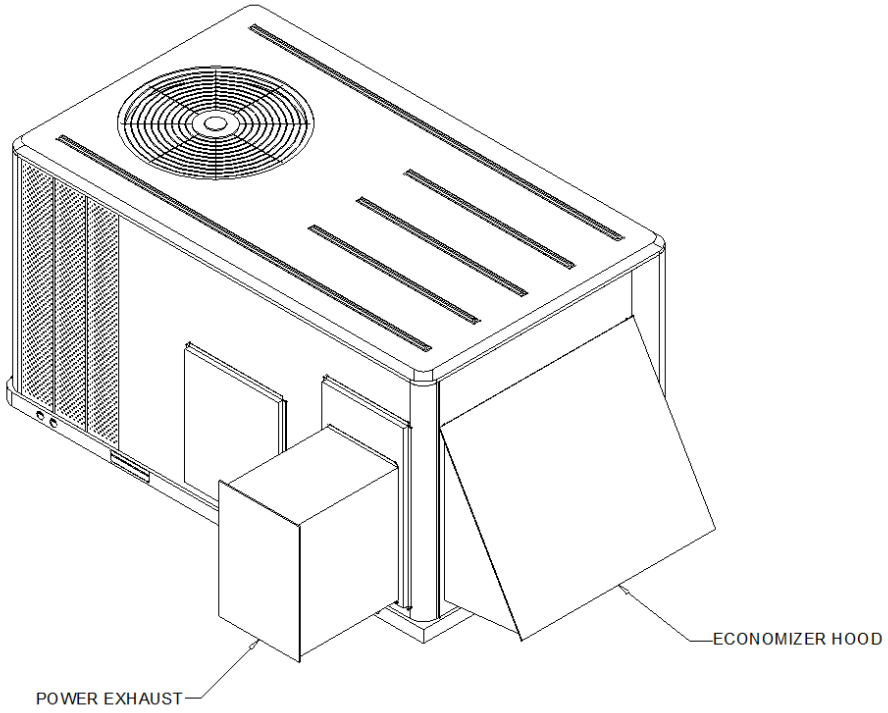
ROOF TOP CURB (BAYCURB043)

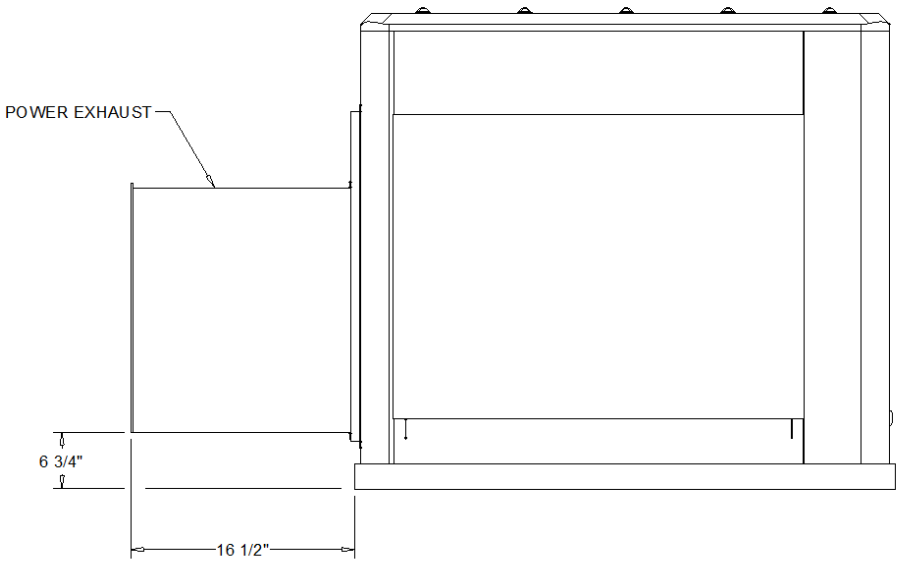
ACCESSORY

Downflow Duct Connections - Field Fabricated
All Flanges - 1 1/4"



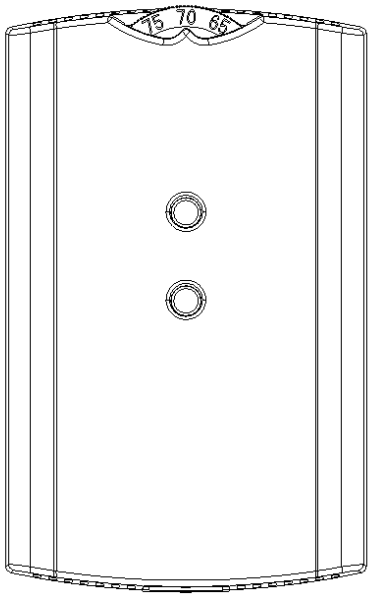
ACCESSORY - DUCT CONNECTIONS

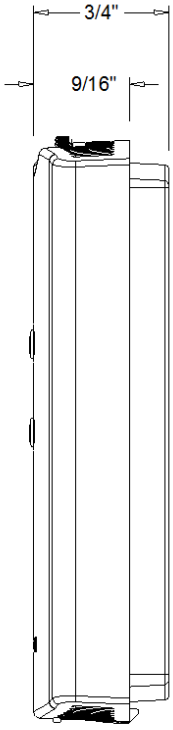


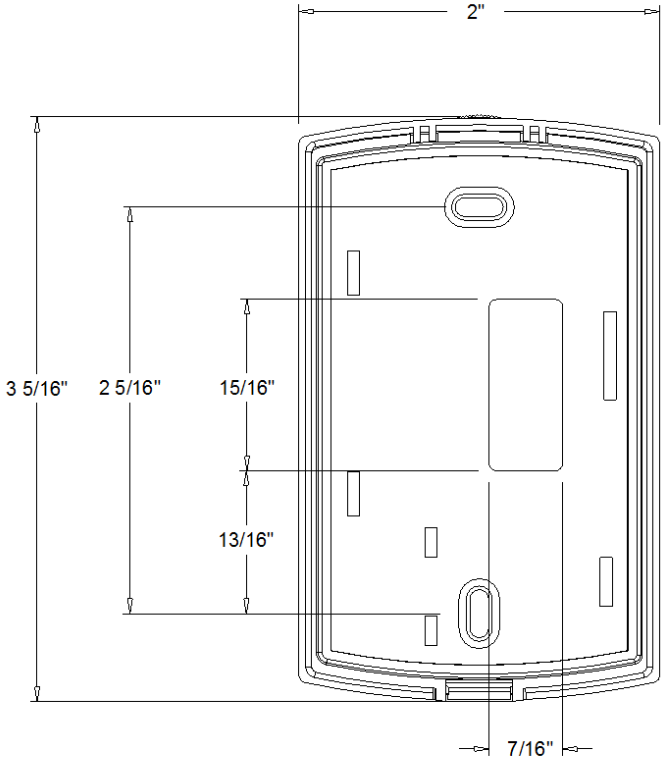


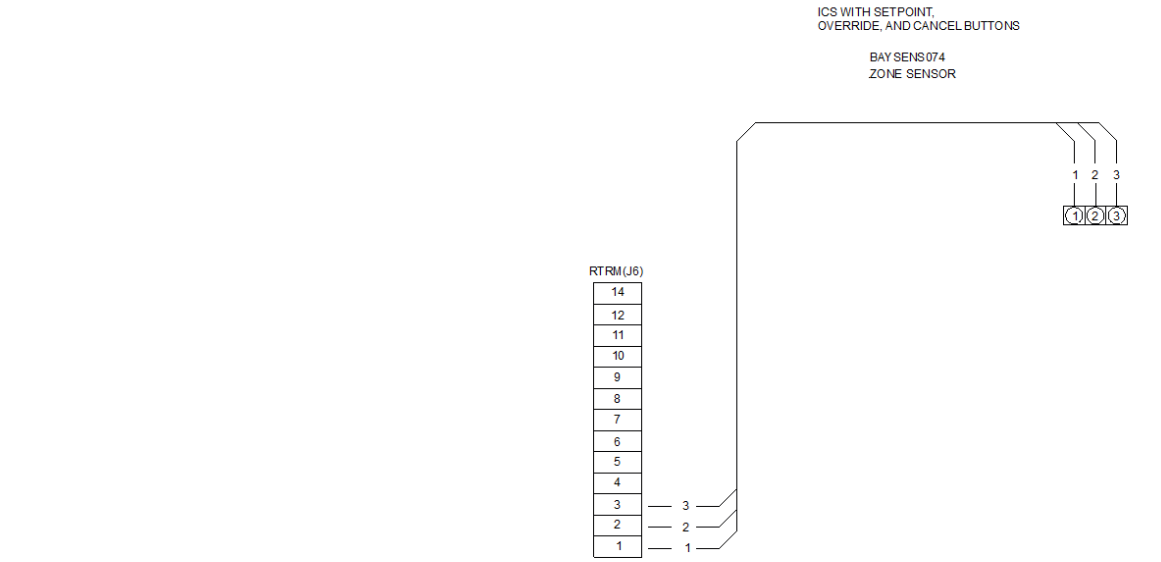
POWER EXHAUST AND HOOD

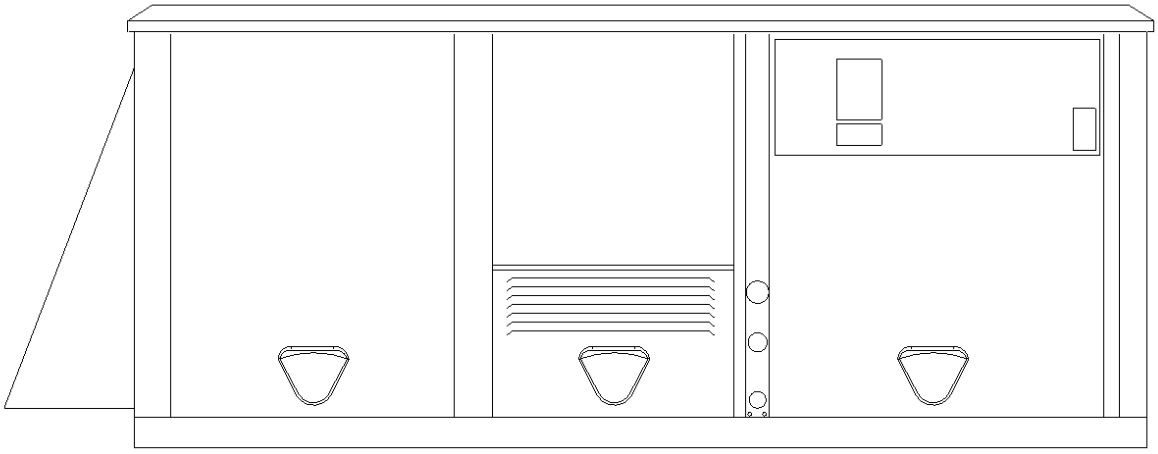
ACCESSORY


75 70 65


3/4"
9/16"


2"
3 5/16"
2 5/16"
15/16"
13/16"
7/16"





ZONE SENSOR WIRE TABLE

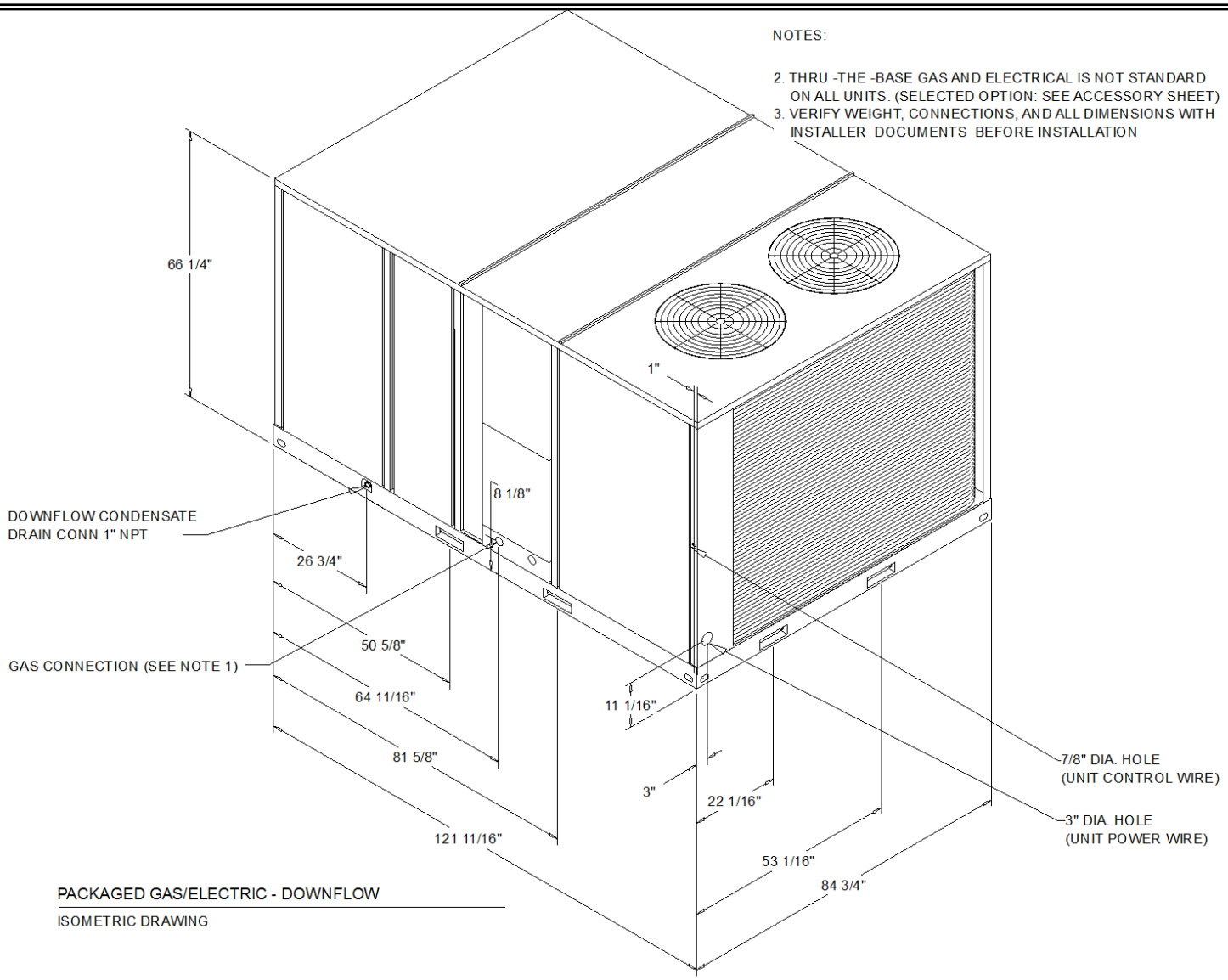
WIRE SIZE	MAXIMUM WIRE LENGTH
22 GAUGE	1800"
20 GAUGE	3000"
18 GAUGE	4500"
16 GAUGE	7200"
14 GAUGE	11700"

NOTE:

1. All wiring and devices shown dashed to be supplied and installed by the customer in accordance with national and local electrical codes.
2. Low voltage control wiring must not be run in conduit with power wiring.

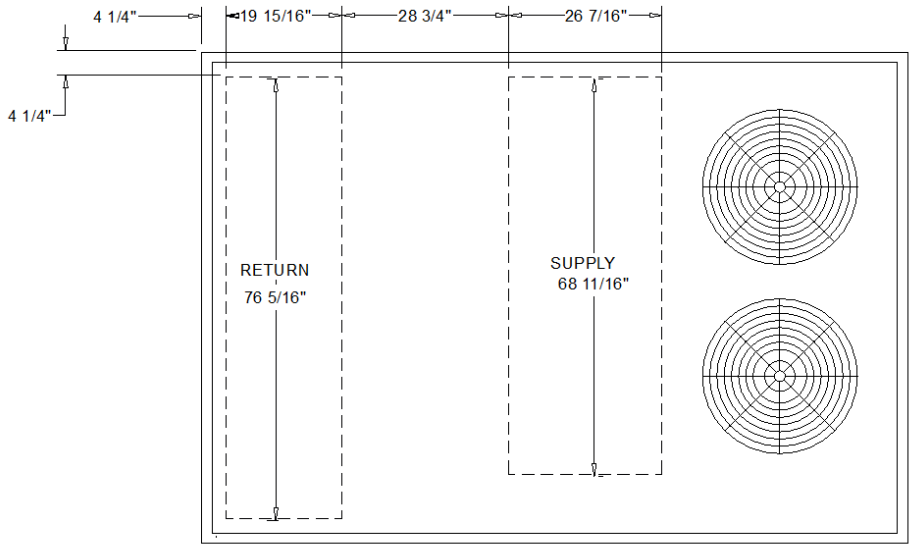
NOTES:

2. THRU -THE -BASE GAS AND ELECTRICAL IS NOT STANDARD ON ALL UNITS. (SELECTED OPTION: SEE ACCESSORY SHEET)
3. VERIFY WEIGHT, CONNECTIONS, AND ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION



PACKAGED GAS/ELECTRIC - DOWNFLOW

ISOMETRIC DRAWING



PACKAGED GAS/ELECTRIC - DOWNFLOW

PLAN VIEW DRAWING

ELECTRICAL / GENERAL DATA

GENERAL PERFORMANCE

Model (Ton):	YZD150F
Unit Operating Voltage Range:	187-253
Unit Primary Voltage:	208
Unit Secondary Voltage:	230
Unit Hertz:	60
Unit Phase:	3
EER: (5)	12.4
IEER	19.6

Standard Motor (1) (3)

Minimum Circuit Ampacity:	71.0/71.0
Maximum Fuse Size:	80.0/80.0
Maximum (HACR) Circuit Breaker:	80.0/80.0

Standard Oversized Motor (1) (4)

Minimum Circuit Ampacity:	
Maximum Fuse Size:	
Maximum (HACR) Circuit Breaker:	

Accessory Oversized Motor (1) (4)

Minimum Circuit Ampacity:	
Maximum Fuse Size:	
Maximum (HACR) Circuit Breaker:	

GAS HEATING

Heating Models:	Modulating Heat
Heating and 1 Stage Input (Btu/h)	350000/140000
Heating and 1 Stage Output (Btu/h):	283500/113400
Min./Max. Gas Input - Pressure Natural or LP (in w.c):	2.5/14.0 (Natural only)
Gas Connection Pipe Size:	3/4"

COMPRESSOR

	Circuit(s)
Number:	3
Horsepower:	3.7
Phase:	3
Rated Load Amps:	14.5/14.5
Locked Rotor Amps:	98.0/98.0
VFD Input Amps:	16.0

INDOOR MOTOR

Standard Motor

Number: (3)	1
Horsepower:	3.0
Motor Speed (RPM):	1740
Phase:	3
Full Load Amps:	10.6
Locked Rotor Amps:	81.0

Standard Oversized Motor (4)

Number:	
Horsepower:	
Motor Speed (RPM):	
Phase:	
Full Load Amps:	
Locked Rotor Amps:	

Accessory Oversized Motor (4)

Number:	
Horsepower:	
Motor Speed (RPM):	
Phase:	
Full Load Amps:	
Locked Rotor Amps:	

OUTDOOR MOTOR

Number:	2
Horsepower:	0.5
Motor speed (RPM):	1140
Phase:	1
Full Load Amps:	5.3
Locked Rotor Amps:	-

POWER EXHAUST

(Field Installed Power Exhaust)

Horsepower:	0.75
Motor Speed (RPM):	1040
Phase:	1
Full Load Amps:	6.6
Locked Rotor Amps:	13.5

COMBUSTION BLOWER MOTOR

(Gas-Fired Heating only)

Horsepower:	0.25
Motor Speed (RPM):	4600/950
Phase:	3
Full Load Amps:	0.8
Locked Rotor Amps:	2.0

FILTER

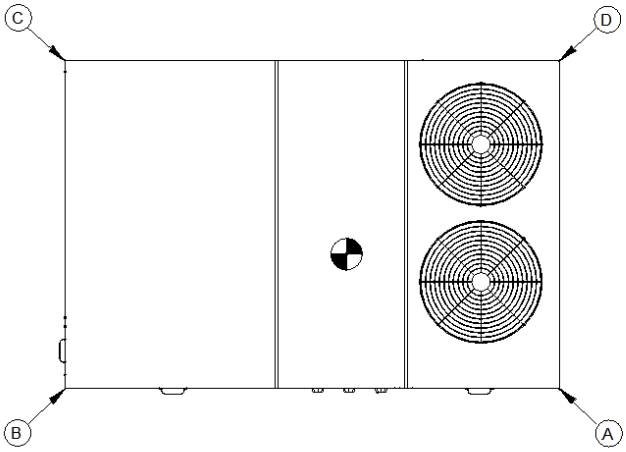
Type:	Throwaway
Furnished:	Yes
Number:	8/4
Recommended Size:	20"x20"x2" 20"x16"x2"

REFRIGERANT (2)

	Circuit #1 / 2
Type:	R410A
Factory Charge Circuit #1 / 2:	14.0 lb/9.0 lb

NOTES:

1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value include Standard Motor.
4. Value include Oversized Motor
5. EER is rated at AHRI conditions and in accordance with DOE test procedures.



CORNER WEIGHT

Base Unit and Corner Weights only

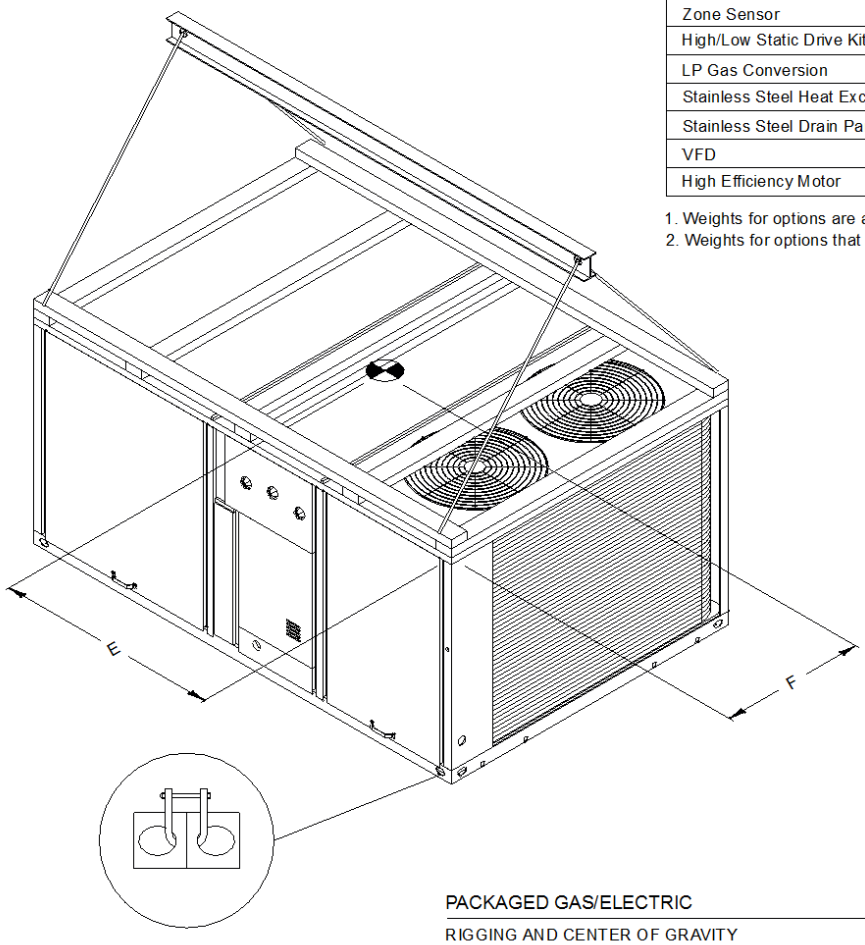
Base unit weights		Corner Weights				Center of Gravity	
SHIPPING	NET	(A)	(B)	(C)	(D)	E	F
2680.0 lb	2237.0 lb	708.0 lb	612.0 lb	420.0 lb	497.0 lb	56"	35"

1. All weights are approximate.
2. The actual weight are listed on the unit nameplate.
3. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
4. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
5. Verify weight, connection, and all dimension with installer documents before installation.
6. Corner weights are given for information only.
7. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.

Installed Options Net Weight Data

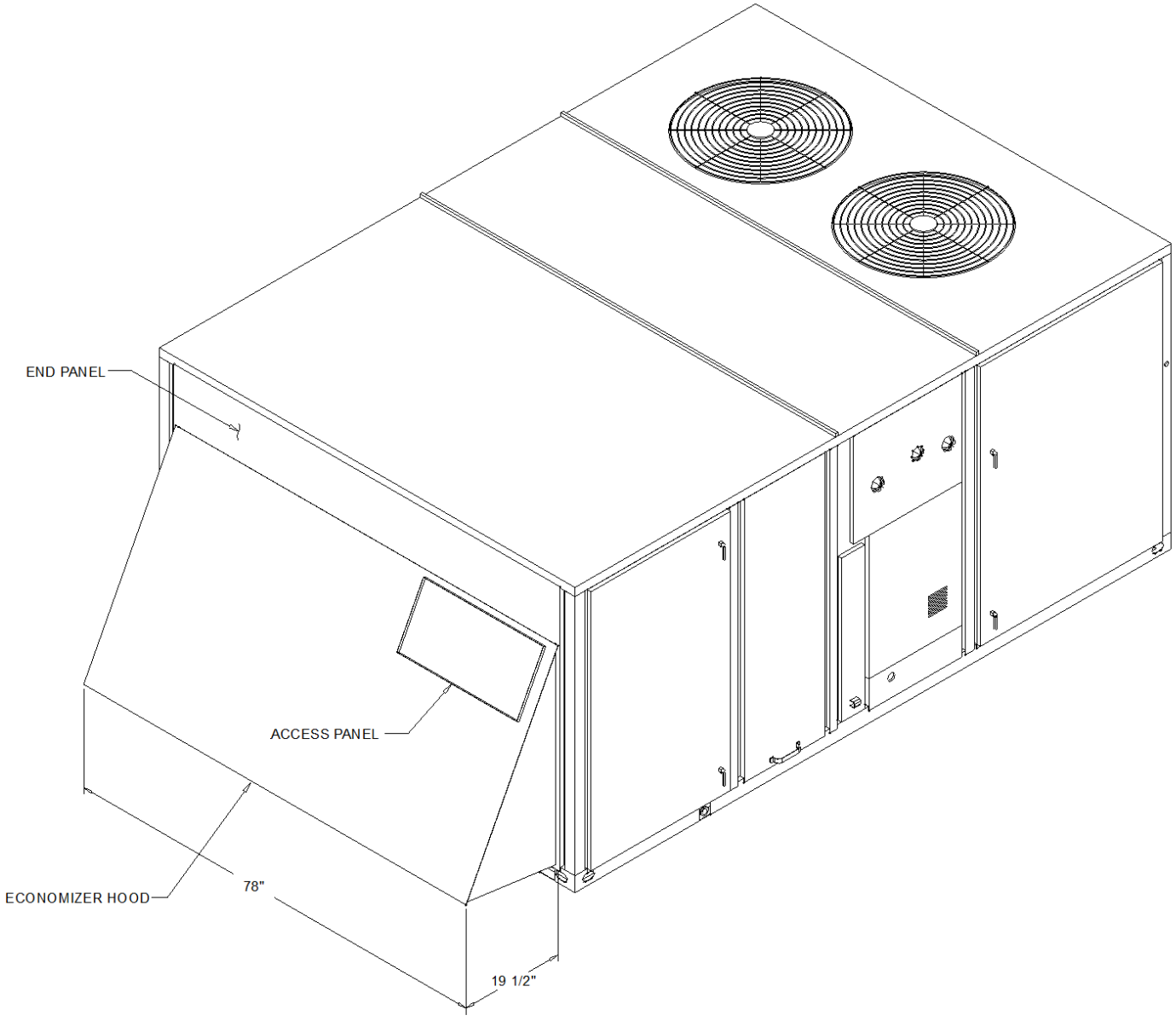
Accessory	Weight
Economizer, Manual and Motorized Outside Air Damper	80.0 lb
Power Exhaust	95.0 lb
Roof Curb	235.0 lb
Oversized Motor	
Hail Guard	43.0 lb
Hinged Access Doors	27.0 lb
Power Conv. Outlet	38.0 lb
Through the Base Electrical	23.0 lb
Circuit Breaker	
Disconnect	10.0 lb
Smoke Detector	
Novar	
Zone Sensor	1.0 lb
High/Low Static Drive Kit	
LP Gas Conversion	
Stainless Steel Heat Exchanger	
Stainless Steel Drain Pan	
VFD	
High Efficiency Motor	

1. Weights for options are approximate.
2. Weights for options that are not list refer to Installation guide.



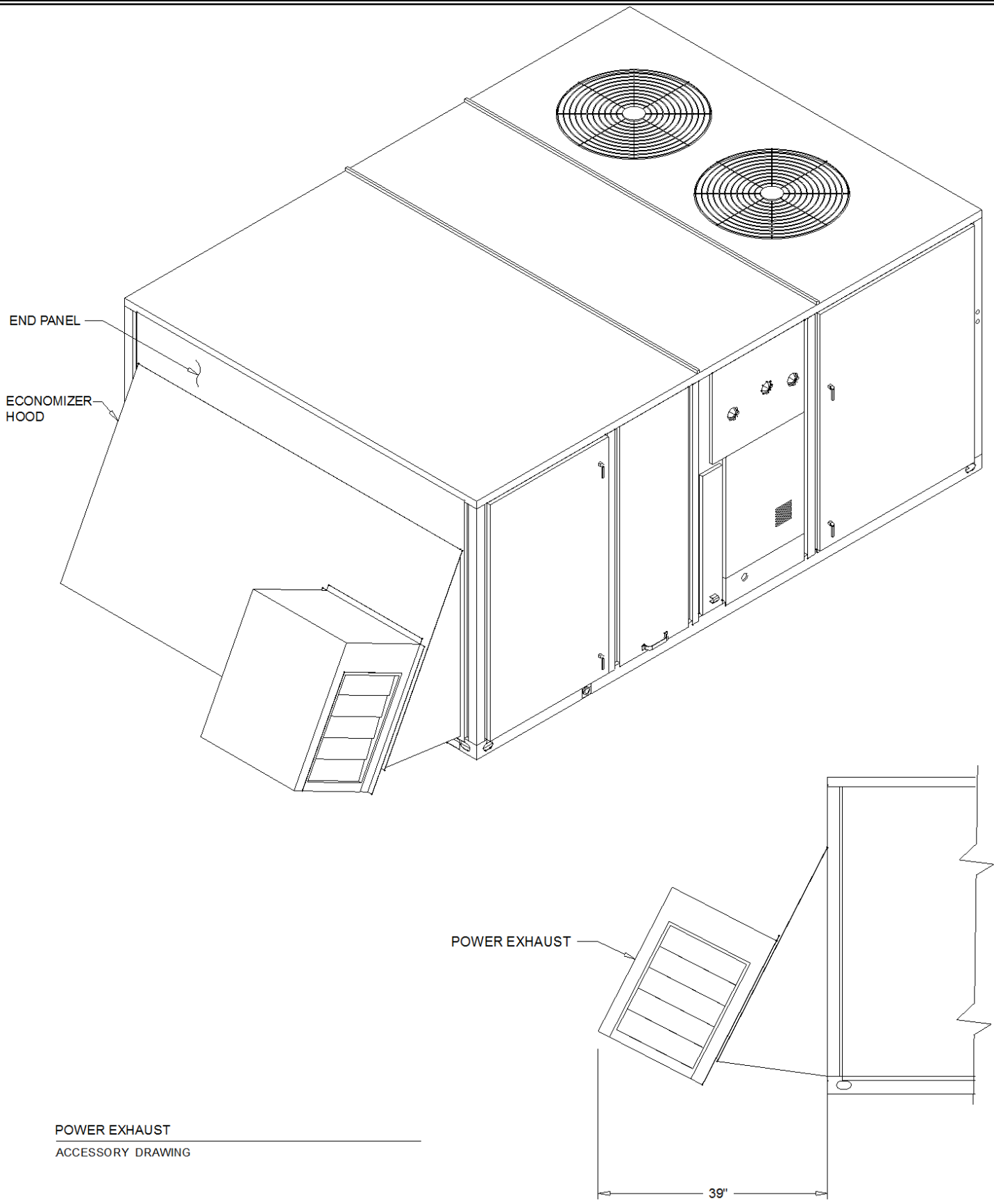
PACKAGED GAS/ELECTRIC

RIGGING AND CENTER OF GRAVITY



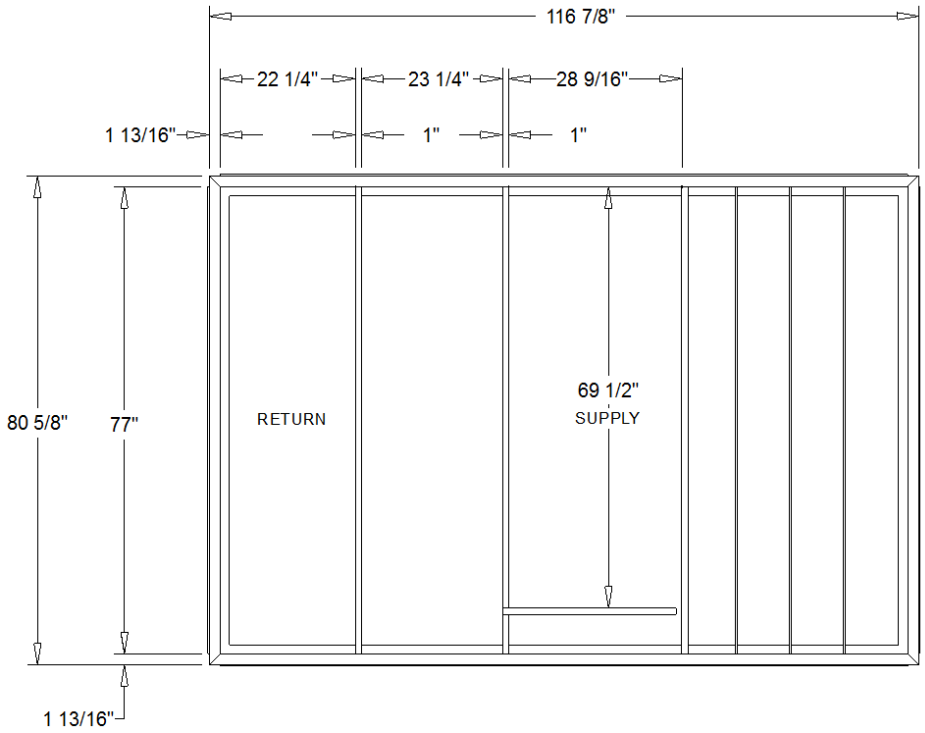
ECONOMIZER HOOD

PLAN VIEW DRAWING

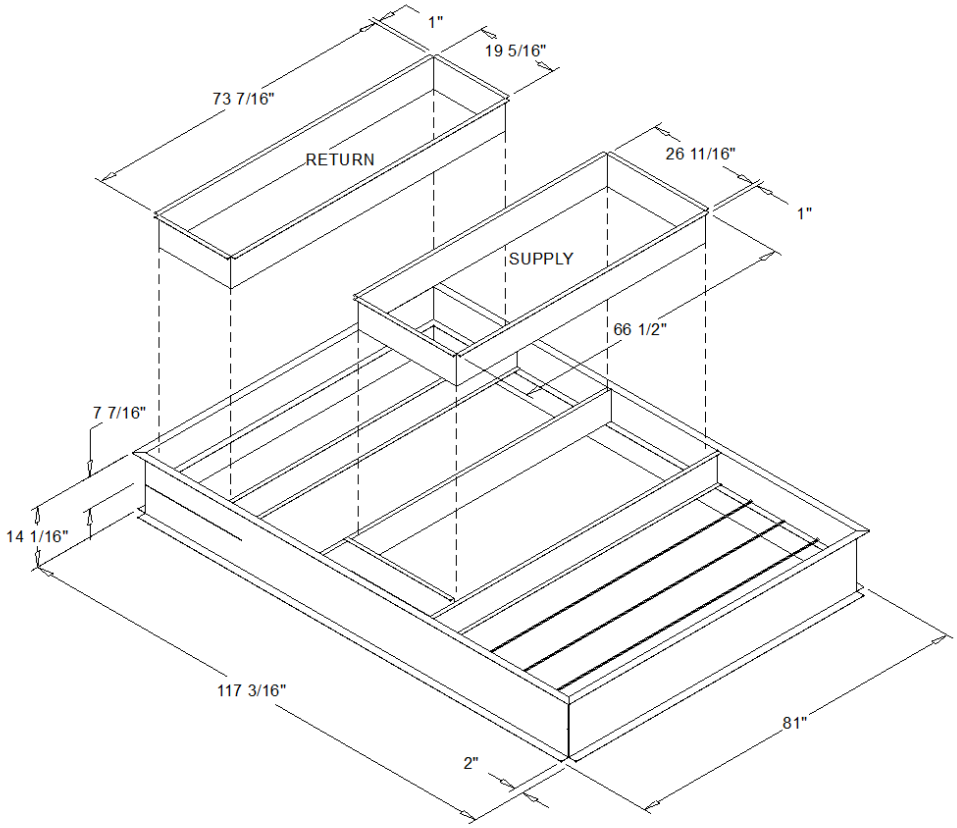


POWER EXHAUST

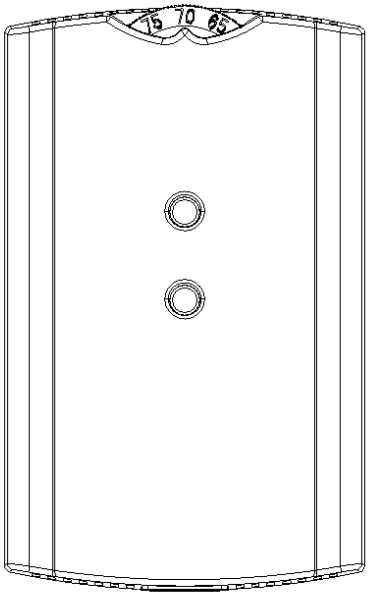
ACCESSORY DRAWING

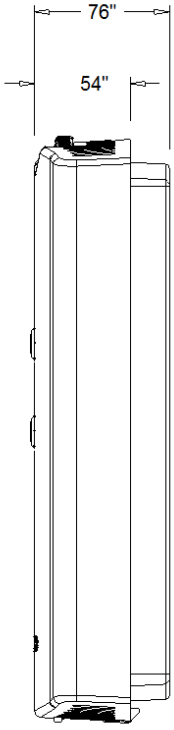


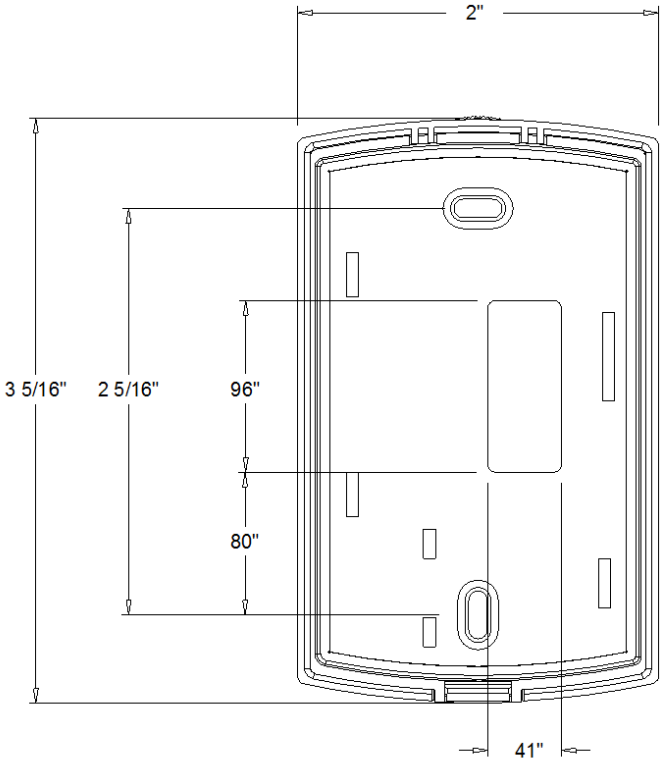
ACCESSORY-ROOF CURB



ACCESSORY-DOWNFLOW DUCT CONNECTIONS


75 70 65


76"
54"


2"
3 5/16"
2 5/16"
96"
80"
41"

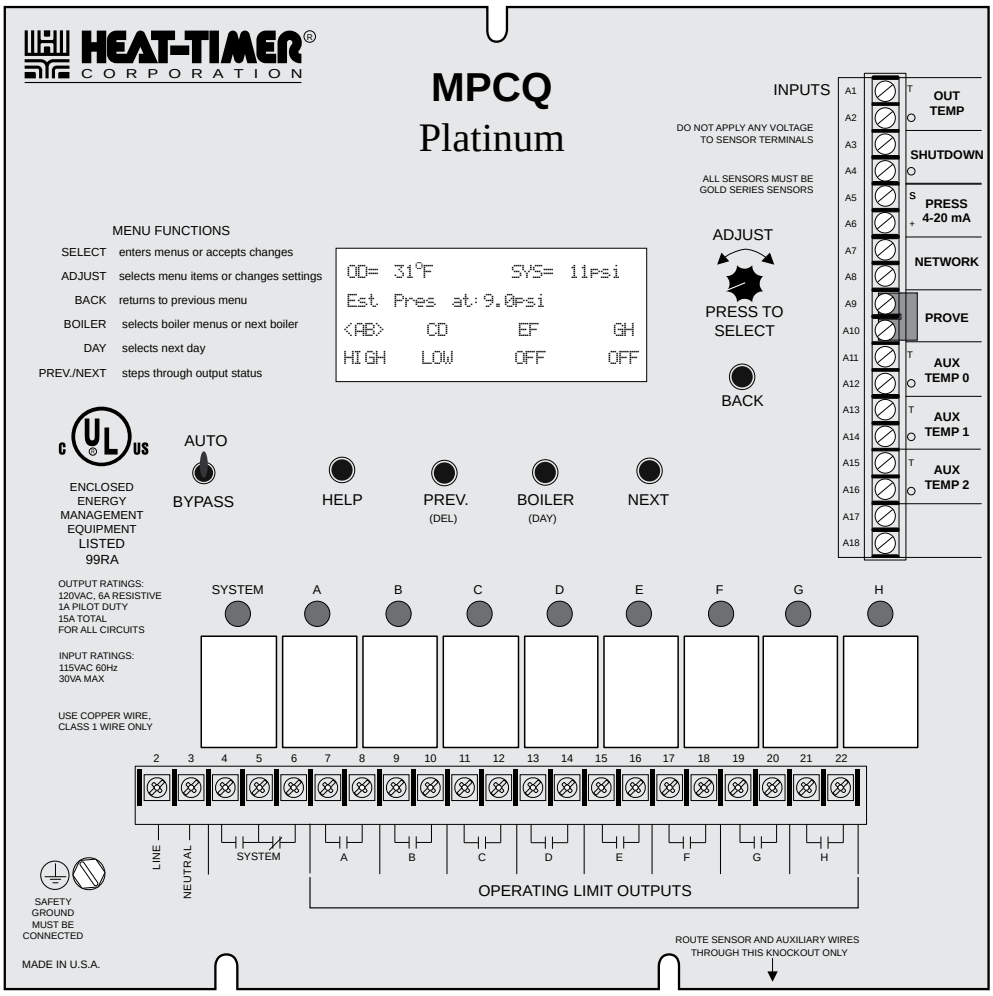
HEAT-TIMER®

INSTALLATION AND OPERATION INSTRUCTIONS

MPCQ Platinum

STEAM HEATING AND SEQUENCING CONTROL

RESET CONTROLS FOR MULTIPLE BOILER STEAM HEATING SYSTEMS



⚠ WARNING

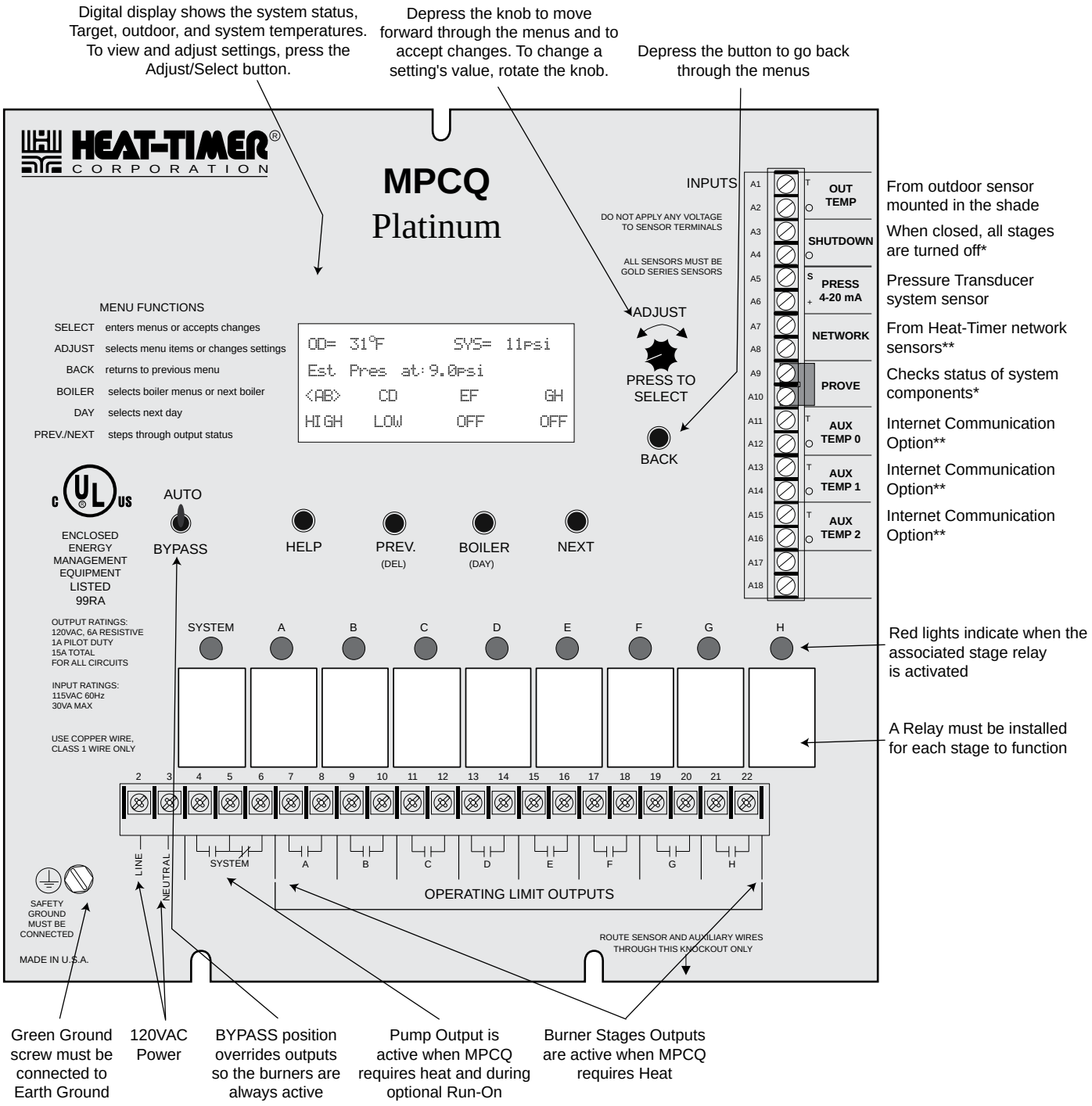
The MPCQ Platinum is strictly an operating control. It CANNOT be used as a limit control. All boilers must have all safety and limit controls required by code. It is the responsibility of the installer to verify that all the safety and limits are working properly before the MPCQ Platinum is installed.

This control must be installed by a licensed electrician.

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Panel Layout



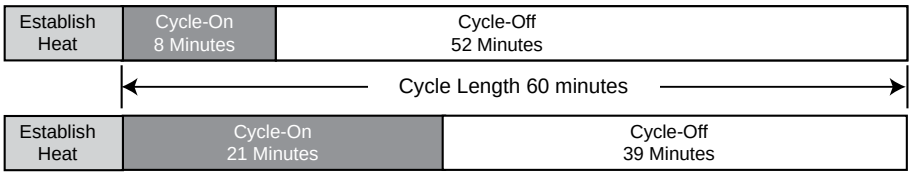
* DRY CONTACT ONLY
** Only available with the Internet Communications package

Understanding Operation Concept

The Heat-Timer MPCQ Platinum is a microprocessor based control for multi-stage/multi-boiler steam heating systems. The control operates a bank of modular steam boilers, automatically activating and deactivating stages so as to provide the desired heat pattern for the application whether heating a building or a process application.

Cycle Operation Concept

Sample Mild Weather Cycle



Sample Cold Weather Cycle

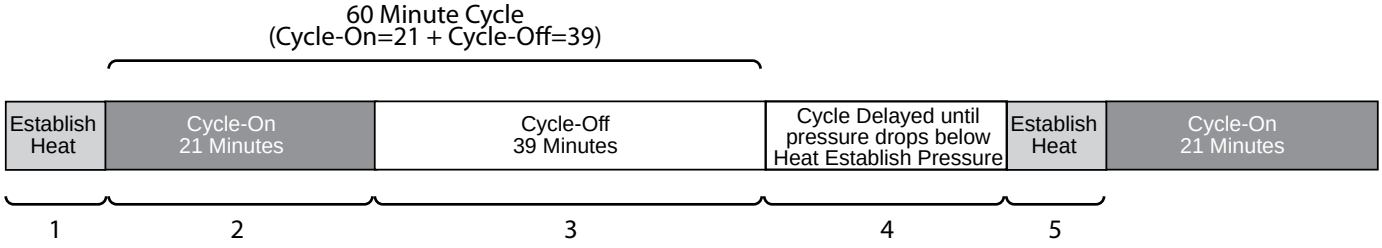
The control operates on the CYCLE principle which was created specifically for steam heating systems. The CYCLE concept was developed by Heat-Timer to overcome the inabilities of standard thermostatic controls to cope with the erratic properties of steam. Steam heat can not be switched on and off instantaneously. Instead, it takes time to build up a “head of steam”. And, once the system starts heating up, it has momentum which can not quickly be stopped.

By monitoring the outside temperature, the MPCQ Platinum is able to anticipate the heating needs of the building. Each fixed time CYCLE period (usually 60 minutes long but adjustable from 10 to 240 minutes) is divided into a heat-ON segment and a heat-OFF segment. The length of the ON segment will vary with the outside temperature. The colder it is outside, the longer the ON part of the cycle will be.

The MPCQ Platinum constantly checks the outside temperature by means of a solid state sensor located on the exterior of the building. At the same time it also monitors pressure by means of a heating system pressure sensor located in the common header. On the basis of this combined data, the MPCQ Platinum sends instructions to the heating plant to control the heat level in the building.

In addition to adjusting the length of the ON part of a cycle, the outdoor temperature acts as a system cutoff. When the outdoor temperature rises above an adjustable set point, the MPCQ Platinum will not call for any heat. When the outdoor temperature drops below the set point, the MPCQ Platinum will automatically begin controlling the heating cycles. Meanwhile, the heating system pressure sensor controls the number of boiler stages which are turned on, and the amount of steam pressure in the system. The effect of these two sensors combined is to provide an even comfortable level of heat throughout the building.

1. The MPCQ Platinum starts activating steam stages when the outside temperature falls below the Outdoor Cutoff (factory set to 55°F for the day and 40°F for the night, but fully adjustable). The MPCQ Platinum will continue to bring on more stages, and/or hold all the stages on, until the system pressure reaches the set point. This indicates that steam has gotten entirely through the system, or that pressure is established.
2. Once pressure is established, the heat-ON segment of the cycle will begin. During the ON part of the cycle, the MPCQ Platinum will activate as many stages as necessary to achieve and hold the pressure set point. Stages which may no longer be needed once set point pressure has been achieved will be turned off.
3. Once the ON part of the cycle has ended, the heat-OFF part of the cycle will begin. All the steam boilers will be turned off.
4. When the OFF part of the cycle is over, the MPCQ Platinum will once again start to establish pressure unless either the outside temperature has risen above the outdoor cutoff, or the header pressure is more than Heat Establish Pressure setting. See page 29.
5. The boilers will start firing once the steam pressure in the system falls below the Heat Establish Pressure setting. See page 29.



Set Point Operation Concept

The MPCQ Platinum can sequence stages using different logics. The PID Logic is primarily used to save energy on building heat. The OSS is used in application where fast response and pressure accuracy are the key factors.

PID Operation

(Available in Set Point Operating Mode)

PID control logic is primarily used for building set point heating. The logic will utilize two primary adjustable settings to add or subtract stages. The Reaction Time is used to turn on/energize stages. On the other hand, the Minimum Runtime is used to turn off/de-energize stages. On a call for heat and when the outdoor temperature is below the Outdoor Cutoff, the MPCQ Platinum will turn on/energize the lead boiler's lowest firing stage to start the Purge Delay. After the elapse of the purge period, the MPCQ Platinum will start calculating the Reaction Time. If after a full Reaction Time the control logic foresees additional stages are needed, the MPCQ Platinum will energize the following stage. If that stage was another boiler, that boiler has to go through a full Purge Delay before starting to calculate the Reaction Time for that stage. Otherwise, if the next stage was the higher firing stage on the same boiler, the Reaction Time will start from the moment the higher firing stage relay is energized.

When the MPCQ Platinum PID logic foresees that the system will overshoot, it will shutdown stages making sure that the last stage turned on/energized elapsed a full Minimum Runtime before it is turned off/de-energized. No additional stages will be turned off/de-energized until another full Minimum Runtime is elapsed. On the other hand, the lead stage will remain energized until the system reading exceeds the Set Point by the Last Stage Hold value in addition to satisfying the Minimum Runtime condition. That is, if the Set Point was 10 PSI and the Last Stage Hold was set to 2 PSI, the lead stage will remain energized until the system reaches 12 PSI and a full Minimum Runtime elapses. This is useful in protecting the lead stages from short cycling in mild weather conditions.

OSS Operation

(Available in Set Point Operating Mode)

OSS is used in fast reacting application as in process applications, where maintaining a set point is critical. The OSS utilizes the Throttle setting, as a mean to calculate the number of stages the MPCQ Platinum shall have on at any point. For every Throttle Range below the set point an additional stage shall be turned on/energized. That is, if the set point was 12 Psi and the Throttle setting was 2 Psi, if the System dropped below 10 Psi (12 Psi - 2 Psi), the lead stage will energize. With further decrease in the system value to 8 Psi (12 Psi - 2 Psi - 2 Psi), the second stage will energize.

As the system pressure rises towards the set point, stages will turn off. Using the previous example, when the system rise to 10 Psi, boiler B will de-energize leaving only boiler A on. Boiler A will remain on until the system rises a one full Throttle range above the set point. This will leave the lead boiler A on until the pressure rises to 14 Psi then turn off/de-energize.

Set Point = 12 Psi Throttle = 2 Psi Boilers (A, B, C, D, E, and F) Lead Stage =<A>

		Falling Pressure		Rising pressure	
System Pressure	**Throttle Ranges**	**Stages Turned On**	**Stages On**	**Stages Turned Off**	**Stages On**
14 Psi	-1	----	None	A	None
12 Psi	0	----	None	----	A
10 Psi	1	A	A	B	A
8 Psi	2	B	A + B	C	A + B
6 Psi	3	C	A + B +C	D	A + B +C
4 Psi	4	D	A + B +C + D	E	A + B +C + D
2 Psi	5	E	A + B +C + D + E	F	A + B +C + D + E
0 Psi	6	F	A + B +C + D + E + F	----	A + B +C + D + E + F

Setback

(Available in Set Point Operating Mode)

Whenever the MPCQ Platinum is at the Night schedule setting, it follows the Night Cutoff as its outdoor temperature system cutoff. It will then allow the system pressure to drop by the Setback setting and sequence the stages to hold that pressure for the full night period. The lower pressure provides the opportunity to save energy in applications where a cycle system does not apply.

Boost and Early Shutdown
(Available in Cycle Operating Mode)

The Morning Boost is designed to return the building to comfortable ambient temperatures after the cooler Night (Save) period. The MPCQ Platinum will accomplish this by holding a constant steam pressure for a given period based on the Schedule Day #1 setting. If no boost is needed on a day of the week, simply DO NOT program the Day #1 setting, and use the Day#2 setting instead. See Boost on page 22.

The Early Shutdown should be used in commercial buildings where the building will be unoccupied in the Night time. A Vari-Boost as described above is run. In addition, the MPCQ Platinum will switch into the Night mode earlier than the latest Night setting for that day. The warmer it is outside, the earlier it will shift into Night. The Early Shutdown time is adjusted using the Morning Boost Adjustment Curve but works in the opposite fashion. The warmer it is outside, the earlier the MPCQ Platinum will shift to night. As it gets colder, the time between early shutdown and the last Night setting diminishes. The maximum amount of Early Shutdown is 90 minutes. See Early Shutdown on page 23.

Initial Pilot Program

Setting an Initial Pilot Program will ease the configuration of the MPCQ Platinum and will give the opportunity to utilize many of the energy saving features and give more comfortable heat when needed.

The program should consist of the following:

Selecting the features that your system can utilize (page 6),
Making sure you have the right control and accessories (page 7),
Install the Control (page 8),
Setting the System Startup (page 17),
Setting the System Settings (page 20),
Setting the Stage (page 23),
Setting the Schedule (page 26),
Setting the Communication (page 6).

Selecting the System Features

The MPCQ Platinum has been designed with steam commercial building heating as well as process heating as the primary functions. With this in mind, many of the MPCQ Platinum features can be utilized to ease, enhance, and improve your system performance. Some of these features are listed in this section.

Cycle or Set Point (Control Mode)

- The MPCQ Platinum can control the System either by adjusting the Cycle-On length according to the Outdoor Temperature (Cycle mode) or by maintaining an adjustable Set Point. The earlier relies on an Outdoor Sensor (supplied with the control) and achieves better fuel savings in building heating in addition to better comfort.

PID or Oversize (Control Logic)

- The MPCQ Platinum can use an algorithm (PID) to look at the rate of change in the System. If the System pressure changes quickly, the MPCQ Platinum will turn on or off stages quickly. If the pressure changes are slow or minor, the MPCQ Platinum will react slowly. The PID logic provides the most stable operation. Stages are brought on or off based on the rate of change of the System pressure and the impact a stage has on that rate.
- For applications where the stages are oversized for most load conditions, the MPCQ Platinum has Oversize System logic. The Oversize logic turns stages on or off proportionally, based on how far the System pressure is from the Set Point.

Number of Stages

- The MPCQ Platinum can be configured to control a variety of boiler-burner configurations. It can control up to 24 boiler stages using the MPCQ Platinum in addition to 2 Extension panels.
- The MPCQ Platinum can control up to 4 stage burners.
- Burner stages can be sequenced Lo/Hi/Lo/Hi or Lo/Lo/Hi/Hi. The first lets a burner fire its lower stage first followed by its higher stages. The second lets all burners lower stages to turn on before starting any higher burner stages. Both can only apply to 2-stage or more burners.

Adding up to 2 Extension Panels for Additional Stages

- When additional Stages are needed, the MPCQ Platinum can control up to 2 additional extension panels for a total of 24 stages.
- Extension panels have built-in Lockout input terminals. The MPCQ Platinum can isolate locked out boilers from the operation process and display their status.

Automatic Rotation among Stages

- Rotating the first burner to be activated on a call for output promotes even wear on all burners. The MPCQ Platinum has three modes of rotation: Manual, First-ON/First-OFF, or automatically every selected time period from every hour to every 41 days.

Schedules

- By setting an operating Schedule and Night Setback, you can save energy while providing comfortable heat to the building. The setting allows the MPCQ Platinum to use a different cycle curve as well as a different outdoor cutoff . In addition, it reduces space target temperature during the night or when building is unoccupied, i.e. office buildings and schools.
- During the day, Day Time settings will change cycle curve, outdoor cutoff, as well as space target. Each weekday can have up to 4 Day Time and 4 Night Time (Setback) settings. See Schedules on page 26.

Boost

- This feature lets the MPCQ Platinum bring the building up to temperature quickly after a Night period. When the MPCQ Platinum is to start the Boost, it starts its boost earlier than the Day #1 schedule setting. The length of boost is determined by the amount set by the Boost Adjustment for a period that is calculated using the outdoor temperature as a guide. See Boost on page 22.

Early Shutdown ESD

- This feature allows the MPCQ Platinum to shift to Night Setback before the last Night Time setting for that day. The Early Shutdown varies based on Outdoor temperature (OD). The warmer the Outdoor temperature the earlier the MPCQ Platinum will shift to Night Setback.. See Boost on page 22.

Remote Communication

- The MPCQ Platinum can be upgraded to Heat-Timer's BACnet (BAC controls) or Internet system (RINet controls) to monitor and control all MPCQ Platinum functions from a remote location. However, only the Internet communication package upgrade allows the MPCQ Platinum to accept additional sensors, to monitor their status, and to provide alarms deliveries to e-mail, text capable mobile phones, and the web if the sensor values are not in the correct range.

Vacation

- The MPCQ Platinum RINet (Internet controls only) can be set to have a third space target for a specified period. This can be used for vacation situation in schools. It offers the user a significant fuel savings during those periods.

Making Sure You Have the Right Control

If you need the MPCQ Platinum to do additional tasks that either is not listed or do not know how to configure them, contact Heat-Timer Corp. Sales Department either by Phone (973)575-4004, Fax (973) 575-4052, or by e-mail support@heat-timer.com.

Installation

Before beginning the installation, carefully evaluate your heating system. The MPCQ Platinum can control the heating system through these different methods:

- Controlling multiple single or multi-stage boilers.
- Controlling up to 24 burner stages by interfacing to a maximum of two Heat-Timer Extension Panels with lockout.

Mounting the Control Box

Locate an appropriate site

- Near the equipment to be controlled at eye level, or where the displays are easily visible and away from excessively high or low temperatures.
- The surface must be strong enough to hold the weight of the control and its enclosure.
- Leave 12" of clearance under the enclosure to ease conduit connection.

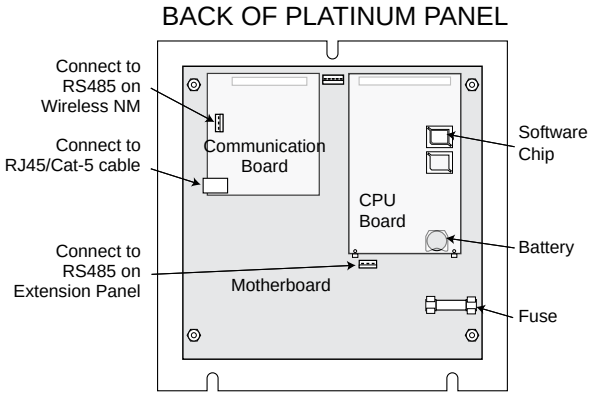
Remove the MPCQ Platinum from its enclosure

- Remove the top center screw holding the panel to the enclosure.
- Loosen the two screws holding the control to the bottom of the enclosure.
- Tilt the panel forward and then remove from enclosure. Make sure to unplug any control cables.
- Mount the enclosure to the surface using the holes provided.
- Connect the conduits and bring the wires to the bottom of the enclosure. Class 1 wiring must enter the enclosure through a different opening from class 2 wiring.

Rear of Panel

Activate the Battery

- Turn the MPCQ Platinum panel over to reveal the piggyback circuit board (CPU board).
- Remove the plastic strap that isolate the battery contacts.
- The battery is used to maintain date and time of the control during power loss periods.



⚠ ALERT

Do not install the battery unless you plan to power and utilize the control at once. If the control is not powered, the battery will lose its charge in 100 days.

Connecting RS485 or Ethernet Cables

- Some panels might include an addition communication board on the back.
- When connecting an RS485 cables for extension communication, the round terminal connection must be screwed to one of the side knockouts on the enclosure.
- Ethernet connections (Internet or BACnet) must have the proper communication board installed.
- Remember that the upgrade to Internet or BACnet control requires adding a communication board and replacing the CPU board.
- When connecting the MPCQ Platinum to an Extension Panel, connect the RS485 to the back of the MPCQ Platinum. Use the center RS485 terminals on the motherboard. Do not use the RS485 terminals on the communication board.

⚠ ALERT

When connecting the MPCQ Platinum to an Extension Panel, use the RS485 terminals on the motherboard. DO NOT use the RS485 on the communication board.

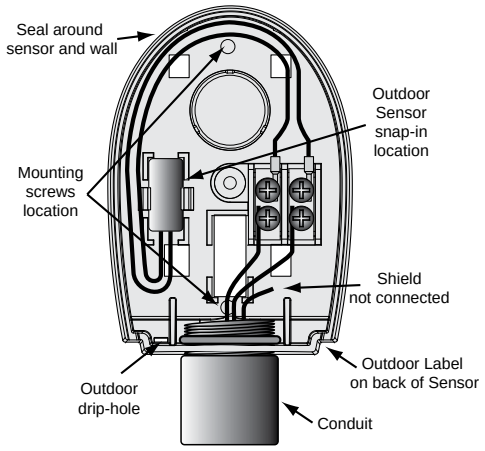
- Install the MPCQ Platinum back into its enclosure

Install the Sensors

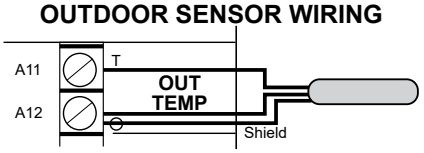
Outdoor Sensor Installation

- Only use the Heat-Timer Outdoor Sensor included with the unit (HT# 904220-00).
- Locate the sensor in the shade on the north side of the building. The sensor should never be in direct sunlight.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources.
- The sensor should be mounted approximately 10' feet above ground level.
- Adhere the Outdoor Label provided to the back of the sensor base.
- Use the Sensor Enclosure Base bottom knockout for the conduit. Use the locknut to hold the conduit and enclosure base together. Screw the cover to the base.
- If screws are used to affix the enclosure to the wall, make sure to seal around the sensor and wall except from the bottom.
- The sensor wires can be extended up to 500' using 2-conductor shielded cable (Belden #8760 or equivalent (#18/2)). Do not connect the shield at the sensor but at the control using the control Outdoor Sensor terminal marked with an "O" (A2).
- Do not run sensor wires in conduit with line voltage wiring.
- To enable the Cycle Mode, an outdoor sensor must be used. See Sensor Type settings on page 17.
- The outdoor sensor is used as an Outdoor Cutoff. The MPCQ Platinum will disable all stages when the outdoor temperature is above the adjustable Outdoor Cutoff temperature. See page 21. This feature will automatically be activated when an outdoor sensor is connected.

Outdoor Sensor



OUTDOOR SENSOR WIRING



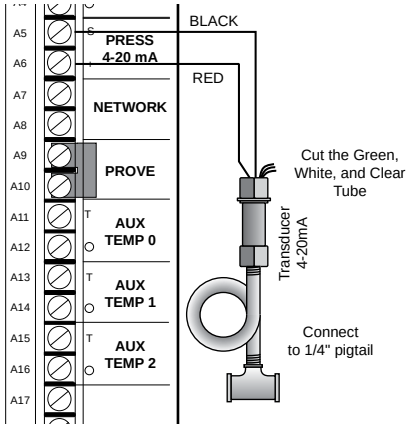
⚠ ALERT

Determining the proper location for the Outdoor Sensor is very important. The MPCQ Platinum will base the heat on the outdoor temperature information it receives from this location. If the sensor is in the sun or covered with ice, its reading will be different from the actual Outdoor temperature (OD).

Heating System Sensor (HSS) Installation

Locating HSS

- Install the System Pressure transducer provided approximately 10' feet past the last boiler on the common supply header but before any takeoffs.
- When installing the pressure transducer, use a threaded Brass Isolation Tube (¼" Brass Pigtail) attached to the steam header.
- The Red and Black wires can be extended up to 500' using shielded 2-conductor cable. The ground, shield, and reference tube on the transducer are not used.
- Do not use an external voltage source for the transducer as the MPCQ Platinum will provide the excitation voltage to the transducer.
- Connect the Black wire from the transducer to terminal *A5 (S)*. Connect the Red wire to terminal *A6 (+)*.
- Do not run sensor wires in conduit with line voltage wiring. Class 1 voltage must use a different knockout and conduit from class 2 voltage.

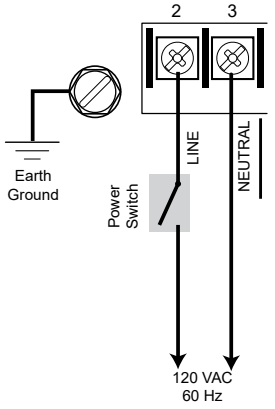


Testing the Sensors

- Power up the MPCQ Platinum.
- The control will go through a countdown, and then the top right of the display marked (SYS) will show the pressure read by the Heating System Sensor (HSS). The top left (OD) will show the temperature read by the Outdoor Sensor.
- If the display reads OPEN, SHORT, or an incorrect sensor value, follow the troubleshooting procedures on page 39.
- Wireless and MIG sensors readings can only be configured and viewed on the Internet through the ICMS website (http://www.htcontrols.com)

Wiring

- When connecting the MPCQ Platinum Output wiring, make sure to use the bottom knockouts. The use of any other knockouts or holes for the Outputs will void the control warranty.



Power Input Wiring

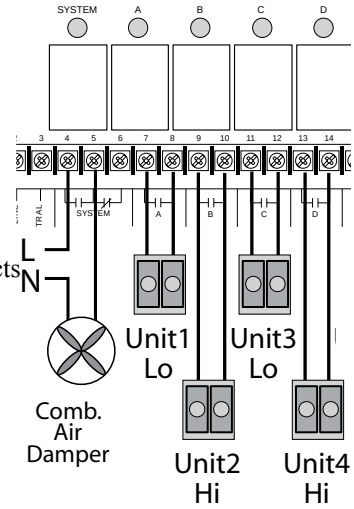
- Bring the power wires through the bottom left knockout of the enclosure. Do not bring wires through the sides or the top as this will interfere with servicing the control.
- Attach 120V 60 Hz to terminals *Line* and *Neutral*.
- Ground wiring must be connected to *Ground screw*. DO NOT use the neutral line as earth ground.
- Class 1 copper wire is required by UL.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage.
- Heat-Timer recommends the installation of a Surge Suppressor and a Power Switch before the Power Line connection for safety and ease of service.

Combustion Air Damper Wiring

- The System relay is designed to operate a combustion air damper. The terminals are dry contacts only. They do not source any power. A separate power source is required.
- Wire the Normally Open (N.O.) dry contact terminals to the combustion air damper.
- Make sure the System relay is installed to allow the operation of the combustion air damper.
- The System relay can operate 1 Amp inductive or 6Amp resistive load at 120 VAC 60 Hz

Burner Stages Wiring

- Each of the MPCQ Platinum outputs operates a single stage on a burner. The outputs are dry contacts only. They do not source any power.
- Bring the boiler wires through one of the enclosure bottom knockouts.
- The Normally Open (N. O.) contacts for each stage must be in series with the boiler limit circuits.
- Make sure any wired stage's relay is installed to allow the operation of that stage.
- Each stage relay can operate 1 Amp inductive or 6Amp resistive load at 120 VAC 60 Hz

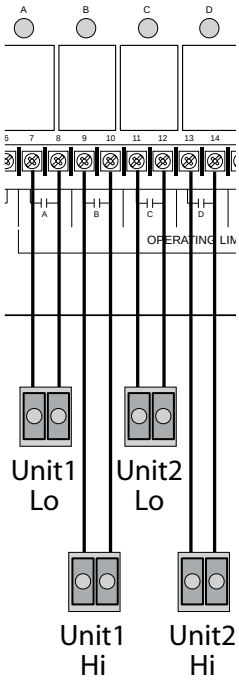


For up to 8 on/off boilers (without an Extension Panel)

- Attach the first boiler to the N. O. contacts marked A (terminals 7 & 8), the second boiler to B (9 & 10), and the third boiler to C (11 & 12), and so on.

For up to 4 lo/hi boilers (without an Extension Panel)

- The N. O. contacts for each boiler must be wired in series with the boiler limit circuit.
- Attach the low stage of the first boiler to the NO contacts marked A (terminals 7 & 8), the high stage to B (9 & 10)
- Attach the low stage of the second boiler to the N. O. contacts marked C (terminals 11 & 12), the high stage to D (13 & 14)



⚠ WARNING

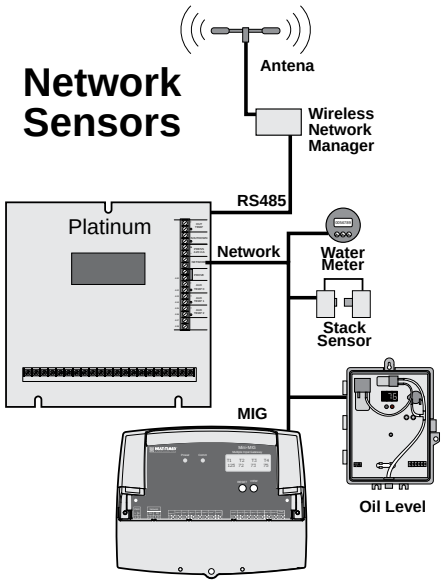
All Output wiring must be run through the BOTTOM Knockouts. The use of other knockouts or drilled holes for the output wiring will void the control warranty.

⚠ WARNING

Never apply external voltage to the input terminals. Permanent damage will occur voiding the control warranty.

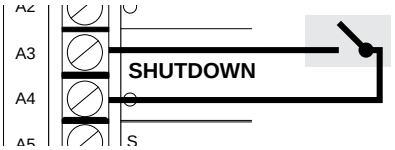
Wiring Network Sensors (Wireless and MIG)

(Requires Communication Package Upgrade)



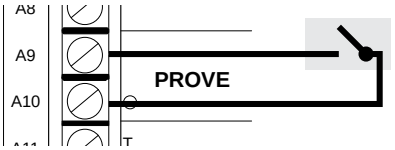
- Remember that network sensors can only be configured remotely through the Internet (http://www.htcontrols.com).
- The MPCQ Platinum Network terminals can connect to up to 64 network sensors.
- When connecting to multiple sensors, a Mini-MIG control can be used to handle up to 16 sensors each. Multiple MIG's can connect to a single MPCQ Platinum.
- Wireless sensors can be used with transceivers to reduce building sensor wiring. The wireless Network Manager can be wired directly to the RS485 on the communication board. The balance of the wireless system will communicate its information to the wireless Network Manager.
- A variety of network sensors are available for the MPCQ Platinum:
  - ◦Stack sensor
  - ◦Count/Pulse sensor (connects to water meters.)
  - ◦Oil tank level sensor (OTM)
  - ◦Pressure, vacuum, and humidity transducers
  - ◦Wireless temperature sensors system
  - ◦Multiple Input Gateway (Mini-MIG) that gives the capability of connecting the control to multiple temperature or switch sensors.

Wiring Shutdown Terminals



- This feature can be used whenever it is desirable to turn off the MPCQ Platinum from a remote location or another controller. A typical use for this feature would be to disable all heat from an Energy Management System (EMS).
- When the Shutdown is enabled (by shorting the *Shutdown* input terminals, all stage relays will de-energize. The System relay will continue to be energized for the Run-On delay period.
- The Shutdown signal must be a dry contact only. No voltage can be placed across the *SHUTDOWN* terminals - *A3, A4*

Wiring Prove Terminals



- The Prove feature checks system components operation before activating any of the boilers stages. It can be used to connect to the combustion air damper's end switch. That way the system relay will energize the combustion air damper and the prove will check if the damper is fully opened prior to activating any boiler stages.
- If the *PROVE* input terminals are open, the MPCQ Platinum will enable only the System relay. All stage relays will be de-energized when the *PROVE* input is open.
- If NO external conditions are to be met before the stage relays are energized, DO NOT remove the factory installed jumper across the *PROVE* terminals.
- The Prove signal must be a dry contact only. No voltage can be placed across the *PROVE* terminals *A9, A10*.

⚠ WARNING

The *PROVE* input CANNOT be used as a safety limit. All equipment must have its own certified limit and safety controls as required by local codes. Any safety interlock MUST be wired back to the boilers or other equipment as required by code.

⚠ ALERT

The *PROVE* terminals must be shorted for MPCQ Platinum to provide heat. DO NOT remove the factory installed PROVE jumper unless replacing it with a Prove signal.

Wiring Aux Input Terminals

(Requires Internet Communication Package Upgrade)

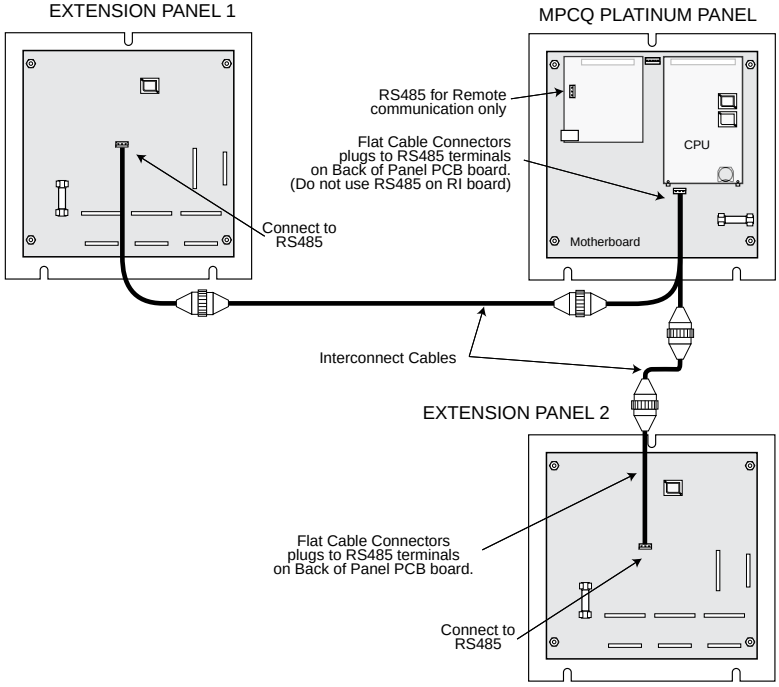
- Remember that Aux sensors can only be configured remotely through the Internet communication package.
- Each Aux terminal can connect to only one temperature (-30°F to 250F) or switch sensor.

Wiring to an Extension Panel

- The MPCQ Platinum can control up to 8 stages solely. By adding a Heat-Timer Extension Panel using RS485 cable, you can add an additional 8 boiler stages. A total of 2 Heat-Timer Extension Panels can be added to any single MPCQ Platinum totaling 24 boiler stages.
- Each Extension Panel has 8 Lockout inputs that can be used by the MPCQ Platinum when sequencing the boilers. Each Lockout controls one boiler regardless of the number of stages it has.
- When the MPCQ Platinum is connected to an Extension Panel, you will be able to scroll through each of the boilers using the *Adjust/Select* Knob.
- If a communication package is purchased with the MPCQ Platinum and the Extension Panel, the Internet will show the status of each boiler including the Extension Panel boilers.
- No Output cards are required for the Extension Panel when used with the MPCQ Platinum. You will need to install the proper relay for each of the stages needed.
- To be able to set the extension panel stages in the MPCQ Platinum Startup menu, the extension must be powered and connected to the MPCQ platinum. The MPCQ Platinum must then be re-powered up.

See Extension Panel documentation for additional wiring instructions.

WIRING MPCQ PLATINUM TO MULTIPLE EXTENSION PANELS



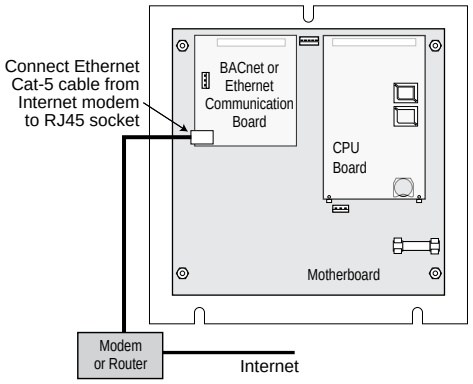
Wiring Extension Panel Lockout

- Each Extension Panel has 8 Lockout inputs that can be used by the MPCQ Platinum when sequencing the boilers.
- The first Lockout terminals on the first Extension panel will control the first MPCQ Platinum boiler, the boiler that has stage A as its first stage. The second Lockout terminals on the first Extension panel will control the second MPCQ Platinum boiler.
- When a boiler Lockout terminals are shorted, the MPCQ Platinum will de-energize that boiler stages. In addition, it will omit that boiler from the sequencing process until those terminals are opened again. The display will show ⌞⋰⌝ under that boiler stages indicating the Lockout Status. I.e. If the MPCQ Platinum was controlling five 2-stage boilers (AB, CD, EF, GH (stages wired to MPCQ Platinum) and IJ (stages wired to the Extension)) and boiler AB and CD where energized at Hi. Then if, the Extensions first lockout input was shorted, boiler AB stages 91st boiler) will de-energize immediately. If any Lockout alarms were configured, a delivery will take place. See Internet Alarms on page 34.

Connecting to the Internet

- The MPCQ Platinum control comes either as a Standard without any communication or with Internet or BACnet communication.
- Any MPCQ Platinum with Internet communication control package has an Internet Communication Board installed on the back of the main board.
- Connect the Internet CAT5 Ethernet cable coming from the Internet Modem to the Internet RJ45 Communication socket on the back of the MPCQ Platinum communication board.
- If the control is sharing the Internet connection with other computers, an Internet Router or Internet server must be used. See Internet Setting on page 33.
- If required, set the MPCQ Platinum Internet Settings as described on page 33.

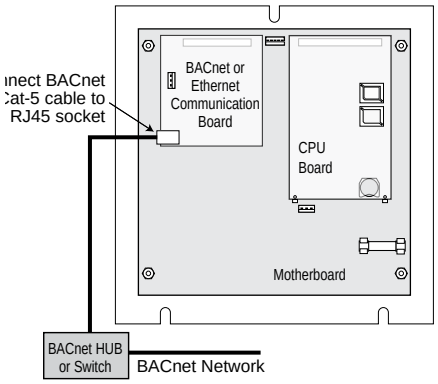
Internet Communiation Connection to Back of Control



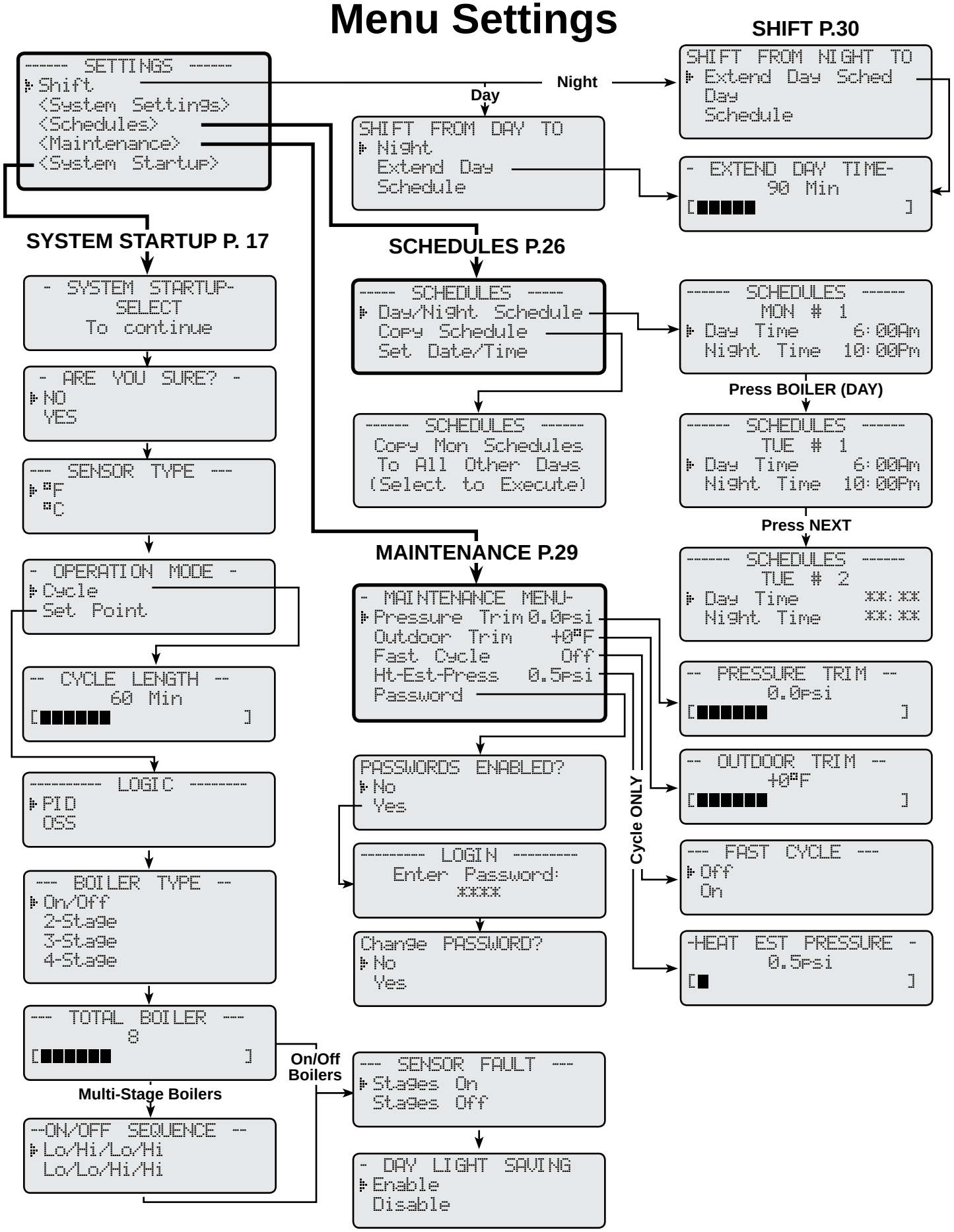
Connecting to the BACnet IP

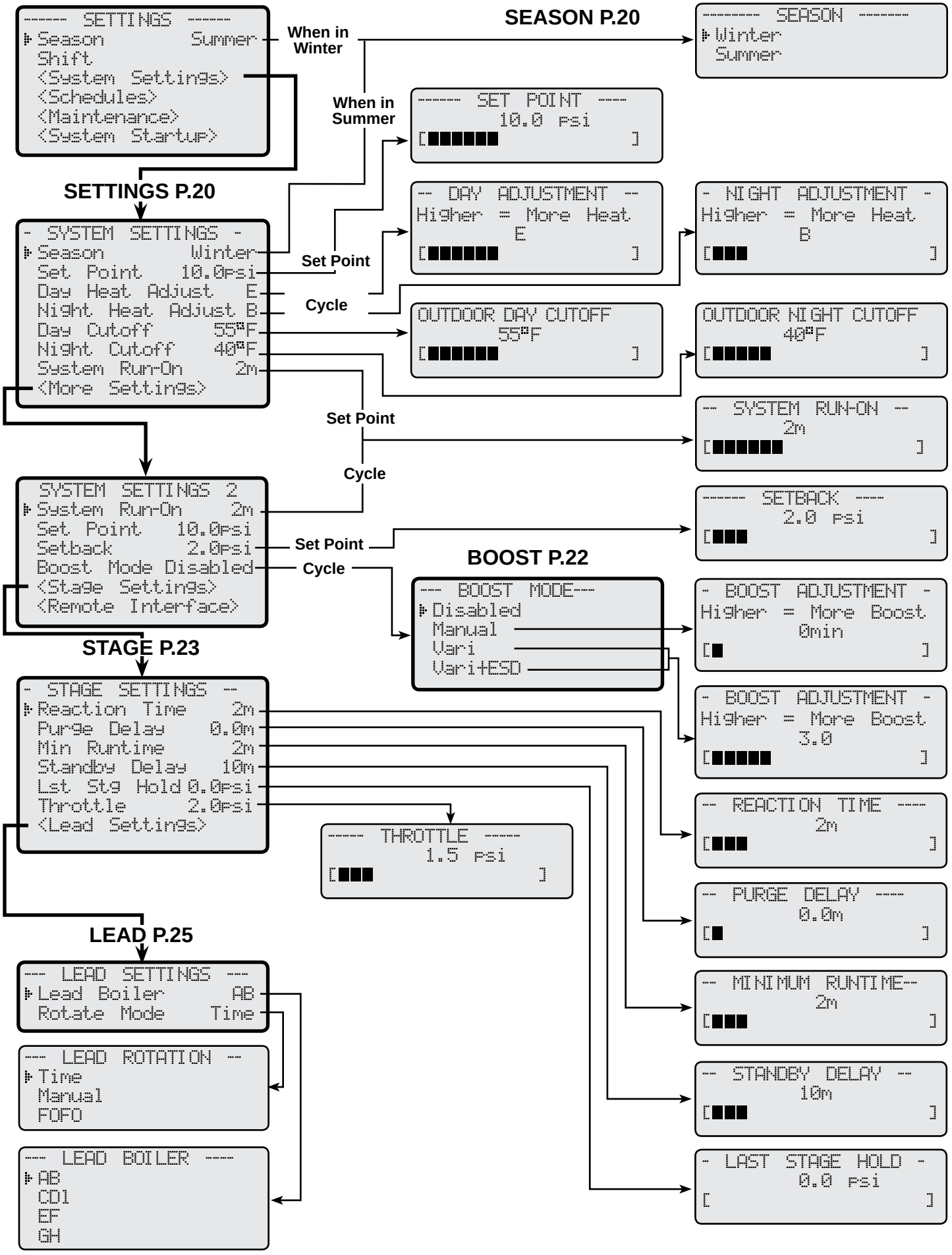
- The MPCQ Platinum control comes either as a Standard without any communication or with Internet or BACnet communication.
- Any MPCQ Platinum with BACnet communication control package has a BACnet Communication Board installed on the back of the main board.
- Connect the BACnet CAT5 Ethernet cable coming from the network to the BACnet RJ45 Communication socket on the MPCQ Platinum communication board.
- Set the MPCQ Platinum BACnet Network Settings as described on page 35.

BACnet Communiation Connection to Back of Control

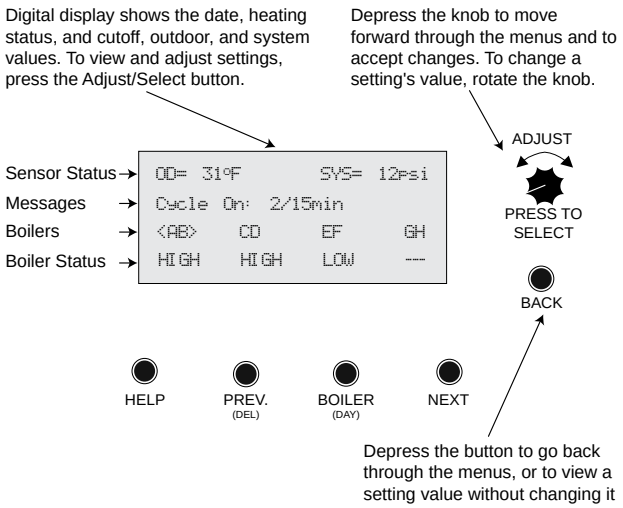


Menu Settings




----- SETTINGS -----
Season Summer
Shift
<System Settings>
<Schedules>
<Maintenance>
<System Startup>
When in Winter
When in Summer
SEASON P.20
------- SEASON ------
Winter
Summer
------ SET POINT ----
10.0 psi
SETTINGS P.20
- SYSTEM SETTINGS -
Season Winter
Set Point 10.0psi
Day Heat Adjust E
Night Heat Adjust B
Day Cutoff 55°F
Night Cutoff 40°F
System Run-On 2m
<More Settings>
Set Point
Cycle
-- DAY ADJUSTMENT --
Higher = More Heat
E
- NIGHT ADJUSTMENT -
Higher = More Heat
B
OUTDOOR DAY CUTOFF
55°F
OUTDOOR NIGHT CUTOFF
40°F
-- SYSTEM RUN-ON --
2m
Set Point
Cycle
SYSTEM SETTINGS 2
System Run-On 2m
Set Point 10.0psi
Setback 2.0psi
Boost Mode Disabled
<Stage Settings>
<Remote Interface>
------ SETBACK ----
2.0 psi
Set Point
Cycle
BOOST P.22
--- BOOST MODE---
Disabled
Manual
Vari
Vari+ESD
- BOOST ADJUSTMENT -
Higher = More Boost
0min
- BOOST ADJUSTMENT -
Higher = More Boost
3.0
STAGE P.23
- STAGE SETTINGS --
Reaction Time 2m
Purge Delay 0.0m
Min Runtime 2m
Standby Delay 10m
Lst Stg Hold 0.0psi
Throttle 2.0psi
<Lead Settings>
----- THROTTLE -----
1.5 psi
-- REACTION TIME ----
2m
-- PURGE DELAY ----
0.0m
-- MINIMUM RUNTIME--
2m
-- STANDBY DELAY --
10m
- LAST STAGE HOLD -
0.0 psi
LEAD P.25
--- LEAD SETTINGS ---
Lead Boiler AB
Rotate Mode Time
--- LEAD ROTATION --
Time
Manual
FOFO
--- LEAD BOILER ----
AB
CD1
EF
GH

Setting the Control



Default Display and Changing Settings

The MPCQ Platinum is equipped with an 80 character (20 character per row x 4 rows) digital display. The Display's default screen is divided into 4 rows of text as per the diagram.

The following is a list of the buttons and knobs and their functionality:

SELECT/ADJUST Is a turning knob and a push button. When turned in the default screen will scroll through all the boilers. When pushed will enter the Settings menu. In menus, it scrolls through the available options when dialed. When clicked, it accepts the selected value.

BACK When in the default screen, pushing it will display the date, time, Space Average, and the Auxiliary input status. When in any menu, pushing it will go back to the parent menu.

NEXT In the default screen, it scrolls forward through the boilers. In Boiler Menu, goes to the next setting. In Schedules, goes to next schedule time for that day.

BOILER (DAY) When in the default screen, will display the Boiler Menu. In the Boiler menu, switches between boilers. In Schedules, switches between different weekdays.

PREV. (DEL) In the default screen, it scrolls backward through the boilers' status. In Schedules, it clears a specific schedule setting. In the Boiler Menu, will display the previous boiler settings.

HELP When clicked on a specific menu item will provide help instructions.

When powering up the MPCQ Platinum for the first time, it will take you through an 70 second count down followed by the System Startup Settings then another 10 second boot setup and finally end with the default system screen. Once the control is mounted and wired, set up an initial pilot program.

- Set and adjust System Startup Settings (page 17)
- Set and adjust System Settings (page 20)
- Set and adjust Stage Settings (page 23)
- Set and adjust Maintenance (page 29)
- Set and adjust Schedules (page 26)

Display Messages

The MPCQ Platinum normal display layout reserved the second line for message indications. The following is a list of the most common Message Display Line information:

- Est Pres at 10 psi — The MPCQ Platinum is set to Cycle Operation Mode and is energizing stages to establish heat prior to starting a heating cycle. See Cycle Operation Concept on page 4.
- Cycle On: 1/5 min — The MPCQ Platinum is in the Cycle-On period for a minute out of a total Cycle-On of 5 minutes. See Cycle Operation Concept on page 4.
- Cycle Off: 6/60 min — The MPCQ Platinum is in the Cycle-Off period. Only 6 minutes has elapsed from the total cycle of 60 minutes. See Cycle Operation Concept on page 4.
- Fast C/D: 68°F — The Boost option is Vari+ESD. The MPCQ Platinum is turning off stages at the end of the last Day schedule setting for the Fast Cool Down until the space average temperature drops below 68°F (Night Space Target). See Fast Cool Down on page 22.
- Pres L/O: 2 psi — In Cycle Operation Mode the MPCQ Platinum is in Pressure Lockout until the pressure drops to 2 psi. See Heat Establish Pressure on page 29.
- Space L/O: 71°F — In Cycle Operation Mode the MPCQ Platinum is in Space Lockout until the space average drops below 71°F. See Space Lock on page 32.
- Vari Boost Active — The MPCQ Platinum has started a Vari Boost in a Cycle Operation Mode. See Boost on page 22.
- Manual Boost 29 min — The MPCQ Platinum has started a Manual Boost in a Cycle Operation Mode. Only 29 minutes are left to terminate the Manual Boost. See Boost on page 22.
- Summer — The control is set to Summer. No heat is active. See Season on page 20.
- No Call For Heat — The Outdoor temperature is above the Outdoor Cutoff. See Day/Night Cutoff on page 21.

- Shutdown Active — The *SHUTDOWN* Terminals are Shorted. No boilers are active. See Shutdown on page 11.
- Sensor Fault — Either the Outdoor or the System sensor is reading Short or Open. All the boilers are either On or Off depending on the Sensor Fault setting on page 18.
- LSH: 12 psi — The Lead boiler is in Last Stage Hold. This example shows that the lead stage will turn off when system pressure reaches 12 Psi. See Last Stage Hold on page 24.
- TGT= 10 psi — In a Set Point Operation Mode the MPCQ Platinum is sequencing stages to hold the Set Point in Day schedule. See Set Point on page 20.
- Setback to 10 Psi — In a Set Point Operation Mode the target has changed to the setback value due to Night Schedule. See Setback on page 22.
- Prove Failure — After boilers have run for a while, Prove signal was opened. The boiler relays will de-energize. However, the System relay will remain energized. See Wiring Prove on page 11.
- Waiting for Prove — There is a call for heat and the Prove terminals are open before the boilers start firing. The boiler relays will be de-energize while the System relay is energized. See Wiring Prove on page 11.
- Sys RunOn: 59sec — The last boiler stage has turned off and the System relay will remain energized for the additional Run-On Delay of 59 seconds. See System Run-On on page 22.

Startup Settings

SELECT: *Settings/System Startup*

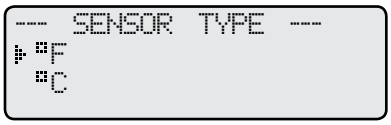
If entering this menu option after the control has been set, several warnings will display prior to entering the Startup menu to emphasize that any changes in this menu will drastically change the way the control behaves.

⚠ ALERT

A good practice after performing any Startup menu modifications is to check all operating settings and adjustments to match the new settings.

Sensor Type

°F for Fahrenheit or °C for Celsius **Default: °F Fahrenheit**

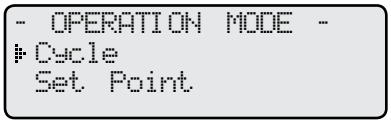


SELECT *Settings/System Startup/.../Sensor Type*

- It allows the user to display temperature information and settings in either ºF (Fahrenheit) or ºC (Celsius).

Operation Mode

Cycle or Set Point **Default: Cycle**



SELECT *Settings/System Startup/.../Operation Mode*

- The MPCQ Platinum can control the sequencing of the steam boilers either by using the cycle concept (See page 4) or by maintaining an adjustable Set Point.
- When Cycle is selected, the MPCQ Platinum will adjust the cycle on length according to the Outdoor Temperature and the Heat Adjustment. This option will provide more comfort and fuel savings for building heating applications.
- The Set Point option is useful when sequencing the boilers to maintain a specified fixed target. This can be used in building heating where additional zone distribution is available or in processing applications.

Cycle Length

(Available with Cycle Operating Mode only)

Adjustable from 10 to 240 minutes **Default: 60 minutes**



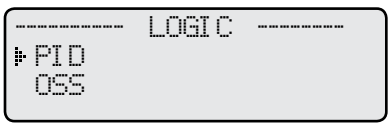
SELECT *Settings/System Startup/.../Cycle Length*

- With most cast iron radiation, choose a 60 minute cycle. If the radiators are very large or the system is oversized, choose a 90 minute cycle.
- For convector or baseboard radiation, choose a 30 minute cycle.
- For air handlers or blower units, choose a 20 minute cycle.
- The cycle length can be adjusted from 10 to 240 minutes, but it is recommended to start with the guidelines above.

LOGIC

(Available with Set Point Operating Mode only)

PID, OSS **Default: PID**



SELECT *Settings/System Startup/.../Logic*

- The PID option allows the MPCQ Platinum to sequence stages based on PID. The PID relies on the rate of change in the System Temperature. The PID logarithmic calculations foresee changes and sequence stages based on those changes. It is the most efficient operation for most heating systems. See PID Operation on page 5.

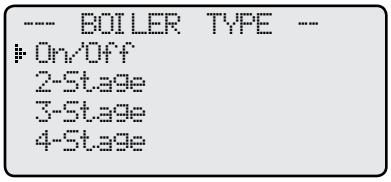
- When PID is Selected, the following are the settings that directly affects this modes operation:
  - Reaction Time (See page 23) SELECT *Settings/System Settings/More Settings/Stage Settings/Reaction Time*
  - Purge Delay (See page 23) SELECT *Settings/System Settings/More Settings/Stage Settings/Purge Delay*
  - Minimum Run Time (See page 24) SELECT *Settings/System Settings/More Settings/Stage Settings/Min Runtime*
  - Standby Delay (See page 24) SELECT *Settings/System Settings/More Settings/Stage Settings/Standby Delay*
  - Last Stage Hold (See page 24) SELECT *Settings/System Settings/More Settings/Stage Settings/Lst Stage Hold*

- The Oversize option sequence stages based on how many Throttling ranges is the system temperature away from the Target Temperature. At one Throttling range below the Set Point, only one stage will be on. For each additional Throttling range below the Set Point, an additional stage will be activated. The last stage on will be allowed to exceed the Set Point by one Throttling range before turning off that stage. This helps to prevent the last stage from short cycling. See OSS Operation on page 5.
- When Oversize (OSS) is Selected, the following are the settings that directly affects this modes operation:
  - Throttle (See page 24) SELECT *Settings/System Settings/More Settings/Stage Settings/Throttle*

Boiler Type

On/Off, 2-Stage, 3-Stage, or 4-Stage **Default: On/Off**

SELECT *Settings/System Startup/.../Boiler Type*

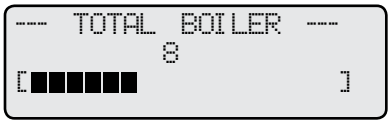


- The MPCQ Platinum can control multiple multi-stage boilers.
- The number of stages per boiler multiplied by the number of boilers will give the total number of stages the MPCQ Platinum will control.

Total Boiler

Adjustable from 1 to 24 depending on Boiler Type **Default: varies**

SELECT *Settings/System Startup/.../Total Boiler*



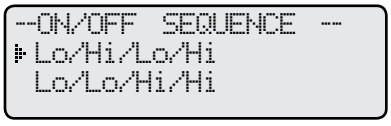
- The MPCQ Platinum can control up to a total of 24 stages using a maximum of two Extension panels. Enter the total number of boilers to be controlled.
- Make sure that the extension panels are connected (See page 12) and powered before adjusting the Total Boiler value.

On/Off Sequence

(Not Available for on/Off Boilers)

Lo/Hi/Lo/Hi or Lo/Lo/Hi/Hi **Default: Lo/Hi/Lo/Hi**

SELECT *Settings/System Startup/.../On-Off Sequence*

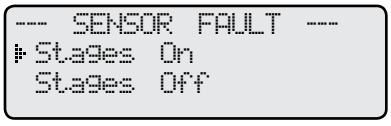


- The MPCQ Platinum can sequence multi-stage burners by boiler (Lo/Hi/Lo/Hi). In this option, the MPCQ Platinum will start the first boiler's lowest stage followed by the remaining stage for that boiler. Then, do the same for the following boilers.
- If the Lo/Lo/Hi/Hi option was selected, the MPCQ Platinum will start the first boiler's lowest stage followed by the second boiler's lowest stage until all boilers set to Auto mode has all their lowest stages on. When more stages are need, the MPCQ will start the secondary stages starting with the lead boiler followed by the next and so on. This option is more efficient for many copper tube and low mass boilers.

Sensor Fault

Stages On or Stages Off **Default: Stages On**

SELECT *Settings/System Startup/.../Sensor Fault*



- This selection determines the status of the stage relays when either the Outdoor Sensor or System Sensor is at fault, sensor reading will display either OPEN or SHORT. In addition, the Display second line will show SENSOR FAULT.
- When Stages On is selected and a sensor is at fault, the System relay in addition to all the stages relays will energize. This will allow all the boilers to run on their own limits.
- When Stages Off is selected and a sensor is at fault, all boiler stages relays and system relay will de-energize.

Day Light Saving

Enable or Disable **Default: Enable**

SELECT *Settings/System Startup/.../Day Light Saving*



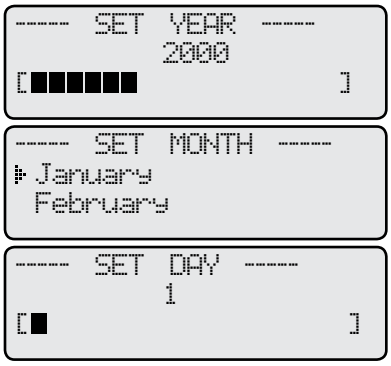
- Enable this feature in areas where Day Light Saving is observed to account for the time changes without having to manually change the time twice a year.

Date and Time Setting

Year, Month, Day, Time

SELECT *Settings/System Startup/.../Set Year*

- Entering the correct date and time assures that the MPCQ Platinum will follow the schedules based on the correct time.
- Use the *Select/Adjust* button to change and accept date and time values.
- Internet controls will automatically adjust their date and time according to the time zone specified in the Internet Building configuration.



System Settings

SELECT: *Settings/System Settings*

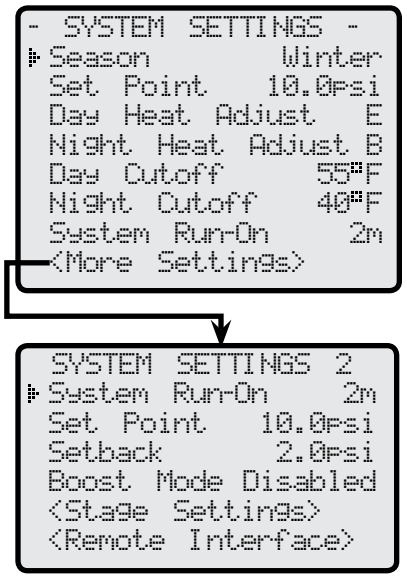
The System Settings and System Settings 2 menus allow for adjusting and fine-tuning the system for enhanced comfort and more fuel savings. The MPCQ Platinum behavior differs based on the selected Control Mode (see Startup Settings on page 17).

Cycle

- Season (Winter or Summer)
- Day/Night Heat Adjustments (page 21)
- Day/Night Outdoor Cutoffs (page 21)
- System Run-On (page 22)
- Set Point (page 20)
- Boost Mode (page 22)
- Stage Settings (page 23)
- Remote Interface (Utilized with Remote Communication Only) (page 6)

Set Point

- Set Point (page 20)
- Setback (page 22)
- Season (Winter or Summer)
- Day/Night Outdoor Cutoffs (page 21)
- System Run-On (page 22)
- Night Setback (page 22)
- Stage Settings (page 23)
- Remote Interface (Utilized with Remote Communication Only) (page 6)



Season

Winter or Summer **Default: Winter**

SELECT *Settings/Season* when in Winter

SELECT *Settings/System Settings/Season* when in Summer



- When switched to Summer, the MPCQ Platinum will de-energize all the boiler stages immediately and will de-energize the System relay after the Run-On Delay.
- When in Winter, the MPCQ Platinum will activate the heat whenever the Outdoor temperature (OD) falls below the Outdoor Cutoff setting. Therefore, adjust this setting to Winter during the heating season.
- When the heating season is over, it is a good practice to switch the MPCQ Platinum to Summer setting.

⚠ ALERT

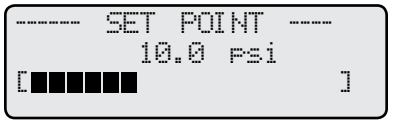
DO NOT turn power off to the MPCQ Platinum when heating season is over. If you do so, the battery will run down and will have to be replaced. Instead switch to Summer.

Set Point

Adjustable 0.0 psi to 30.0 psi **Default: 10.0 psi**

SELECT *Settings/System Settings/Set Point* in Set point Operation Mode

SELECT *Settings/System Settings/More Settings/Set Point* in Cycle Operation Mode



- The Set point is the pressure the MPCQ Platinum will use to control the system.
- The MPCQ Platinum will add, subtract, or hold the stages to maintain the system pressure around the Set point.
- The system is expected to fluctuate around the set point. The amount of fluctuation depends on the System and Stage Settings.
- In Cycle Operation Mode, the Set Point is the pressure at which heat has gotten all the way through the buildings radiation system. Ideally, this point should be set to the system pressure when the last radiator in the building gets warm.

⚠ WARNING

The boiler operating limit controls must be set above the System Sensor Set Point. Otherwise the boilers will run on their limits.

- To set the System Sensor Set Point, use the following procedure:
  1. Turn the heating system off and wait until the radiators are cool when touched.
  2. Set the boilers high pressure operating limits to the highest value the manufacturer or system recommends.
  3. Set the System Sensor Set Point to 10 PSI.
  4. Start the heating system.
  5. Go to the furthest radiator (in terms of longest piping distance) or to a radiator in a location known to get heat last.
  6. Wait until the radiator is warm. Depending on the steam distribution, this may take up to half an hour, or even more.
  7. Return to the MPCQ Platinum control and read the current System pressure. Adjust the System Sensor Set Point down to that pressure. The Cycle-On message comes on.

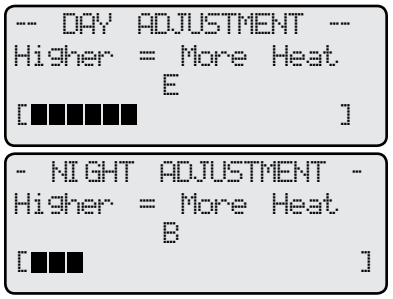
Day/Night Heat Adjustment

(Available in Cycle Operating Mode Only)

Adjustable from A to P **Default: E/ B**

SELECT *Settings/System Settings/Day Heat Adjust*

SELECT *Settings/System Settings/Night Heat Adjust*



- The Heat Adjustment change the amount of heat provided based on outdoor temperature. An A setting gives the least amount of heat at any given outside temperature, and a P setting gives the most heat.
- Note that the length of the ON part of the cycle is based on the Outdoor Cutoff minus the actual Outdoor Sensor reading. This means if you set both the Day and Night Heat Adjustments to the same value, you will get less heat at night. For instance, with both Heat Adjustments set to F and the factory set Outdoor Sensor Set Points of 55°F for Day and 40°F for Night, if the outdoor temperature is 25°F the On part of the cycle will last for 15 minutes in the Day, and only 7 minutes at Night.
- If the building is too cold in cold weather, adjust the appropriate setting up one letter. That is, from F to G. Then wait at least 24 hours before evaluating if the adjustment was sufficient. Similarly, if it is too hot in the cold weather, adjust the setting one letter and wait for at least 24 hours.



Cycle Length Table

Outdoor Cutoff Minus Outdoor Temperature

Heat Adjustment Setting	95°F	90°F	85°F	80°F	75°F	70°F	65°F	60°F	55°F	50°F	45°F	40°F	35°F	30°F	25°F	20°F	15°F	10°F	5°F	1°F
A	45	41	37	33	29	25	22	18	15	13	10	8	5	3	2	0	0	0	0	0
B	57	51	46	41	37	33	28	25	21	18	15	12	9	7	5	3	1	0	0	0
C	C	59	54	48	43	38	33	29	25	21	18	15	12	9	7	5	3	1	0	0
D	C	C	C	55	49	43	38	34	29	25	21	17	14	11	9	6	4	2	1	0
E	C	C	C	C	55	49	43	38	33	28	24	20	17	13	10	8	6	4	2	1
F	C	C	C	C	C	55	49	43	37	32	27	23	19	15	12	9	7	5	3	2
G	C	C	C	C	C	C	54	48	42	36	31	26	22	18	14	11	8	6	4	3
H	C	C	C	C	C	C	C	53	47	40	35	29	25	20	16	13	10	7	5	4
I	C	C	C	C	C	C	C	59	52	45	39	33	27	23	18	15	11	9	6	5
J	C	C	C	C	C	C	C	C	58	50	43	37	31	25	21	16	13	10	7	6
K	C	C	C	C	C	C	C	C	C	56	48	41	34	28	23	19	15	11	8	7
L	C	C	C	C	C	C	C	C	C	C	53	45	38	32	26	21	16	13	9	7
M	C	C	C	C	C	C	C	C	C	C	59	51	43	35	29	23	18	14	11	8
N	C	C	C	C	C	C	C	C	C	C	C	56	47	39	32	26	20	16	12	9
O	C	C	C	C	C	C	C	C	C	C	C	C	53	44	36	29	23	17	13	10
P	C	C	C	C	C	C	C	C	C	C	C	C	59	49	40	32	25	19	15	12

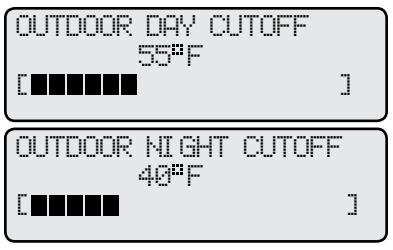
Minutes ON (based on 60 minute cycle length)

Day/Night Cutoff

Adjustable from 20°F to 100°F **Default: 55°F/ 40°F**

SELECT *Settings/System Settings/Day Cutoff*

SELECT *Settings/System Settings/Night Cutoff*



- The Day/Night Cutoffs will determine when can the MPCQ Platinum start heating the System. When the Outdoor temperature (OD) is above the Outdoor Cutoff, the MPCQ Platinum will turn off all burner stages. When the Outdoor temperature (OD) falls below the Outdoor Cutoff, the MPCQ Platinum will sequence the boiler stages for heating.
- In Cycle heating applications, in addition to using the Outdoor Cutoff as a start heating point, the difference between Outdoor Cutoff and the current outdoor temperature is used in determining the Cycle-On length period. See Cycle Length Table on this page.

System Run-On

Adjustable from 0 to 60 minutes **Default: 2 minute**



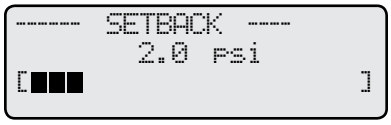
SELECT *Settings/System Settings/System Run-On*

- The System relay can control a combustion air damper. When the Outdoor temperature increases 2°F above the Outdoor Cutoff after the last burner stage relay has de-energized, the System relay will stay on for a period of time set by the System Run-On. This allows the combustion air damper to bring fresh air into the building.

Setback

(Available in Set Point Operating Mode Only)

Adjustable 0.0 psi to 10.0 psi **Default: 2.0 psi**



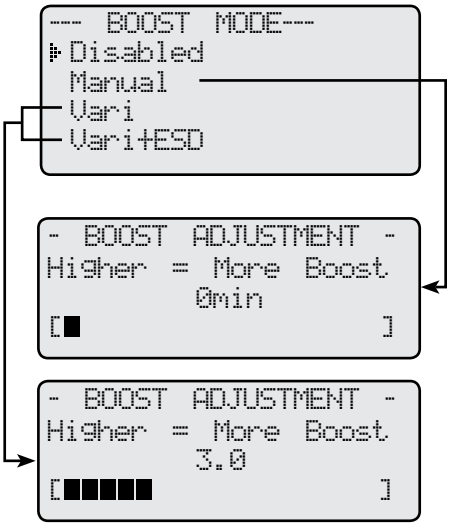
SELECT *Settings/System Settings/More Settings/Setback*

- When in Set Point Operating Mode, the MPCQ Platinum has two heat levels. The Day Time setting is for when a building is occupied and people are active. It follows that Day schedule. The Night Time settings hold a lower pressure set point when the building is unoccupied and it will follow the Night schedule.
- The Night Time setting lowers the pressure of the system by the setback indicated. In other words, if the control is in Setback, the MPCQ Platinum will subtract the value of the Night Setback setting from the Set Point setting and use the result as the new target.

Boost, Early Shutdown, and Boost Adjustment

(Available in Cycle Operating Mode Only)

Disabled, Manual, Vari, and Vari+ESD **Default: Vari**
Manual Boost Adjustment: 0 to 120 minutes **Default:0 minutes**
Vari Boost Adjustment: 0.1 to 6.4 **Default:3**



SELECT *Settings/System Settings/More Settings/Boost Mode*

- The Morning Boost is designed to return the building to comfortable ambient temperatures after the cooler Night (Save) period. The MPCQ Platinum will accomplish this by holding a constant steam pressure for a given period based on the Schedule Day #1 setting. See Schedules on page 26.
- If no boost is needed on a day of the week, simply DO NOT program the Day #1 setting, and use the Day #2 setting for any Day starting time.
- To set up the Morning Boost, you must select the type of Boost and its amount. There are three types of Boost:

Manual

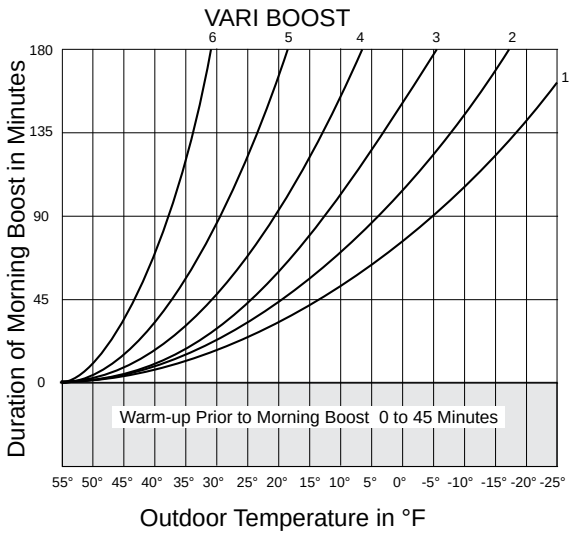
- This Boost begins at the Day #1 time, and lasts for as many minutes as set by the Boost Adjustment. This type of Boost does not adjust with outside temperature and is not affected by the space temperature.

Vari-Boost

- This boost begins earlier than the Day #1 time. The colder the outdoor temperature, the earlier the Vari-Boost will start. A Vari-Boost curve of 0.1 gives the shortest Boost period, and a curve of 6.4 gives the longest Boost period.
- If Space Lockout was enabled, the Vari-Boost can extend up to an hour past the Day #1 schedule setting trying to satisfy the Day Space Target.
- Whenever Vari-Boost is selected, it will have an added 15 minute Warm-up time. This accounts for the time it takes for the boilers to establish pressure from a cold start, and is automatically added to the Boost time. So that, the total Boost period is equal to Boost time plus the Warm-up time.



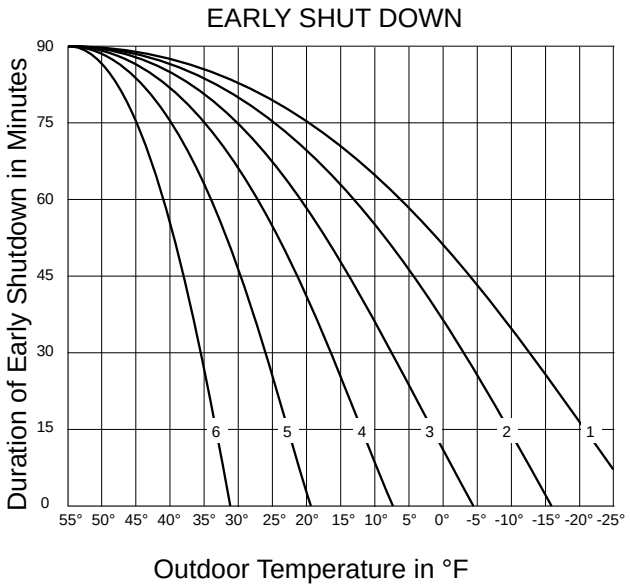




- If Warm-up Learn was enable over the Internet, the MPCQ Platinum will learn the length of time it takes the system sensor to reach the Set Point over multiple days and apply that to the following Warm-ups.
- Both Warm-up and Warm-up Learn can only be deactivated/ activated through the Internet.

Early Shutdown

- This should be used in commercial buildings where the building will be unoccupied in the Save (Night) times. A Vari-Boost as described above is run. In addition, the MPCQ Platinum will switch into the Night mode earlier than the latest Night setting for that day. The warmer it is outside, the earlier it will shift into Night.
- The Early Shutdown time is adjusted using the Morning Boost Adjustment Curve but works in the opposite fashion. The warmer it is outside, the earlier the MPCQ Platinum will shift to night. As it gets colder, the time between early shutdown and the last Night setting diminishes. The maximum amount of Early Shutdown is 90 minutes.



Stage Settings

SELECT: *Settings/System Settings/More Settings/Stage Settings*

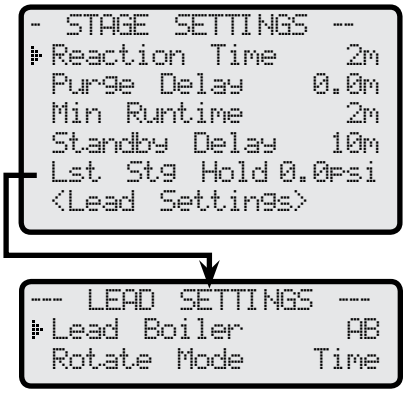
The Stage Settings is for adjusting how the burners and their stages should respond to different operation steps. The Stages behave differently based on the selected Control Logic (see Startup Settings on page 17).

Cycle or PID

- Reaction Time
- Purge Delay
- Minimum Run Time (page 24)
- Standby Delay (page 24)
- Last Stage Hold (page 24)
- Lead Boiler (page 25)
- Rotate Mode (page 25)

Oversize (OSS)

- Throttle (page 24)
- Lead Boiler (page 25)
- Rotate Mode (page 25)



Reaction Time

(Available with PID Control Logic Only)

Adjustable from 1 minute to 10 minutes **Default: 2 minutes**

SELECT *Settings/System Settings/More Settings/Stage Settings/Reaction Time*

- It is the amount of time it takes a single stage to affect the system.
- After the MPCQ Platinum turns on a stage trying to meet a set point, it will not turn on another stage until the reaction time has elapsed. Then, if a stage is needed, it will be energized.
- To determine the optimum time, start with a hot system in mild weather. Then, turn on a single stage and calculate how long it takes until the system begins to respond to that stage. That period should be set as the Reaction Time.



Purge Delay

(Available with PID Control Logic Only)

Adjustable from 0.0 minute to 10.0 minutes **Default: 0 minutes**

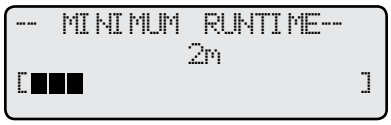
SELECT *Settings/System Settings/More Settings/Stage Settings/Purge Delay*

- Most boilers must go through a purge cycle before they are brought online.
- When the MPCQ Platinum activates a boiler (the lowest stage on a burner), it does not start to calculate its output until the Purge Delay is over. This ensures that the unit can fully come online and is capable of producing output.



- The Purge Delay helps prevent short cycling of a newly activated burner. Once the lowest burner stage is activated, it **MUST** run through the entire Purge Delay period. The Reaction Time for that stage will start after the elapse of the Purge Delay.
- The minimum Purge Delay setting **MUST** be set to the time required by the boiler's manufacturer.

Minimum Run Time



(Available with PID Control Logic Only)

Adjustable from 1 minute to 60 minutes **Default: 2 minutes**

SELECT *Settings/System Settings/More Settings/Stage Settings/Min Runtime*

- It is the minimum amount of time any stage will run. It reduces short cycling.
- For the lowest stage on a burner, the Minimum Run Time starts after the purge delay.
- In addition to the Minimum Run Time, the Last Stage Hold applies to the last stage online.
- Initially, set the Minimum Run Time to half the Reaction Time.
- If System tends to overshoot, reduce the Minimum Run Time. If boilers tends to short cycle, increase Minimum Run Time.

Standby Delay



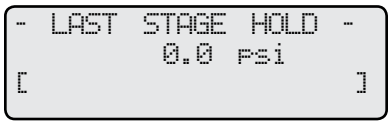
(Available with PID Control Logic Only)

Adjustable from 1 minute to 60 minutes **Default: 10 minutes**

SELECT *Settings/System Settings/More Settings/Stage Settings/Standby Delay*

- The Standby Delay time only applies to boilers in Standby Mode.
- A Standby Boiler can only be activated after all the boilers in Auto Mode have run at high fire for the full Standby Delay.
- Standby boilers are usually used for backup or extreme load conditions. A Standby boiler can never be a Lead Boiler
- The full Standby Delay must always elapse regardless of what happens the system pressure. Therefore, a shorter Standby Delay will result in smoother set point operation in extreme conditions. Longer Standby Delay may prevent a standby boiler from firing if the other boilers can eventually meet the load or if the load decreases.
- When setting Standby Delay, remember that it will be added to the Reaction Time for the first stage on the first Standby boiler. The following stages start time will rely on the Purge Delay and Reaction Time only.

Last Stage Hold



(Available with PID Control Logic Only)

Adjustable from 0°F to 30°F **Default: 5°F**

SELECT *Settings/System Settings/More Settings/Stage Settings/Lst Stage Hold*

- The Last Stage Hold prevents short cycling of the Lead Stage during low load conditions.
- In low load conditions, the system might have a load that is significantly less than the output of one Stage. When the MPCQ Platinum brings on the Lead Stage, the Set Point is quickly exceeded and the MPCQ Platinum turns the Lead Stage off.
- To prolong the run time during this type of condition, use the Last Stage Hold setting. The MPCQ Platinum will allow the system pressure to exceed the Set Point by the Last Stage Hold value before the Lead Stage is turned off.
- For example; with a Set Point of 10 Psi and a Last Stage Hold setting of 2 Psi, the Lead Stage boiler will remain on until the Set Point reaches 12 Psi then de-energize.

Avoiding Conflicting Boiler Limits

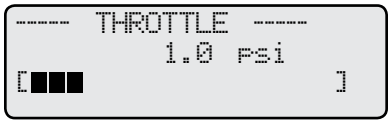
⚠ ALERT

The pressure limits set on the boilers must be higher than the MPCQ Platinum Set Point. Read the section at left for details to prevent erratic system operation.

The pressure limits set on the boilers MUST be set considerably higher than the MPCQ Platinum's Set Point for the reasons detailed below.

- The System sensor is located on the common header some distance from the boilers.
- As the pressure rises in the header and before reaching the sensor location, energy is dissipated and due to steam characteristics and steam pipe length, pressure drops. Therefore, the pressure in the header will be lower than that registered by the boilers.
- In addition to the normal drop experienced between the boiler pressure and that read by the MPCQ Platinum sensor, the Last Stage Hold setting must be accounted for. The boiler limit must be set above the Set Point PLUS the Last Stage Hold PLUS the normal drop experienced in the piping.
- Using the previous example of a 2 Psi Last Stage Hold with a 10 Psi Set Point, the boilers' limits must be set enough over 12 Psi to prevent the boilers' internal limits from being reached. In this situation, the boiler high limit should be set at approximately 14 Psi.

Throttle



(Available with OSS Control Logic Only)

Adjustable from 0.5 Psi to 5.0 Psi **Default: 1.0 Psi**

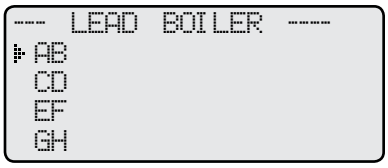
SELECT *Settings/System Settings/More Settings/Stage Settings/Throttle*

- The Throttling sets a pressure band around the Set Point that controls when stages will be turned on or off.
- For example, in the Oversize (OSS) Control Logic, no stages will be activated until the pressure falls one full Throttle below the Set Point. A second stage will be activated when the pressure falls to two full Throttles below the Set Point, and so on, with one extra stage being turned on for every Throttle below the Set Point the System pressure reaches.
- Stages will be turned off as the pressure rises toward the Set Point with one full Throttle as a difference.
- The last stage to be turned off will be allowed to exceed the Set Point by a full Throttle before it is turned off. This helps prevent the last stage from short cycling when the load is low or when the stage is oversized.

Set Point = 12 Psi Throttle = 2 Psi Boilers (A, B, C, D, E, and F) Lead Stage =<A>

		Falling Pressure		Rising pressure	
System Pressure	**Throttle Ranges**	**Stages Turned On**	**Stages On**	**Stages Turned Off**	**Stages On**
14 Psi	-1	----	None	A	None
12 Psi	0	----	None	----	A
10 Psi	1	A	A	B	A
8 Psi	2	B	A + B	C	A + B
6 Psi	3	C	A + B +C	D	A + B +C
4 Psi	4	D	A + B +C + D	E	A + B +C + D
2 Psi	5	E	A + B +C + D + E	F	A + B +C + D + E
0 Psi	6	F	A + B +C + D + E + F	----	A + B +C + D + E + F

Lead Boiler and Rotation Settings



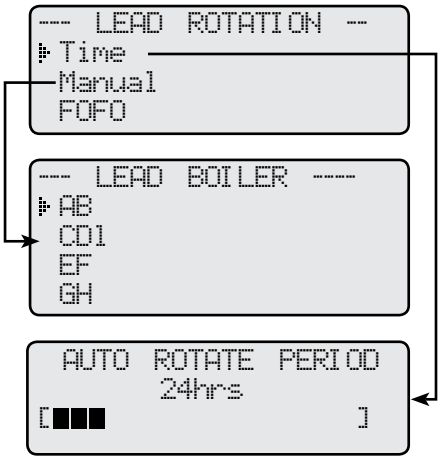
Lead Boiler

Adjustable to Any Auto Configured Boiler Default: <A>

SELECT *Settings/System Setting/More Setting/Stage Setting/Lead Boiler*

SELECT *Settings/System Setting/More Setting/Stage Setting/Lead Settings/Lead Boiler*

- The Lead Boiler's lowest firing stage will always be the first stage brought on when there is a call for output. As more output is needed, additional stages are added.
- The Lead Boiler is shown on the main display in brackets. The letters in brackets will indicate the stages controlled by the boiler
- In a 2-Stage system (see Boiler Type on page xx), the display will show the two Lead Boiler stages bracketed <AB>. In a 3-Stage system, the display will show the three Lead Boiler stages bracketed <ABC>, and so on.
- The Lead Boiler can be rotated based on the Rotation Mode selected. (See next setting)



Rotate Mode

Time (1 - 999hrs), Manual, First-On/First-Off (FOFO) Default: Time(24hrs)

SELECT *Setting/System Setting/More Setting/Stage Setting/Rotate Mode*

SELECT *Setting/System Setting/More Setting/Stage Setting/Lead Setting/Rotate Mode*

- Automatically rotating the Lead Boiler among the active boilers promotes more even wear on the boilers and can help prolong their life.
- On power up, or any time the MPCQ Platinum loses power, the Lead Boiler will be the lowest Boiler in Auto Mode (A).
- The MPCQ Platinum has three Lead Boiler rotation options.

Time

- If the default 24 hour rotation is used, at 2 am every morning the Lead Boiler will change to the next Boiler in Auto Mode.
- Note: If the system time is not set, the MPCQ Platinum will assume it was installed at 2 PM. Thus, rotating the first time after 12 hours, followed by every 24 hours.
- If the Rotate Time (Auto Rotate Period) is changed, the Lead Boiler will change to the next Boiler in Auto Mode every time the Rotate Time (Auto Rotate Period) has elapsed. For example, with a 48 hour Rotate Time, the Lead Boiler will rotate from A to B after the first 48 hours of operation, and then from B to C after the next 48 hours, and so on.
- When less output is needed, the additional boiler stages are turned off in the reverse order of how they were added. For instance, if the boiler stages were added in the sequence A, B, and C, then they will be turned off in the sequence C, B, and A.
- After selecting the Time rotation option, you'll need to select the Auto Rotation Time Period from the next screen.

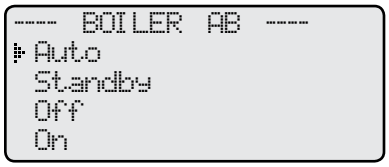
Manual

- If Manual is selected, the Lead Boiler will not automatically rotate.
- In Manual, whichever Boiler is presently the Lead will remain the Lead until there is a power failure. Then the MPCQ Platinum will revert to the lowest Boiler in Auto Mode.

First-On/First-Off (FOFO)
(AVAILABLE IN PID CONTROL MODE ONLY)

- If First-On/First-Off (FOFO) is selected, the concept will follow this example; if A is the lead, the starting sequence of boilers will be A, B, then C. When the de-energizing of the stages starts, it will turn off A, B, Then C. Then, stage D will be the new lead for the next load.

Boiler Operation Mode



Auto, Standby, Off, On **Default: Auto**

BOILER (Button)

By pressing the *BOILER* button, the Boiler Operation mode menu selection will display. There are four modes. By pressing the *BOILER*, *NEXT*, or *PREV* buttons the display will scroll between the different modes.

- ***Auto*** - In this mode boiler stage will operate based on control settings. Boiler can be used in rotation. The status will read:
  - ---(All stages are Off)
  - LOW (Only lowest firing stage on a multi-stage boiler is On)
  - MED (Both Low and Medium firing stages on a 3-stage boiler are On)
  - MLOW (Both Low and Medium Low firing stages on a 4-stage boiler are On)
  - MHIGH (The three lowest firing stages on a 4-stage boiler are On)
  - HI (The On/Off boiler stage is On)
  - HIGH (All firing stages on a multi-stage boiler are On)
- ***Standby*** - Boiler will start only after all Boilers set to Auto are on for the full Standby Delay. The display status will read STB.
- ***Off*** - Boiler relay will be Off until this setting is changed. The display status will read OFF.
- ***On*** - Boiler relay as well as System relay will be On until this setting is changed. The display status will read ON.

- The following are the possible stage status:
  - C/E - Will only occur to a boiler wired to an extension and the Extension communication has terminated.
  - L/O - The boiler is in lockout due to lockout input is shorted on the Extension.

Schedules

SELECT *Setting//Schedules*



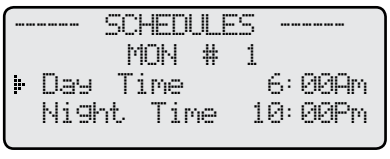
- The MPCQ Platinum has two levels of heat. The Day Time level is used when a building is occupied and people are active.
- The Night Time (Setback) level is used when a building is not occupied, or when people are sleeping.
- The MPCQ Platinum can have up to four Day Time and four Night Time (Save) periods for each individual day of the week. The MPCQ Platinum will show which period is being edited on the 2nd line of the display.
- Every time the MPCQ Platinum updates the clock time, it checks the Day/Night program. If there is a matching Day/Night time programmed, it sets the heat level accordingly, otherwise, the heat level is not changed.
- If an office building is unoccupied all weekend, simply set the last Night setting (8:00 PM on Friday). Then, set all the Saturday and Sunday programs to **:** (using the DEL button). The control will stay in Night Time (Save) until it reaches a Day setting (6:00AM on Monday).

⚠ ALERT

The MPCQ Platinum will ignore any Time setting that reads **:**.

The Day #1 setting for any Day Time is used by the Boost. The last Night Time setting is used by the Early Shutdown ESD.

Day/Night Schedule



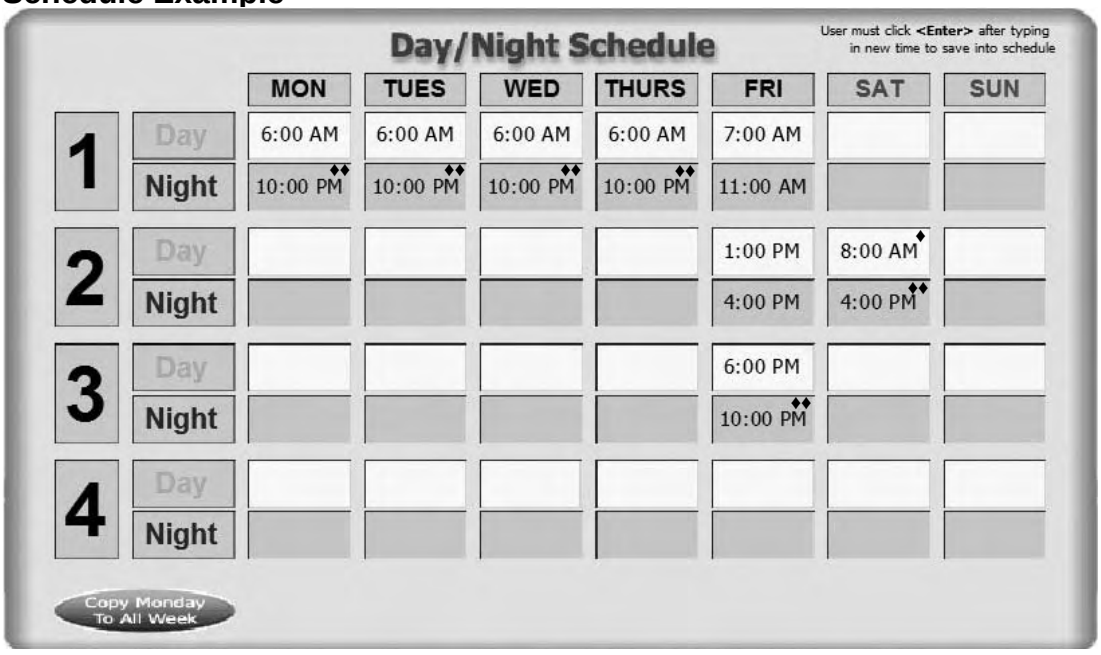
Day#1, Day#2, Day#3, and Day#4 **Day #1 default: 6:00 am**
Night#1, Night#2, Night#3, and Night#4 **Night #1 default: 10:00 PM**

SELECT: *Settings/Schedules/Day Night Schedule*

- Use this setting to set up to 4 Day Time and 4 Night Time (Save) settings per each day of the week. The Day Time settings allows the MPCQ Platinum to cycle based on the Day Outdoor Cutoff, Day Heat Adjustment, and Day Space Target (when Cycle is selected as the Operation Mode) or based on the Set point and Day Outdoor Cutoff (when Set Point is selected as a Operation Mode). See Operation Mode on page 17.

- If Manual Boost feature is being used, it uses the Day #1 time on (1st setting of that day) as a Boost calculation starting point.
- If Vari-Boost feature is being used, it uses the Day #1 time on (1st setting of that day) as a Boost calculation ending point.
- The actual Boost start time varies depending on the Outdoor Temperature (OD) and Boost Adjustment. See page 22.
- The Night Time settings lets the MPCQ Platinum follow the cycle based on the Night Outdoor Cutoff, Night Heat Adjustment, and Night Space Target (when Cycle is selected as the Operation Mode). Furthermore, if the Early Shutdown feature is being set, it uses the last Night Time setting of that weekday as an Early Shutdown calculation ending point. In this case, the actual Early Shutdown start time will vary based on Outdoor temperature and Boost Adjustment. See page 22.
- In this area of the MPCQ Platinum control menu 3 buttons will take effect. The NEXT button will allow the scroll between the 4 different settings of a specific weekday. The BOILER/DAY button will allow the scroll between all weekdays. The PREV/DEL button will erase the Day Time and Night Time settings for a specific day schedule.
- When setting the date and time over the Internet, type each time value in a (hh:mm AM) format. Then, press the Enter on your keyboard after each field.

Schedule Example



♦ No boost will take effect.

♦♦ Early Shut Down ends. Night Schedule begins

Weekday	Cycle	Set Point
Monday through Thursday	• Vari-Boost begins before 6 AM and ends at 6 AM♦ • Day Cutoff, Day Heat Adjustment, and Day Space Target are maintained from 6 AM until before 10 PM • Early Shutdown starts before 10 PM and ends at 10 PM • Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained from 10 PM until the Vari Boost of the following morning	• No Boost will take effect • Day Cutoff and Set Point are maintained from 6 AM until before 10 PM • No Early Shutdown will take effect • Night Cutoff and Set Point less Setback are maintained from 10 PM until before 6 AM of the following morning
Friday	• Vari-Boost begins before 7 AM and ends at 7 AM♦ • Day Cutoff, Day Heat Adjustment, and Day Space Target are maintained from 7 AM until before 11 AM • Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained from 11 AM until before 1 PM • Day Cutoff, Day Heat Adjustment, and Day Space Target are maintained from 1 PM until before 4 PM • Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained from 4 PM until before 6 PM • Day Cutoff, Day Heat Adjustment, and Day Space Target are maintained from 6 PM until before 10 PM • Early Shutdown starts before 10 PM and ends at 10 PM • Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained from 10 PM until before 8 AM of the following morning	• No Boost will take effect • Day Cutoff and Set Point are maintained from 7 AM until before 11 AM • Night Cutoff and Set Point less Setback are maintained from 11 AM until before 1 PM • Day Cutoff and Set Point are maintained from 1 PM until before 4 PM • Night Cutoff and Set Point less Setback are maintained from 4 PM until before 6 PM • Day Cutoff and Set Point are maintained from 6 PM until before 10 PM • No Early Shutdown will take effect • Night Cutoff and Set Point less Setback are maintained from 10 PM until before 8 AM of the following morning

Weekday	Cycle	Set Point
Saturday	• No Vari-Boost as the Day #1 is not programmed • Day Cutoff, Day Heat Adjustment, and Day Space Target are maintained from 8 AM until before 4 PM • Early Shutdown starts before 4 PM and ends at 4 PM • Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained from 4 PM until before 6 AM Monday morning	• No Boost will take effect • Day Cutoff and Set Point are maintained from 8 AM until before 4 PM • No Early Shutdown will take effect • Night Cutoff and Set Point less Setback are maintained from 4 PM until before 6 AM Monday morning
Sunday	• Night Cutoff, Night Heat Adjustment, and Night Space Target are maintained all Sunday until before 6 PM	• Night Cutoff and Set Point less Setback are maintained all Sunday until before 6 AM Monday morning

♦ If no space sensors with space average are available the Vari-Boost will end at the Day #1 time setting. However, if space sensors with space average are available and Space Lock was enabled, the Vari-Boost can extend up to 1 hour past the Day #1 setting.

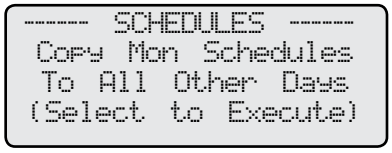
⚠ ALERT

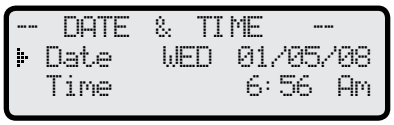
When working with MPCQ Platinum Internet communication with Space Lock enabled, the Boost can extend to an additional hour past the Day #1 setting if Day Space Target was not reached within the Boost period.

Copy Schedule

SELECT: *Settings/Schedules/Copy Schedule*

- To reduce the need for setting each weekday time schedule, this feature has been made to allow the copying of the Monday schedule settings to the reset of the week.





Set Date and Time

SELECT: *Settings/Schedules/Set Date & Time*

- The Date and Time will need to be set n the startup process of the MPCQ Platinum.
- Selecting Date will allow you to set the year followed by the month then finally the day.
- Adjust the time by selecting Time from the menu and then scrolling through the hours followed by the minutes.
- Pay attention to the AM/PM when adjusting the hours.
- Internet controls will receive their date and time based on their Internet configured building time zone automatically.

⚠ ALERT

Remember that the battery is the only backup for the Date and Time. If no power is supplied to the MPCQ Platinum and there was no battery or battery had no power, date and time values will be lost and will need to be re-entered.

Vacation Schedule Setting

(Available with RINet (Internet Communication Controls Only)

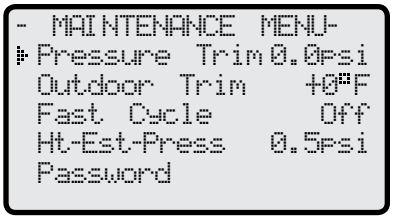
- The vacation Space Target and settings can only be set on the Internet ICMS website.
- The MPCQ Platinum offers a Vacation Schedule which provide the user with an adjustable lower space target that can be maintained between two specified date/time periods. See Vacation Schedule on page 33.



Maintenance

SELECT: *Settings/Maintenance*

The Maintenance menu gives access to sensor trimmings, Fast Cycle, Heat Establish Pressure, and the Password protection.



System and Outdoor Sensor Trim

(Pressure) Adjustable from -3.0 to +3.0 **Default: 0.0**

(Outdoor) Adjustable from -5 to +5 **Default: 0**

SELECT: *Settings/Maintenance/Pressure Trim*

SELECT: *Settings/Maintenance/Outdoor Trim*





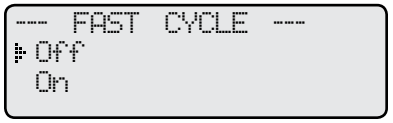
- The Heat-Timer pressure transducer and thermistor type sensors are very accurate, and normally require no calibration. However, sometimes it may be desirable to make small adjustments to the displayed value for either the Outdoor temperature (OD) or the System pressure (SYS) to match other gauges or sensors on the same system. The Trim setting can be used to adjust the displayed value.
- Do not use the Trim setting to make the Outdoor temperature sensor match that reported on the radio or TV. Outdoor temperature can vary widely over a broadcast range. Only trim the outdoor sensor based on an accurate thermometer reading taken where the sensor is located.

Fast Cycle

(Available in Cycle Operating Mode Only)

On, Off **Default: Off**

SELECT: *Settings/Maintenance/Fast Cycle*



- The Fast Cycle changes cycle minutes to cycle seconds, so a 60 minute cycle can be reviewed in 60 seconds.
- The Fast Cycle is primarily used to test the MPCQ Platinum cycle operation. If the control is in the OFF part of a cycle, selecting Fast Cycle = On, will allow the remaining cycle to be completed in less than a minute. At that point, the MPCQ Platinum will not sequence start another cycle until the Heat is Established.
- Note the Fast Cycle feature only works when the MPCQ Platinum is in a cycle. It cannot be used to override the Heat Established function or to prevent the Pressure Lockout.

Heat Establish Pressure and Pressure Lockout

(Available in Cycle Operating Mode Only)

Adjustable from 0.5 psi to 5.0 psi **Default: 0.5 psi**

SELECT: *Settings/Maintenance/Heat Est Pressure*

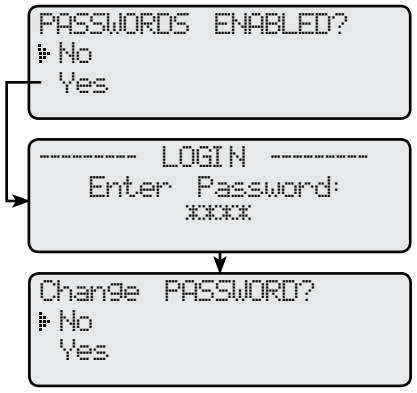


- The Pressure Lockout prevents another cycle from starting when the heating system is still hot. Any pressure at or above the Heat Establish Pressure will indicate a Pressure Lockout.
- Having the system pressure at or above this setting indicates that the building steam pressure is high enough to provide heat and no stage should start until the steam pressure has dropped. See Cycle Operation Concept on page 4.

Password and Local Security

Adjustable to any four letters **Default: MPCQ**

SELECT: *Settings/Maintenance/Password*



- The Password is used as a security measure to prevent unauthorized local control users from making changes to the MPCQ Platinum settings.
- It will not protect against any remote changes. Remote changes have a web login screen with a different password for each user.
- Setting up the Password feature makes servicing more difficult and can disable the system if management or ownership should change.
- The Password feature is not active unless a user enables it. If you choose to enable the Password, DO NOT forget the Password. Write it down and store it in a safe location known to at least one other authorized user.
- When the Password is enabled, none of the settings, except Shift to Extend Day, Auto/Bypass toggle switch, and Schedules can be changed without entering the Password.

- When a change is to be made at a protected control, a login screen will show upon trying to a setting. To enter the Password, turn the ADJUST/SELECT knob until the desired letter is shown. Then, press the ADJUST/SELECT to move on to the next letter.
- Once the Password is entered, you can make multiple changes. The Password will expire 5 minutes after the last change has been made.
- To enable or change the Password, enter the Maintenance menu and select Password. Then, follow the prompts to enable or change the Password.
- To allow an Internet communication control overridden values to be adjusted locally, the Panel Password Mode under the Maintenance screen must be set to either "Only Overrides Require Password" or "All Changes Require Password". This will allow a control user with the proper password to make changes to overridden settings.

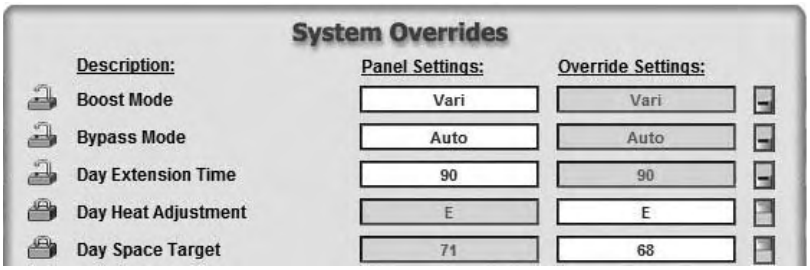
⚠ ALERT
When password is enabled, all settings will be read only except for the Shift to Extend Day and the Auto/Bypass switch operation.

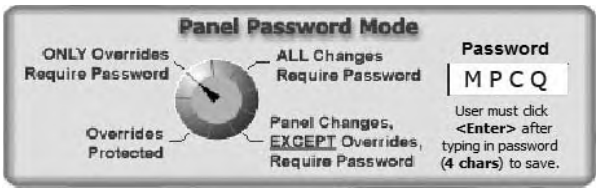
⚠ WARNING
Any setting that is changed remotely will automatically be set to override. An overridden setting is not adjustable unless "ONLY OVERRIDES REQUIRES PASSWORD" or "ALL CHANGES REQUIRE PASSWORD" has been selected from the Internet Maintenance screen.

Override Remote Changes
(Requires a Communication Package)

- With remote communication, any setting that is changed remotely will automatically be set to override. An overridden setting will have a star next to its value on the control display (The screen shows the System Run-On with as an overridden value). In addition, it will not be modifiable unless the password is entered.
- Internet controls offers the capability of taking a specific value out of its override status. Just go to the ICMS System Override webpage and click the button to the right of that setting.
- To take all settings out of override, go the ICMS System Overrides webpage and select "Remove all Overrides" button.
- To allow an Internet communication control overridden values to be adjusted locally, the Panel Password Mode under the Maintenance live session must be set to either "Only Overrides Require Password" or "All Changes Require Password". This will allow a control user with the proper password to make changes to overridden settings.
- All BACnet IP communication controls provide access to change their override values locally when the password is entered.

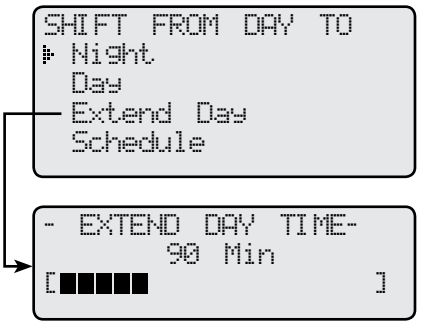






Shift

Day, Night, Extended Day, Schedule **Default: Schedule**
Extend Day (60 to 240 minutes) **Default: 90 minutes**
SELECT: *Settings/Shift*
SELECT: *Settings/Shift/Extend Day*



- The Shift selection allows you to manually shift from any setting into Night, Day, Extended Day Schedule, or programmed Schedules. This can be used to temporarily override the programmed schedule.
- A typical example where the shift would be used is in a school where an event has gone into overtime. Instead of re-programming the control to keep it from going into the Night mode, simply select the Shift to Extend Day.
- The amount of time the MPCQ Platinum will hold the shift is based on the following:
  - ***Shifting from Day to Night***
    The control will stay in the Night mode until the start of the next programmed Day mode time. The Display will show NIT SHT to indicate this status.
  - ***Shifting from Night to Day***
    The control will stay in the Day mode until the start of the next programmed Night mode time. The Display will show DAY SHT to indicate this status.

- ***Shifting to Extended Day***
  The control will stay in the Day mode for an adjustable amount of time (adjustable between 60 to 240 minutes), and then revert automatically back to the scheduled program. This prevents a user (without a programming password) from shifting the MPCQ Platinum to Day mode for an extended period of time when it is scheduled as Night. When the control is manually shifted to Extended Day, the Display will alternate between the DAY EXT and the Extended Time balance remaining in minutes indicating the Extended Day mode.

• The Shift to Extended Day option will be available to anyone to change. Password protection will not affect this option.

Auto/Bypass

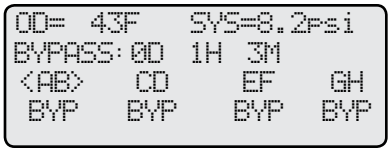
Auto **Default: ±0.0**



- The Bypass switch offers the user the capability of bypassing the control operation and allowing the stages and system relays to run using their own operating limits.
- Therefore, if there is no heat, test the system and the boilers by switching the control to bypass. If the units do not run, the problem is not with the MPCQ Platinum control.
- When the switch is in the bypass position, no automated functions will be executed. That means, sensor fault, shutdown, and prove will have no effect on the System and stage relays. All System and stage relays will energize regardless of their Stage mode. The display will change to read the total time the control has been in Bypass and all stage status will display BYP.
- The switch must be in the AUTO position for the MPCQ Platinum to control the system and stage relays.
- This switch will not be affected by any password setting.
- If the control was set to Bypass locally, remote operation of the Bypass will not function.
- If the control was set to Bypass remotely, then only remotely can the control be removed from Bypass operation.

⚠ ALERT

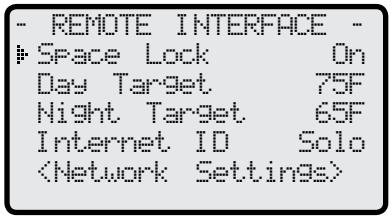
When the MPCQ Platinum is switched to Bypass locally or remotely, all stages will turn on regardless of the Boiler Mode setting. In this case, Sensor Fault, Shutdown, and Prove will have no effect on the control operation.



Communication

- The MPCQ Platinum is available as a stand alone or with one of the communication options. Each of the communication options requires the purchase of the control with that specific remote communication option or the upgrade of the control.
- An Internet communication option (MPCQ Platinum RINet) provides the user with access to modify control settings, add space sensors and other sensors, e-mail alarms and reports, view history, and much more.
- A BACnet communication option (MPCQ Platinum BAC) provides the user with the capability of changing settings and communicating over a BACnet IP network. The same control can be used with Fieldserver and other gateways to communicate over a multitude of protocols. Contact Heat-Timer to find out about the possibility of interfacing to other protocols.

Remote Interface



SELECT *Settings/System Settings/More Settings/Remote Interface*

- The MPCQ Platinum can be controlled remotely through the Internet or a BACnet network. The Internet communication is started by creating an account using the Heat-Timer Internet Control Management System (ICMS) website (http://www.htcontrols.com). After the account is approved, the user can create the building where the control will reside. Then when the control communicates, he can assign the control to the building. Visit the ICMS website for additional help information.
- Several features are only available to Internet controls including: Configuring additional sensors (Space, Temperature, Oil level, Stack temperature, pulse/count sensor (for water meters), , vacuum, humidity, and pressure), Space feedback, Vacation schedule, Alarm activation and deliveries, history analysis and reporting, Data Export to a variety of spreadsheets and databases.

Space Lock



(Requires RINet Package and Space Sensors)

On or Off **Default: Off**

SELECT *Settings/System Settings/More Settings/Remote Interface/Space Lockout*

- The Space lockout is a major energy saving feature that disables the MPCQ Platinum from starting another heating cycle when the space average is at or exceeds the Day or Night Space targets.
- The Space Lockout is required to be set to On to be able to use Space sensors for Day Target and Night Target. This option can be set when the MPCQ Platinum has the Internet communication packages.
- At least one space sensor with Space Average activated must be configured through the Internet to utilize the Space Lock. However, Heat-Timer recommends a minimum of four sensors but should have approximately one sensor in 10% of the total units..

Day Target



(Requires RINet Package and Space Sensors)

Adjustable from 55°F to 85°F **Default: 75°F**

SELECT *Settings/System Settings/More Settings/Remote Interface/Day Target*

- For the Day Target to be used, Space Lock must be enabled.
- The Day Target is the space temperature the MPCQ Platinum will try to reach during the Boost period (Day #1 setting) when coming out of the Night Time setting.
- During the Day schedule, the MPCQ Platinum will check the Space Average temperature before starting a new heating cycle. If it was below the Day Target, the MPCQ Platinum will start another heating cycle. Otherwise, the control will go into Space Lockout and no other heating cycles will start unless the Space Average drops below the Day Target.

Night Target



(Requires RINet Package and Space Sensors)

Adjustable from 50°F to 80°F **Default: 65°F**

SELECT *Settings/System Settings/More Settings/Remote Interface/Night Target*

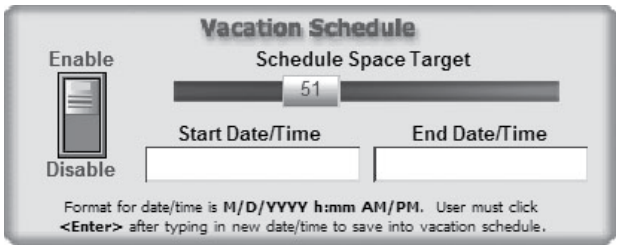
- For the Nighty Target to be used, Space Lock must be enabled.
- The Night Target is the space temperature the MPCQ Platinum will try to reach during the Early Shutdown ESD period when switching from the Day setting.
- During the Night schedule, the MPCQ Platinum will check the Space Average temperature before starting a new heating cycle. If it was below the Night Target, the MPCQ Platinum will start another heating cycle. Otherwise, the control will go into Space Lockout and no other heating cycle will start unless the space average drops below the Day Target.
- If Boost with ESD was enabled, during the Early Shutdown while the space average is above the Night Target, the control will be in Fast Cool Down where it will not start another cycle until the Space Average temperature drops below the Night Target.

Vacation Schedule

(Requires RINet Package and Space Sensors)

Adjustable from 43°F to 58°F **Default: 45°F**

Adjustable only through the Internet ICMS website



- The MPCQ Platinum offers a Vacation Schedule, which provides the user with an adjustable lower space target that can be maintained between two specified date/time periods.
- This is useful for schools and office buildings to be used during holidays and vacations.
- After the vacation end time, the control will switch to boost until the Day Target is reached or three hours, whichever comes sooner.

Internet Communication

Visit (http://www.htcontrols.com)

(Requires Internet Package)

- The MPCQ Platinum can be set to communicate over the Internet.

Internet ID

(Requires RINet Package)

Solo, 1-32, Custom **Default: Solo**



SELECT *Settings/System Settings/More Settings/Remote Interface/Internet ID*

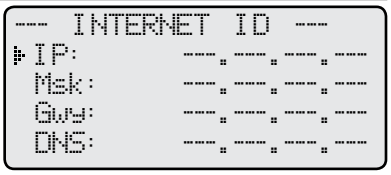
- If the control is connected directly to the Internet using a dynamic cable modem without a firewall, then the user must select Solo as the Internet ID. The MPCQ Platinum will acquire its Internet information directly from the cable modem.
- If the control is behind an Internet router or a server with an active DHCP server, the firewall must be configured for port forwarding. (See Internet Port Forwarding Table.) In addition, the MPCQ Platinum must have its Internet ID set to any number between 1 and 32. The DHCP server must not provide an internet IP that matches the control local static IP. (See Internet Port Forwarding Table.)
- The Custom option is primarily used when the Internet connection on the WAN side is Static or when the DHCP server is not activated. Thus, allows the user to manually configure the Internet connection by entering the IP, Mask, Gateway, and DNS information. All the information must be entered in an IP format.
- On a power up, the MPCQ Platinum will have a delayed Internet start (approximately one to two minutes) to allow routers, modems, and servers to initialize and get online.

⚠ ALERT

When connecting multiple panels to the Internet, a Heat-Timer Internet Router is required.

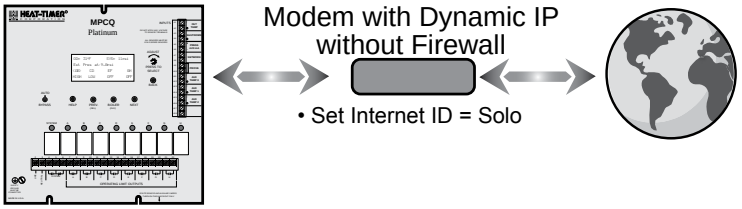
⚠ ALERT

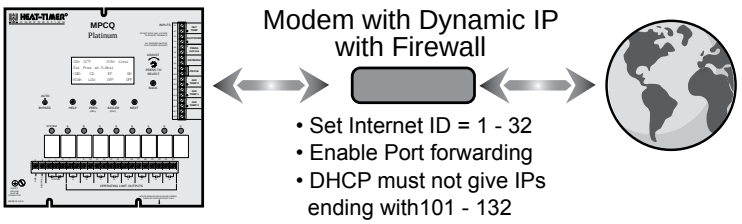
If the MPCQ Platinum is behind a firewall, make sure that outgoing port 4133 is open.

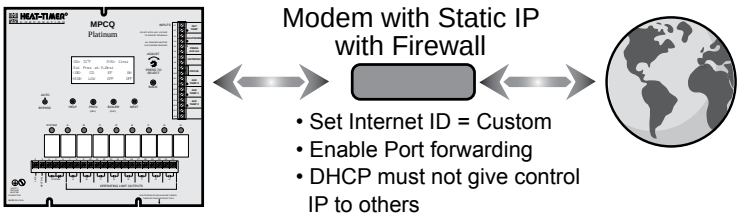


Internet Port forwarding Table

Internet ID	Actual IP	Port to Forward
Solo	N/A	8082
1	---.---.---.101	8082
2	---.---.---.102	8083
3	---.---.---.103	8084
4	---.---.---.104	8085
5	---.---.---.105	8086
6	---.---.---.106	8087
7	---.---.---.107	8088
8 - 31	---.---.---.108 to ---.---.---. 131	8089 to 8112
32	---.---.---.132	8113
Custom	Any IP	8082







Internet Alarms

- The MPCQ Platinum RINet has a set of pre-configured control alarms that can be activated through the Internet ICMS website by visiting the control Alarms webpage.
- Each alarm can be activated by creating at least one delivery. Simply, click on the *Alarm* button. Then, add a delivery by clicking on the *Add Delivery* button on the right hand side of the screen. A delivery method option (Web or e-mail) must be selected from the drop down list. Then, fill the fields with the delivery information including subject, e-mail, and message.
- A delivery can be in the form of a web alarm (the building and control icons will have a Red dot), e-mail alarm, a text message to a cell phone (it is an e-mail in the form of 1111111111@CellCompany.com where CellCompany.com will vary with the cell phone carrier).



- The MPCQ Platinum control alarms are:

  - (#1000) In Bypass for Over 1 Hour: This alarm will generate if the control has been put into Bypass either locally (Auto/bypass switch. See page 31.) or remotely for a full continuous hour.
    (#6000) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

  - (#1002)/(#1003) Space Temp Exceeds/Below Target by More Than 10°: This alarm will be sent only if the space average over the past two hours has averaged 10°F above or below the space target.
    (#6002)/(#6003) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

  - (#1004) Extension Module Communications Error: This alarm will be generated if the extension panel communication the MPCQ Platinum has terminated.
    (#6004) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

  - (#1005) Lockout on Boiler: This alarm will be generated for any boiler that has gone into lockout status. The message will indicate the specific boiler in lockout.
    (#6005) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

  - (#1006) System Pressure Fault: This alarm will be generated whenever the System sensor goes open or short.
    (#6006) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

  - (#1008) No prove for More Than 10 Minutes: This alarm will be generated whenever there is a call for output but the Prove terminals have not been shorted for over 10 minutes..
    (#6008) Is an end alarm that can be set to indicate that the initial alarm status has terminated.

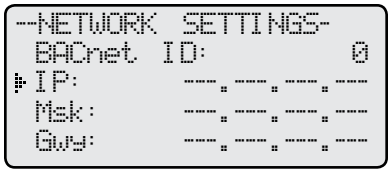
BACnet Communication

(Requires BAC Package)

- The MPCQ platinum BAC is designed to communicate over a BACnet IP network.
- If the MPCQ Platinum was purchased with a BACnet communication package, some of the following settings must be configured to guarantee proper communication.

BACnet Communication Option

SELECT: *MENU/<System Settings>/<more Settings>/Remote Interface/Network Settings*



- After connecting the MPCQ Platinum to the BACnet network, see Wiring the BACnet Communication on page 13, the user must set the following parameters according the BACnet Network Administrator's instructions.

BACnet Device ID

- This is a unique ID within the BACnet network. It must be provided by the BACnet Network Administrator and entered into the BACnet ID field. The value must not be 0.

IP, Mask, and Gateway Address

- These fields are either left blank if the IP information is automatically provided by the network (DHCP server assigns IPs). Otherwise, fill in these information as per the Network Administrator instructions

⚠ ALERT

A MPCQ Platinum that is BACnet capable will display -- NETWORK PANEL -- on the 2nd row of the display when it is in screen saver mode.

MPCQ Platinum BACnet Variable List

The following is the BACnet variable list that can be used to communicate with the MPCQ Platinum.

OBJ ID	OBJECT NAME	DESCRIPTION	TYPE*	UOM	RANGE	READ ONLY
0	BOOSTADJ	Vari-Boost Adjustment	AV	none (95)	0.1 - 6.4	
100	BOOSTMODE	Boost Mode	MV		1=Disabled, 2=Manual, 3=Vari, 4=Vari+ESD	
200	BOOSTTIME	Manual Boost Time	AV	Minutes(72)	0 – 120	
300	BPTIME	Bypass Time	AV	Minutes(72)	0 - 2,147,483,647	X
400 through 431	BSTATUS	Boiler Status	MV		1=Off, 2=On1=Off, 2=Low, 3=High1=Off, 2=Low, 3=Med, 4=High1=Off, 2=Low, 3=MLow, 4=MHigh	X
500	BTYPE	Boiler Type	MV		1=On/Off, 2=2-Stage3=3-Stage, 4=4-Stage	
600	BYPASSMODE	Bypass Mode	BV		0=AUTO, 1=ON	
700	CLENGTH	Cycle Length	AV	Minutes(72)	10 - 240	
800 through 831	COMERR00 through COMERR31	Communication Error	BV		0="", 1=C/E	X
900	DADJUST	Day Heat Adjustment	MV		1=A, 2=B, 3=C, 4=D, 5=E, 6=F, 7=G, 8=H, 9=I, 10=J, 11=K, 12=L,13=M, 14=N, 15=O, 16=P	
1000	DCUTOFF	Outdoor Day Cutoff	AV	°C(62), °F(64)	-6 - 38, 20 - 100	
1100	DLS	Day Light Saving	BV		0=Enable, 1=Disable	
1200	FAULTMODE	Sensor Fault Mode	BV		0=OutputOn,1=OutputOff	
1300	INMODE	Sensor Mode	BV		0=°F, 1=°C	
1400	LEAD	Lead Boiler	MV		(Refer to Table 2)	
1500 through 1531	LOCK00 through LOCK31	Lockout Input	BV		0=(inactive),1=L/O,	X
1600	LOGIC	Logic Mode	BV		0-PID	
1700	LSTHOLD	Last Stage Hold	AV	psi(56)	0 – 5 psi	

OBJ ID	OBJECT NAME	DESCRIPTION	TYPE*	UOM	RANGE	READ ONLY
1800	MINRUN	Min Runtime	AV	Minutes(72)	1-60	
1900 through 1931	MODE00 through MODE31	Boiler Mode	MV		1=Auto,2=Standby,3=Off,4=On	
2000	NBOILER	Total Boilers	AV		1 – 32/(BTYPE+1)	
2100	NADJUST	Night Heat Adjustment	MV		1=A, 2=B, 3=C, 4=D, 5=E, 6=F, 7=G, 8=H, 9=I, 10=J, 11=K, 12=L,13=M, 14=N, 15=O, 16=P	
2200	NCUTOFF	Outdoor Night Cutoff	AV	°C(62), °F(64)	-6 - 38, 20 - 100	
2300	ODTEMP	Outdoor Sensor	AV	°C(62), °F(64)	-40 - +250	X
2400	ODTRIM	Outdoor Sensor Trim	AV	°C(62), °F(64)	-3 - +3, -5 - +5	
2500	OPMODE	Operation Mode	BV		0=Cycle, 1=Set Point	
2600	PDATE	Panel Date	AV	Days (70) since 1/1/1981	0 - 2,147,483,647	
2700	PRETRIM	Pressure Sensor Trim	AV	psi(56)	-3 - 3	
2800	PTIME	Panel Time	AV	Minutes(72) since 0:00	0 - 1439	
2900	PURGE	Purge Delay	AV	Minutes(72)	0-10	
3000	REACT	Reaction Time	AV	Minutes(72)	1 - 10	
3100	RTMODE	Lead Stage Rotation Mode	MV		1-Time	
3200	RTTIME	Periodic Rotation Interval	AV	Hours(71)	1 - 999	
3300 through 3355	SCHEDULES00 through SCHEDULES55	Schedules	AV	Minutes(72) since 0:00	0 - 1439, 1440=empty schedule	
3400	SEASON	Season	BV		0=Winter, 1=Summer	
3500	SEQUENCE	Sequence	BV		0=Lo/Hi/Lo/Hi1=Lo/Lo/Hi/Hi	
3600	SETBACK	Night Setback Temp	AV	psi(56)	-10 – 0psi	
3700	SETPT	Set point	AV	Psi(56)	0 – 30psi	
3800	SHIFT	Day/Night Shift	MV		1=To-Day, 2=To-Night, 3=Extend-Day,	
3900	STBYDLY	Standby Delay	AV	Minutes(72)	1 - 60	
4000	SYSPRES	System Pressure Sensor	AV	psi(56)	-5 - +35	X
4100	SRUNON	System Run-on	AV	Minutes(72)	0 - 60	
4200	SYSTEM	System Relay	BV		0=Off, 1=On	X
4300	THROTTLE	Throttle Range	AV	psi(56)	0.5 – 5	
4400	XYZPRESSURE	Heat Establish Pressure	AV	psi(56)	0.5 – 5	

* AV=analog value(2), BV=binary value(5), MV=multi-state value(19).

Note: The device object id is set through the menus. The device object name is 'HTC_' followed by the panel serial number.

Note: All variables with multiple UOM's depend upon the value of INMODE to determine which one to use.

Note: Use BOOSTADJ, BOOSTMODE, and BOOSTTIME when OPMODE set to 0. Use BOOSTADJ when BOOSTMODE is set to VariDay and VariDayNight. Use BOOSTTIME when BOOSTMODE is set to ManualBoost.

Note: BSTATUS range changes with BTYPE. For example: when BTYPE is set to 0, BSTATUS range 0 to 1; when BTYPE is set to 1, BSTATUS range 0 to 2.

Note: Use DADJUST, FASTCYCLE, NADJUST, and XYZPRESSURE if OPMODE set to 0.

Note: Use SETBACK if OPMODE set to 1

Note: Use LSTHOLD, MINRUN, PURGE, REACT, STBYDLY when LOGIC set to 0.

Note: Use RTTIME when RTMODE set to 0.

Note: Use THROTTLE when LOGIC set to 1.

Note: The MPC has a schedule, which is 7-days, 4 day/night pairs per day. For example: Instance 2000 is the first DAY schedule of Monday; Instance 2001 is the first NIGHT schedule of Monday; Instance 2008 is the first DAY schedule of Tuesday; Instance 2009 is the first NIGHT schedule of Tuesday and so on.

Note: Use the MPCQ installation menu for supplementary information.

Boiler Type Variable Table

BTYPE	LEAD – Special value (Up to NBOILER –1)
0	1 – 32 → ‘A’ ‘B’ ‘C’ … ‘X’ ‘Y’ ‘Z’ ‘a’ ‘b’ ‘c’ ‘d’ ‘e’ ‘f’
1	1 – 16 → ‘AB’ ‘CD’ ‘EF’ … ‘WX’ ‘YZ’ ‘ab’ ‘cd’ ‘ef’
2	1 – 10 → ‘ABC’ ‘DEF’ ‘GHI’ … ‘STU’ ‘VWX’ ‘abc’ ‘def’
3	1 – 8 → ‘ABCD’ ‘EFGH’ ‘IJKL’ ‘MNOP’ ‘QRST’ ‘UVWX’ ‘abcd’ ‘efgh’

Platinum BACnet PICS Statement

Product	Model Number	Protocol Revision	Software Version	Firmware Version
Platinum series BACnet Controls	Varies	1.5	tbd	tbd

Vendor Information
Heat-Timer Corp.
20 New Dutch Ln.Fairfield, NJ 07004
(973)575-4004
Vendor ID: 248

Product Description
Various controls for heating or cooling applications. Includes Platinum Models MPC, MPCQ, HWR, HWRQ, Multi-Mod, SRC. (see http://www.heat-timer.com for more information)

BACnet Standardized Device Profile (Annex L)

Product	Device Profile
Platinum series BACnet Controls	BACnet Application Specific Controller (B-ASC)

Supported BIBBs (Annex K)

Supported BIBBs	BIBB Name
DS-RP-B	Data Sharing-ReadProperty-B
DS-WP-B	Data Sharing-WriteProperty-B
DM-DDB-B	Device Management-Dynamic Device Binding-B
DM-DOB-B	Device Management-Dynamic Object Binding-B
DM-DCC-B	Device Management-DeviceCommunicationControl-B

Standard Object Types Supported

Object Type	Creatable	Deletable
Analog Value	No	No
Binary Value	No	No
Multi-State Value	No	No
Device	No	No

Data Link Layer Options (Annex J)

Product	Data Link	Options
Platinum series BACnet Controls	BACnet/IP	

Segmentation Capability

Segmentation Type	Supported	Window Size(MS/TP product limited to 1)
Able to transmit segmented messages	No	
Able to receive segmented messages	No	

Device Address Binding

Product	Static Binding Supported
Platinum series BACnet Controls	No

Character Sets

Product	Character Sets supported
Platinum series BACnet Controls	ANSI X3.4

Troubleshooting

Sensor INPUTS

Display shows Sensor OPEN or SHORT

When OPEN, Check if the sensor is connected and the wires are continuous to the MPCQ Platinum. Finally, follow the procedure for Display Shows Incorrect Temperature or Pressure. When in SHORT Remove the wires from the sensor terminals. The display should change to read OPEN. If it does not, the MPCQ Platinum may be damaged.

Display shows an Incorrect Temperature

Remove the wires from the sensor terminals. The display should change to read OPEN. If it does not, the MPCQ Platinum may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the Temperature sensor Table. If it does not, the sensor may be damaged.

Display shows an Incorrect Pressure

If the reading is a specified amount above or below the actual pressure adjust it using the System Trim. If the reading is SHORT, remove the wires from the sensor terminals. The display should change to read OPEN. If it does not, the MPCQ Platinum may be damaged.

CONTROL OPERATION

Too Much Heat

Check if the control has any of the following:

- **Heat Adjustment** - If the overheating occurs only during specific hours, check the Day/Night Schedule (page 26), Day/Night Heat Adjustment (page 21), Day/night Cutoff (page 21), or the Setback settings (page 22).
- **Boiler Mode Settings** - The MPCQ Platinum will only sequence boilers their mode is set to Auto or Standby. Make sure none of the boilers have their Mode set to ON. See page 26.
- **Control Settings** - The Last Stage Hold will allow only the Lead boiler to exceed the set point. If the setting is too high and only the Lead boiler is on, the system can overshoot. Reduce the Last Stage Hold setting. See page 24.

Too Little Heat

Check if the control has any of the following:

- **Setback and Day/Night Schedule** - If reduced heat occurs only during specific hours, check the Day/Night Schedule (page 26), Day/Night Heat Adjustment (page 21), Day/night Cutoff (page 21), or the Setback settings (page 22).
- **Boiler Mode Settings** - The MPCQ Platinum will only control boilers their mode is set to Auto or Standby after a delay. Check if any boilers have their Mode set to Manual, Off, or Standby Delay. See page 26.

Boilers are Short-Cycling

- **Minimum Runtime** - Increase the Minimum Runtime only if all boilers tend to short-cycle. See page 24.
- **Last Stage Hold** - Increase the Last Stage Hold only if the lead boiler tends to short-cycle. See page 24.

System is Overshooting or Oscillating

- **Reaction Time and Minimum Runtime** - If the system is overshooting, increase the Reaction Time (See page 23). This will allow the MPCQ Platinum enough time to respond before bringing on another stage. However, if the system was oscillating, increase the Reaction Time and the Minimum Runtime. See page 24.
- **PID vs OSS** - If the application requires fast response that the normal PID mode cannot provide, try using the OSS mode and adjust the Throttle according to the system requirements. See page 17.

Temperature Sensor Chart

TEMPERATURE (in Degrees °F)	Value (in Ohms)
-30	117720
-20	82823
-10	59076
0	42683
10	31215
20	23089
25	19939
30	17264
35	14985
40	13040
45	11374
50	9944
55	8714
60	7653
70	5941
80	4649
90	3667
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412
210	349
220	297
230	253
240	217
250	187

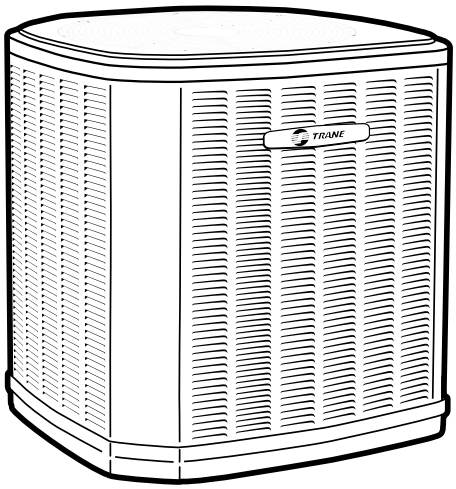
Specifications

Voltage Input: 120 VAC 60 Hz
Power Consumption: 30 VA Max
Operating Temperature: 20°F/-7°C to 120°F/49°C
Operating Humidity: 20% to 80%
Dimensions: 13”W x 13” H x 5 ½” D
Weight: 14 pounds
Output Relay Ratings: 1 Amp inductive, 6Amp resistive at 120 VAC 60 Hz, 15A total for all circuits
Temperature Display: Fahrenheit or Celsius.
Display: 80 character Alphanumeric (4 rows with 20 characters each)
LED: (1) System Output relay (RED LED), (8) Boiler Output relays (RED LED)
Sensor Ranges: .Outdoor temperature sensor - minus 35°F/-37°C to 250°F/ 121°C
Pressure Transducer (0 - 30 psi)
Day/Night Outdoor Cutoff Range: 20°F/-7°C to 100°F/38°C
Set Point Pressure Range: 0 - 30 psi
Setback: Pressure 0.0-10.0 psi
Operating Mode: Cycle or Set Point
Cycle Length: 10 - 240 minutes
Logic: .PID Logarithm (Cycle or Set Point) or Oversize System (OSS) (Set Point Only)
Boiler Type: On/Off, 2-Stage, 3-Stage, 4-Stage
Sequencing Mode: Lo/Hi/Lo/Hi, Lo/Lo/Hi/Hi
Sensor Fault Mode: Stages On, Stages Off
Day/Night Heat Adjustment: A (Least Heat) through P (Most Heat)
Reaction Time: 1 to 10 minutes
Minimum Boiler Run Time: 1 to 10 minutes
Stage Operation Modes: On, Off, Standby, Auto
Standby Time Delay: 0 to 60 minutes
Stage Rotation Modes: Time (1 to 999 Hours (41 days)), Manual, *Last-On*
Stage Sequencing: .Lo/Hi/Lo/Hi or Lo/Lo/Hi/Hi
Last-Stage-Hold: 0.0 to 5.0 Psi
Throttle: 0.5 to 5.0 Psi
Purge Delay: 0.0 to 10.0 minutes
System Run-On: 0 to 360 minutes
Schedules: 4 Day Time and 4 Night Time (Setback) settings per day
Morning Boost: .Vari-Boost - Self-adjusting from 0 to 180 minutes
Early Shutdown - Self-adjusting from 0 to 90 minutes
Manual - Adjustable from 0 to 120 minutes
Power Backup: Lithium coin battery, 100 days minimum 5 year replacement (Maintains Clock in power outages).
Remote Communication Option: Internet (RINet) or BACnet IP (BAC)
External Inputs: 1 Network Input, 3 Aux Inputs, Shutdown Input, and Prove Input.
Add-On Extension Panels: .up to two Extension Panels using RS485, Each Panel with 8 stages
Network Input Maximum Sensors: 64 Neuron Sensors including MIG Sensors.
Season: Winter and Summer.

Product Data

Split System Air Conditioner
3–Phase, 208/230V
3–Phase, 460V

4TTA4036A3000A
4TTA4042A3000A
4TTA4048A3000A
4TTA4060A3000A
4TTA4036A4000A
4TTA4042A4000A
4TTA4048A4000A
4TTA4060A4000A



Note: *"Graphics in this document are for representation only. Actual model may differ in appearance."*

October 2016

22-1928-1B-EN

Product Specifications

Model No. [a] [b]	4TTA4036A3000A	4TTA4042A3000A	4TTA4048A3000A	4TTA4060A3000A
POWER CONNS. — V/PH/HZ [c]	208/230/3/60	208/230/3/60	208/230/3/60	208/230/3/60
MIN. BRCH. CIR. AMPACITY	12	15	18	21
BR. CIR. PROT. RTG. — MAX. (AMPS)	20	25	30	35
COMPRESSOR	CLIMATAUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
R.L. AMPS [d] — L.R. AMPS	9— 71	11.2— 84	13.8— 83	15.9 — 110
Outdoor Fan FL AMPS	0.77	1.05	1.05	1.05
Fan HP	1/8	1/5	1/5	1/5
Fan Dia (inches)	23.0	27.5	27.5	27.5
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A[e]	6 LBS., 1 OZ	6 LBS., 7 OZ	6 LBS., 9 OZ	7 LBS., 10 OZ
LINE SIZE — IN. O.D. GAS [f] [g]	3/4	3/4	7/8	7/8
LINE SIZE — IN. O.D. LIQ. [h]	3/8	3/8	3/8	3/8
Charge Spec. Subcooling	10°F	12°F	10°F	10°F
Dimensions H x W X D Crated (IN.)	38 x 30.1 x 33	34.4 x 35.1 x 38.7	34.4 x 35.1 x 38.7	42.4 x 35.1 x 38.7
Weight — Shipping (lbs.)	183	216	212	246
Weight — Net (lbs.)	156	184	189	211
Optional Accessories:				
Evaporator Defrost Control	AY28X079	AY28X079	AY28X079	AY28X079
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT0023	BAYECMT004	BAYECMT004	BAYECMT004
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM103	BAYLOAM103	BAYLOAM103	BAYLOAM103
Refrigerant Lineset [i]	TAYREFLN7*	TAYREFLN7*	TAYREFLN3*	TAYREFLN3*
Sound Enclosure	BAYSDEN003	BAYSDEN004	BAYSDEN004	BAYSDEN004
Snow Legs — 6”	BAYLEGS002	BAYLEGS002	BAYLEGS002	BAYLEGS002
Snow Legs Extension — 4”	BAYLEGS003	BAYLEGS003	BAYLEGS003	BAYLEGS003
Service Valve Panel Cover	TAYSVPANL3343AA	TAYSVPANL0032AA	TAYSVPANL0032AA	TAYSVPANL0044AA

[a] Certified in accordance with the Air-Source Unitary Air-conditioner Equipment certification program, which is based on AHRI standard 210/240.
[b] Rated in accordance with AHRI standard 270.
[c] Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
[d] This value shown for compressor RLA on the unit nameplate and on this specification sheet is used to compute minimum branch circuit ampacity and max. fuse size. The value shown is the branch circuit selection current.
[e] This value approximate. For more precise value see unit nameplate.
[f] Reference the outdoor unit ship-with literature for refrigerant piping length and lift guidelines. Reference the refrigerant piping software pub # 32-3312-xx or refrigerant piping application guide SS-APG006-xx for long line sets or specialty applications (xx denotes latest revision).
[g] Trane outdoor condensing units are factory charged with the system charge required for the outdoor condensing unit and 15 feet of tested connecting lines. If connecting line length exceeds 15 feet, then final refrigerant charge adjustment is necessary. Each additional foot over 15 feet requires 0.6 ozs of refrigerant. See the Installer’s Guide for full charging instructions.
[h] This value approximate. For more precise value see unit nameplate.
[i] * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Model No. [a] [b]	4TTA4036A4000A	4TTA4042A4000A	4TTA4048A4000A	4TTA4060A4000A
POWER CONNS. — V/PH/HZ [c]	460/3/60	460/3/60	460/3/60	460/3/60
MIN. BRCH. CIR. AMPACITY	8	8	8	9
BR. CIR. PROT. RTG. — MAX. (AMPS)	15	15	15	15
COMPRESSOR	CLIMATAUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
R.L. AMPS [d] — L.R. AMPS	5.8 — 38	5.6 — 44	6.2 — 41	7.1 — 52
Outdoor Fan FL AMPS	0.38	0.6	0.6	1.05
Fan HP	1/8	1/5	1/5	1/5
Fan Dia (inches)	23.0	27.5	27.5	27.5
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A[e]	6 LBS., 1 OZ	6 LBS., 7 OZ	6 LBS., 9 OZ	7 LBS., 10 OZ
LINE SIZE — IN. O.D. GAS [f] [g]	3/4	3/4	7/8	7/8
LINE SIZE — IN. O.D. LIQ. [h]	3/8	3/8	3/8	3/8
Charge Spec. Subcooling	10°F	12°F	10°F	10°F
Dimensions H x W X D Crated (IN.)	38 x 30.1 x 33	34.4 x 35.1 x 38.7	34.4 x 35.1 x 38.7	42.4 x 35.1 x 38.7
Weight — Shipping (lbs.)	183	216	212	246
Weight — Net (lbs.)	156	184	189	211
Optional Accessories:				
Evaporator Defrost Control	AY28X079	AY28X079	AY28X079	AY28X079
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT0023	BAYECMT004	BAYECMT004	BAYECMT004
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM103	BAYLOAM103	BAYLOAM103	BAYLOAM103
Refrigerant Lineset [i]	TAYREFLN7*	TAYREFLN7*	TAYREFLN3*	TAYREFLN3*
Sound Enclosure	BAYSDEN003	BAYSDEN004	BAYSDEN004	BAYSDEN004
Snow Legs — 6”	BAYLEGS002	BAYLEGS002	BAYLEGS002	BAYLEGS002
Snow Legs Extension — 4”	BAYLEGS003	BAYLEGS003	BAYLEGS003	BAYLEGS003
Service Valve Panel Cover	TAYSVPANL3343AA	TAYSVPANL0032AA	TAYSVPANL0032AA	TAYSVPANL0044AA

(a) Certified in accordance with the Air-Source Unitary Air-conditioner Equipment certification program, which is based on AHRI standard 210/240.
(b) Rated in accordance with AHRI standard 270.
(c) Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
(d) This value shown for compressor RLA on the unit nameplate and on this specification sheet is used to compute minimum branch circuit ampacity and max. fuse size. The value shown is the branch circuit selection current.
(e) This value approximate. For more precise value see unit nameplate.
(f) Reference the outdoor unit ship-with literature for refrigerant piping length and lift guidelines. Reference the refrigerant piping software pub # 32-3312-xx or refrigerant piping application guide SS-APG006-xx for long line sets or specialty applications (xx denotes latest revision).
(g) Trane outdoor condensing units are factory charged with the system charge required for the outdoor condensing unit and 15 feet of tested connecting lines. If connecting line length exceeds 15 feet, then final refrigerant charge adjustment is necessary. Each additional foot over 15 feet requires 0.6 ozs of refrigerant. See the Installer’s Guide for full charging instructions.
(h) This value approximate. For more precise value see unit nameplate.
(i) * = 15, 20, 25, 30, 40 and 50 foot lineset available.

MODEL	A-Weighted Sound Power Level [dB(A)]	Full Octave Sound Power(dB)							
		63 Hz*	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
4TTA4036A	71	73	73	72	69	68	60	52	45
4TTA4042A	71	81	72	69	69	66	60	57	54
4TTA4048A	71	81	72	69	69	66	60	57	54
4TTA4060A	71	81	72	69	69	66	60	57	54

Note: Rated in accordance with AHRI Standard 270–2008 *For Reference Only

Accessory Description and Usage

Anti-Short Cycle Timer — Solid state timing device that prevents compressor recycling until five (5) minutes have elapsed after satisfying call or power interruptions. Use in area with questionable power delivery, commercial applications, long lineset, etc.

Evaporation Defrost Control — SPST Temperature actuated switch that cycles the condenser off as indoor coil reaches freeze-up conditions. Used for low ambient cooling to 30°F with TXV.

Rubber Isolators — Five (5) large rubber donuts to isolate condensing unit from transmitting energy into mounting frame or pad. Use on any application where sound transmission needs to be minimized.

Hard Start Kit — Start capacitor and relay to assist compressor motor startup. Use in areas with marginal power supply, on long linesets, low ambient conditions, etc.

Extreme Condition Mount Kit — Bracket kits to securely mount condensing unit to a frame or pad without removing any panels. Use in areas with high winds, or on commercial roof tops, etc.

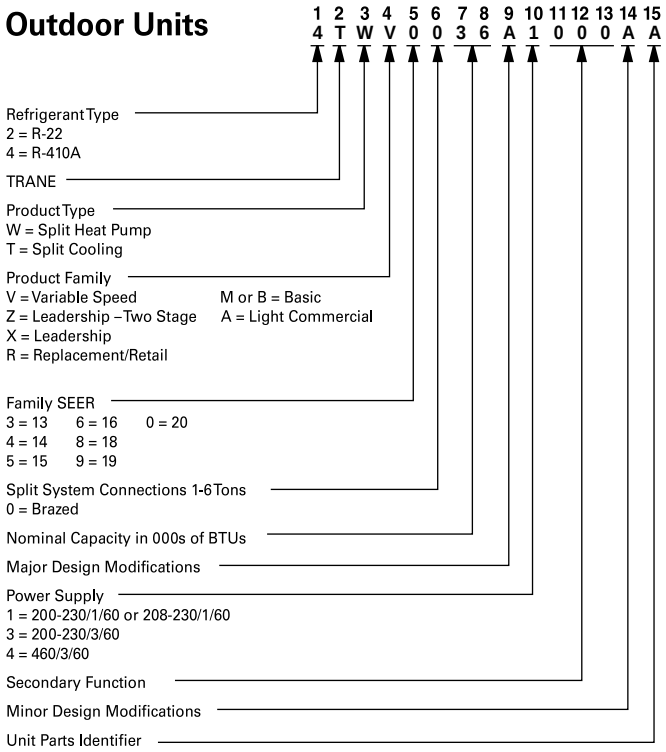
AHRI Standard Capacity Rating Conditions

AHRI Standard 210/240 Rating Conditions

1. Cooling 80°F DB, 67°F WB air entering indoor coil, 95°F DB air entering outdoor coil.
2. High Temperature Heating 47°F DB, 43°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
3. Low Temperature Heating 17°F DB air entering indoor coil.
4. Rated indoor airflow for heating is the same as for cooling.

AHRI Standard 270 Rating Conditions — (Noise rating numbers are determiend with the unit in cooling operations.) Standard Noise Rating number is at 95°F outdoor air.

Model Nomenclature



Schematic Diagrams

Figure 1. D157062P04 — 230V Models

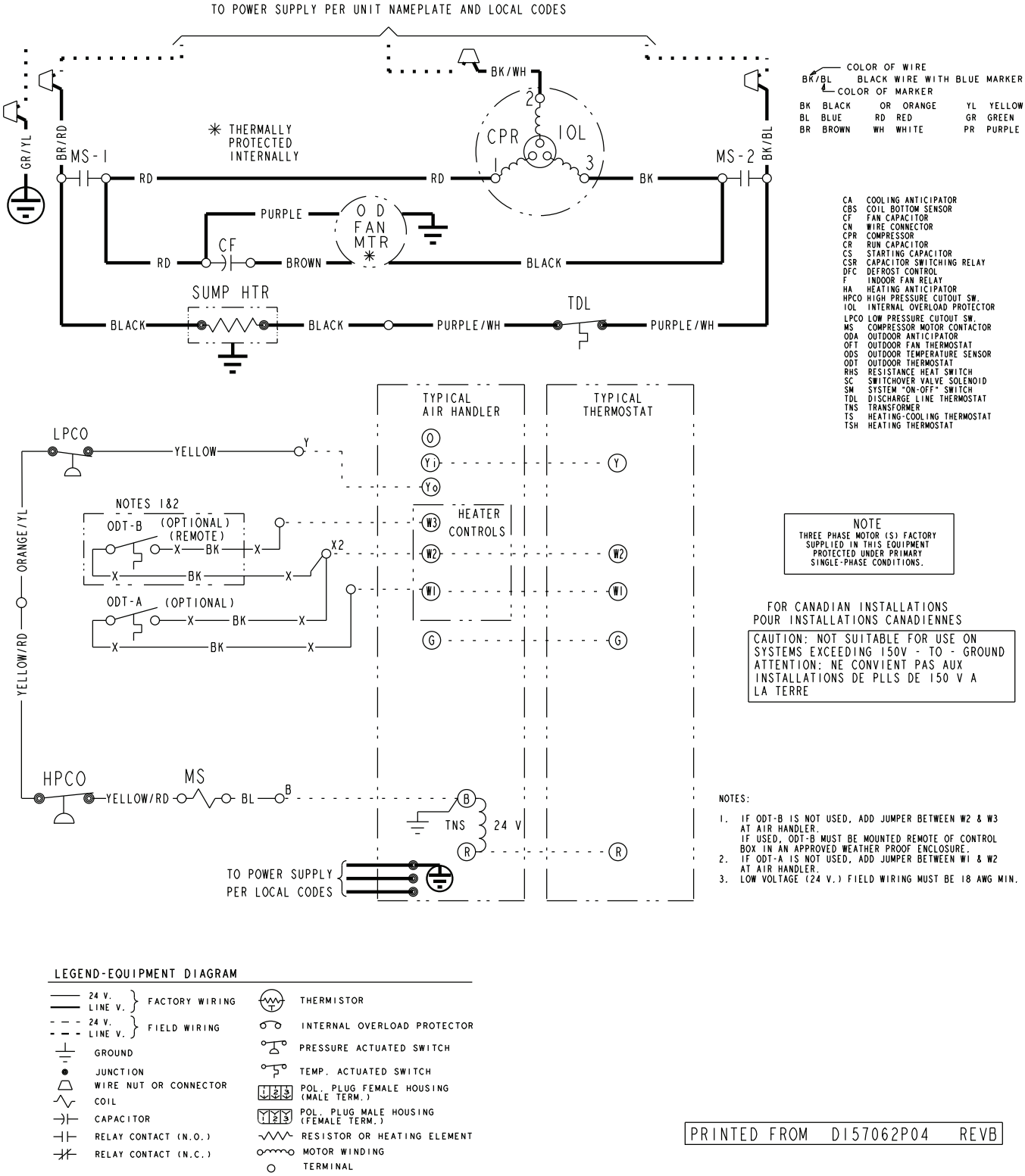
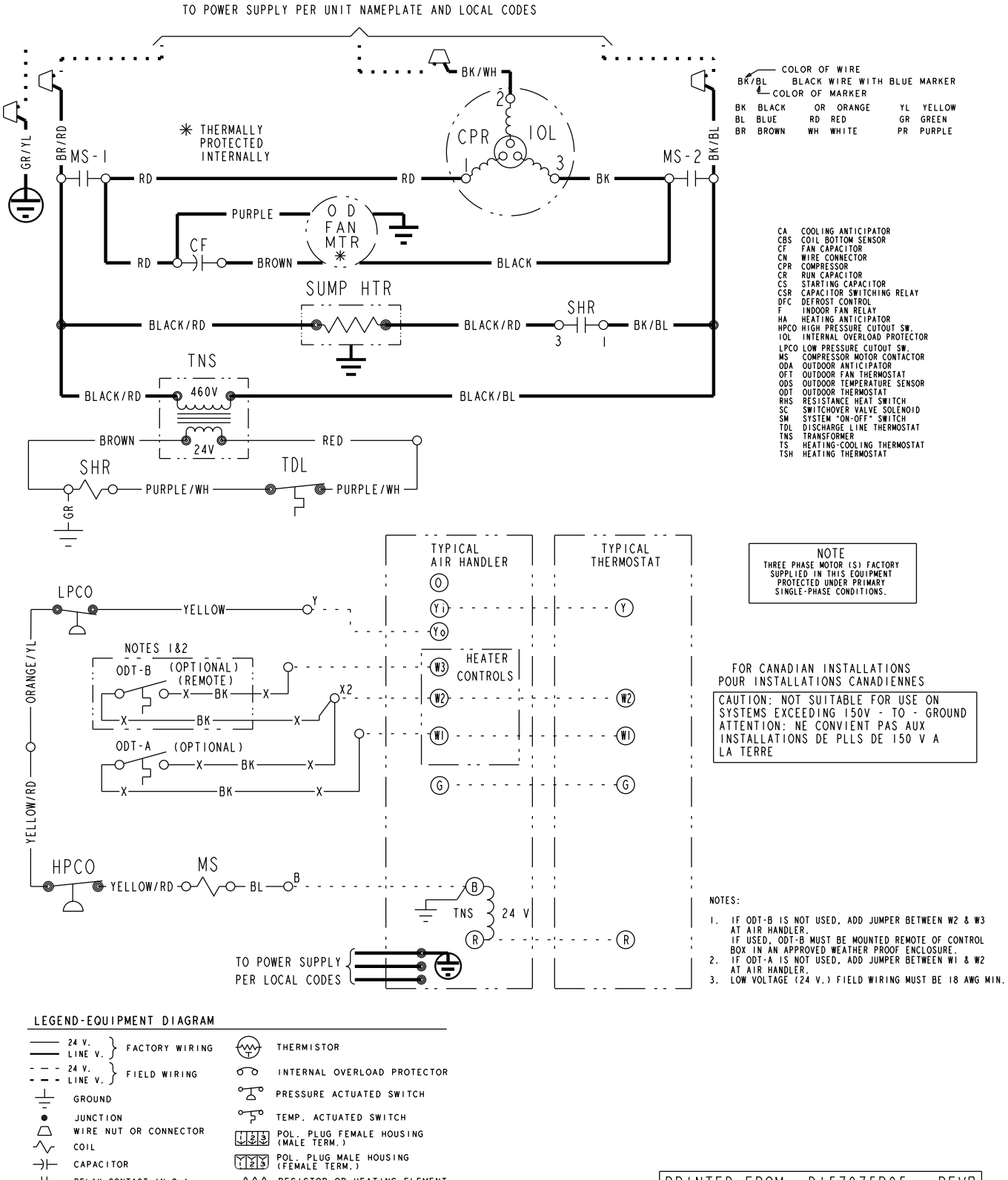
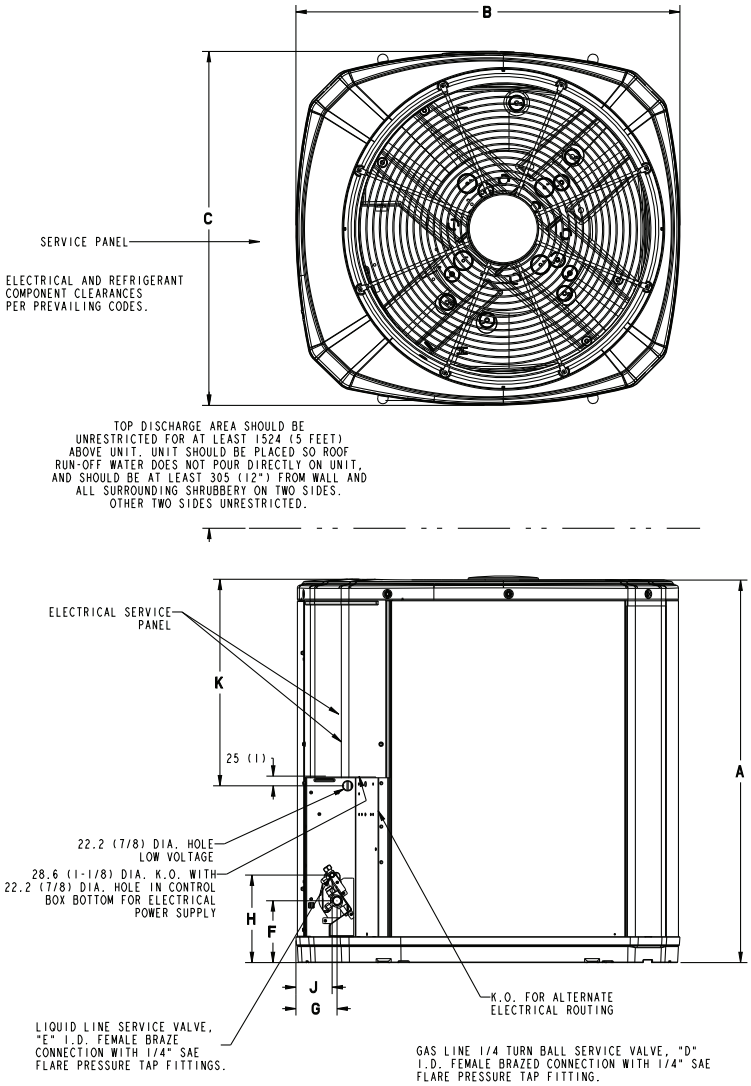


Figure 2. D157075P05 — 460V Models



Outline Drawing



Model	Base	A	B	C	D	E	F	G	H	J	K
4TTA4036A	3	832 (32–3/4)	829 (32–5/8)	756 (29–3/4)	3/4	3/8	127 (5)	76 (3)	197 (7–3/4)	60 (2–3/8)	508 (20)
4TTA4042A	4	741 (29–1/8)	946 (37–1/4)	870 (34–1/4)	3/4	3/8	143 (5–5/8)	83 (3–1–4)	206 (8–1/8)	70 (2–3/4)	508 (20)
4TTA4048A	4	741 (29–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	143 (5–5/8)	83 (3–1–4)	206 (8–1/8)	70 (2–3/4)	508 (20)
4TTA4060A	4	943 (37–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	143 (5–5/8)	83 (3–1–4)	206 (8–1/8)	70 (2–3/4)	508 (20)

Mechanical Specification Options

General

The Outdoor Units are fully charged from the factory for up to 15 feet of piping. This unit is designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities are matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit is certified to UL 1995. Exterior is designed for outdoor application.

Casing

Unit casing is constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish on all louvered panels and the fan top panel. The corner panels are prepainted. All panels are subjected to our 1,000 hour salt spray test . The base is made of a CMBP-G30 weatherproof material to resist corrosion.

Refrigerant Controls

Refrigeration system controls include condenser fan, compressor contactor and high pressure switch. High and low pressure controls are inherent to the compressor. A factory supplied liquid line drier is standard. Some models may require field installation.

Compressor

The compressor features internal over temperature, pressure protection and total dipped hermetic motor. Other features include: Centrifugal oil pump and low vibration and noise.

Condenser Coil

The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

Low Ambient Cooling

As manufactured, this system has a cooling capacity to 55°F. The addition of an evaporator defrost control permits operation to 40°F. The addition of an evaporator defrost control with TXV permits low ambient cooling to 30°F.

Thermostats—Cooling only and heat/cooling (manual and automatic change over). Sub-base to match thermostat and locking thermostat cover.

Evaporator Defrost Control — See Low Ambient Cooling.

Notes





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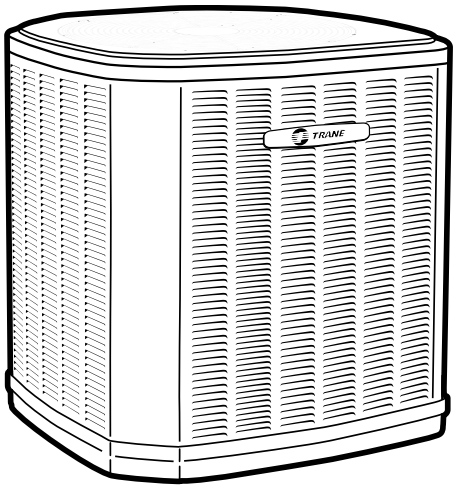
22-1928-1B-EN 19 Oct 2016
Supersedes 22-1928-1A-EN (July 2016)



Product Data

Split System Air Conditioner
3–Phase

4TTA7036A3000A
4TTA7048A3000A
4TTA7060A3000A
4TTA7036A4000A
4TTA7048A4000A
4TTA7060A4000A



Note: *"Graphics in this document are for representation only. Actual model may differ in appearance."*

August 2016

22-1924-1B-EN

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Product Specifications

Model No. [a] [b]	4TTA7036A3000A	4TTA7048A3000A	4TTA7060A3000A
POWER CONNS. — V/PH/HZ [c]	208/230/3/60	208/230/3/60	208/230/3/60
MIN. BRCH. CIR. AMPACITY	15	18	22
BR. CIR. PROT. RTG. — MAX. (AMPS)	25	30	35
COMPRESSOR	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
R.L. AMPS [d] — L.R. AMPS	11.6 — 73	14 — 83	16.2 — 110
Outdoor Fan FL AMPS	0.74	0.93	1.30
Fan HP	1/8	1/5	1/4
Fan Dia (inches)	27.6	27.6	27.6
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A[e]	9 LBS., 13 OZ	11 LBS., 15 OZ	12 LBS., 9 OZ
LINE SIZE — IN. O.D. GAS [f] [g]	3/4	7/8	1 1/8
LINE SIZE — IN. O.D. LIQ. [h]	3/8	3/8	3/8
Charge Spec. Subcooling	9°F	8°F	8°F
Dimensions H x W X D Crated (IN.)	51.0 x 38.7 x 35.1	51.0 x 38.7 x 35.1	51.0 x 38.7 x 35.1
Weight — Shipping (lbs.)	283	285	308
Weight — Net (lbs.)	245	248	271
Optional Accessories:			
Anti-short Cycle Timer	TAYASCT501A	TAYASCT501A	TAYASCT501A
Evaporator Defrost Control	AY28X079 [i]	AY28X079 [i]	AY28X079 [i]
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT004	BAYECMT004	BAYECMT004
Crankcase Heater Kit	—	—	—
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM107	BAYLOAM107	BAYLOAM107
Refrigerant Lineset [j]	TAYREFLN7*	TAYREFLN3*	TAYREFLN3*
Sound Enclosure	BAYSDEN004	BAYSDEN004	BAYSDEN004
Snow Legs — 6″	BAYLEGS002	BAYLEGS002	BAYLEGS002
Snow Legs Extension — 4″	BAYLEGS003	BAYLEGS003	BAYLEGS003
Service Valve Panel Cover	TAYSVPANL0044AA	TAYSVPANL0044AA	TAYSVPANL0044AA

[a] Certified in accordance with the Air-Source Unitary Air-conditioner Equipment certification program, which is based on AHRI standard 210/240.
[b] Rated in accordance with AHRI standard 270.
[c] Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
[d] This value shown for compressor RLA on the unit nameplate and on this specification sheet is used to compute minimum branch circuit ampacity and max. fuse size. The value shown is the branch circuit selection current.
[e] This value approximate. For more precise value see unit nameplate.
[f] Reference the outdoor unit ship-with literature for refrigerant piping length and lift guidelines. Reference the refrigerant piping software pub # 32-3312-xx or refrigerant piping application guide SS-APG006-xx for long line sets or specialty applications (xx denotes latest revision).
[g] Trane outdoor condensing units are factory charged with the system charge required for the outdoor condensing unit and 15 feet of tested connecting lines. If connecting line length exceeds 15 feet, then final refrigerant charge adjustment is necessary. Each additional foot over 15 feet requires 0.6 ozs of refrigerant. See the Installer's Guide for full charging instructions.
[h] This value approximate. For more precise value see unit nameplate.
[i] AY28X*** Evaporator Defrost Control not required when indoor unit has EEV.
[j] * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Product Specifications

Model No. [a] [b]	4TTA7036A4000A	4TTA7048A4000A	4TTA7060A4000A
POWER CONNS. — V/PH/HZ [c]	460/3/60	460/3/60	460/3/60
MIN. BRCH. CIR. AMPACITY	8	9	10
BR. CIR. PROT. RTG. — MAX. (AMPS)	15	15	15
COMPRESSOR	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
R.L. AMPS [d] — L.R. AMPS	5.7 — 38	6.4 — 41	7.6 — 52
Outdoor Fan FL AMPS	0.40	0.60	0.72
Fan HP	1/8	1/5	1/4
Fan Dia (inches)	27.6	27.6	27.6
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A[e]	9 LBS., 13 OZ	11 LBS., 15 OZ	12 LBS., 9 OZ
LINE SIZE — IN. O.D. GAS [f] [g]	3/4	7/8	1 1/8
LINE SIZE — IN. O.D. LIQ. [h]	3/8	3/8	3/8
Charge Spec. Subcooling	9°F	8°F	8°F
Dimensions H x W X D Crated (IN.)	51.0 x 38.7 x 35.1	51.0 x 38.7 x 35.1	51.0 x 38.7 x 35.1
Weight — Shipping (lbs.)	283	285	308
Weight — Net (lbs.)	245	248	271
Optional Accessories:			
Anti-short Cycle Timer	TAYASCT501A	TAYASCT501A	TAYASCT501A
Evaporator Defrost Control	AY28X079 [i]	AY28X079 [i]	AY28X079 [i]
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT004	BAYECMT004	BAYECMT004
Crankcase Heater Kit	—	—	—
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM107	BAYLOAM107	BAYLOAM107
Refrigerant Lineset [j]	TAYREFLN7*	TAYREFLN3*	TAYREFLN3*
Sound Enclosure	BAYSDEN004	BAYSDEN004	BAYSDEN004
Snow Legs — 6″	BAYLEGS002	BAYLEGS002	BAYLEGS002
Snow Legs Extension — 4″	BAYLEGS003	BAYLEGS003	BAYLEGS003
Service Valve Panel Cover	TAYSVPANL0044AA	TAYSVPANL0044AA	TAYSVPANL0044AA

[a] Certified in accordance with the Air-Source Unitary Air-conditioner Equipment certification program, which is based on AHRI standard 210/240.
[b] Rated in accordance with AHRI standard 270.
[c] Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
[d] This value shown for compressor RLA on the unit nameplate and on this specification sheet is used to compute minimum branch circuit ampacity and max. fuse size. The value shown is the branch circuit selection current.
[e] This value approximate. For more precise value see unit nameplate.
[f] Reference the outdoor unit ship-with literature for refrigerant piping length and lift guidelines. Reference the refrigerant piping software pub # 32-3312-xx or refrigerant piping application guide SS-APG006-xx for long line sets or specialty applications (xx denotes latest revision).
[g] Trane outdoor condensing units are factory charged with the system charge required for the outdoor condensing unit and 15 feet of tested connecting lines. If connecting line length exceeds 15 feet, then final refrigerant charge adjustment is necessary. Each additional foot over 15 feet requires 0.6 ozs of refrigerant. See the Installer's Guide for full charging instructions.
[h] This value approximate. For more precise value see unit nameplate.
[i] AY28X*** Evaporator Defrost Control not required when indoor unit has EEV.
[j] * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Sound Power Level

Sound Power Level

MODEL	A-Weighted Sound Power Level [dB(A)]	Full Octave Sound Power(dB)							
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
4TTA7036A	72	74	71	72	70	69	62	59	55
4TTA7048A	73	85	74	68	69	69	63	58	54
4TTA7060A	74	75	71	71	71	70	65	58	52

Accessory Description and Usage

Anti-Short Cycle Timer — Solid state timing device that prevents compressor recycling until five (5) minutes have elapsed after satisfying call or power interruptions. Use in area with questionable power delivery, commercial applications, long lineset, etc.

Evaporation Defrost Control — SPST Temperature actuated switch that cycles the condenser off as indoor coil reaches freeze-up conditions. Used for low ambient cooling to 30°F with TXV.

Rubber Isolators — Five (5) large rubber donuts to isolate condensing unit from transmitting energy into mounting frame or pad. Use on any application where sound transmission needs to be minimized.

Hard Start Kit — Start capacitor and relay to assist compressor motor startup. Use in areas with marginal power supply, on long linesets, low ambient conditions, etc.

Extreme Condition Mount Kit — Bracket kits to securely mount condensing unit to a frame or pad without removing any panels. Use in areas with high winds, or on commercial roof tops, etc.

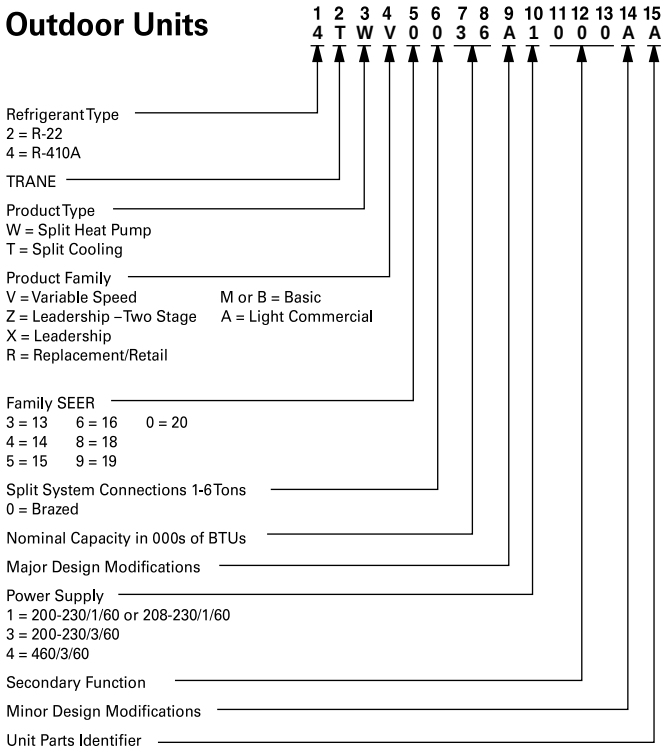
AHRI Standard Capacity Rating Conditions

AHRI Standard 210/240 Rating Conditions

1. Cooling 80°F DB, 67°F WB air entering indoor coil, 95°F DB air entering outdoor coil.
2. High Temperature Heating 47°F DB, 43°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
3. Low Temperature Heating 17°F DB air entering indoor coil.
4. Rated indoor airflow for heating is the same as for cooling.

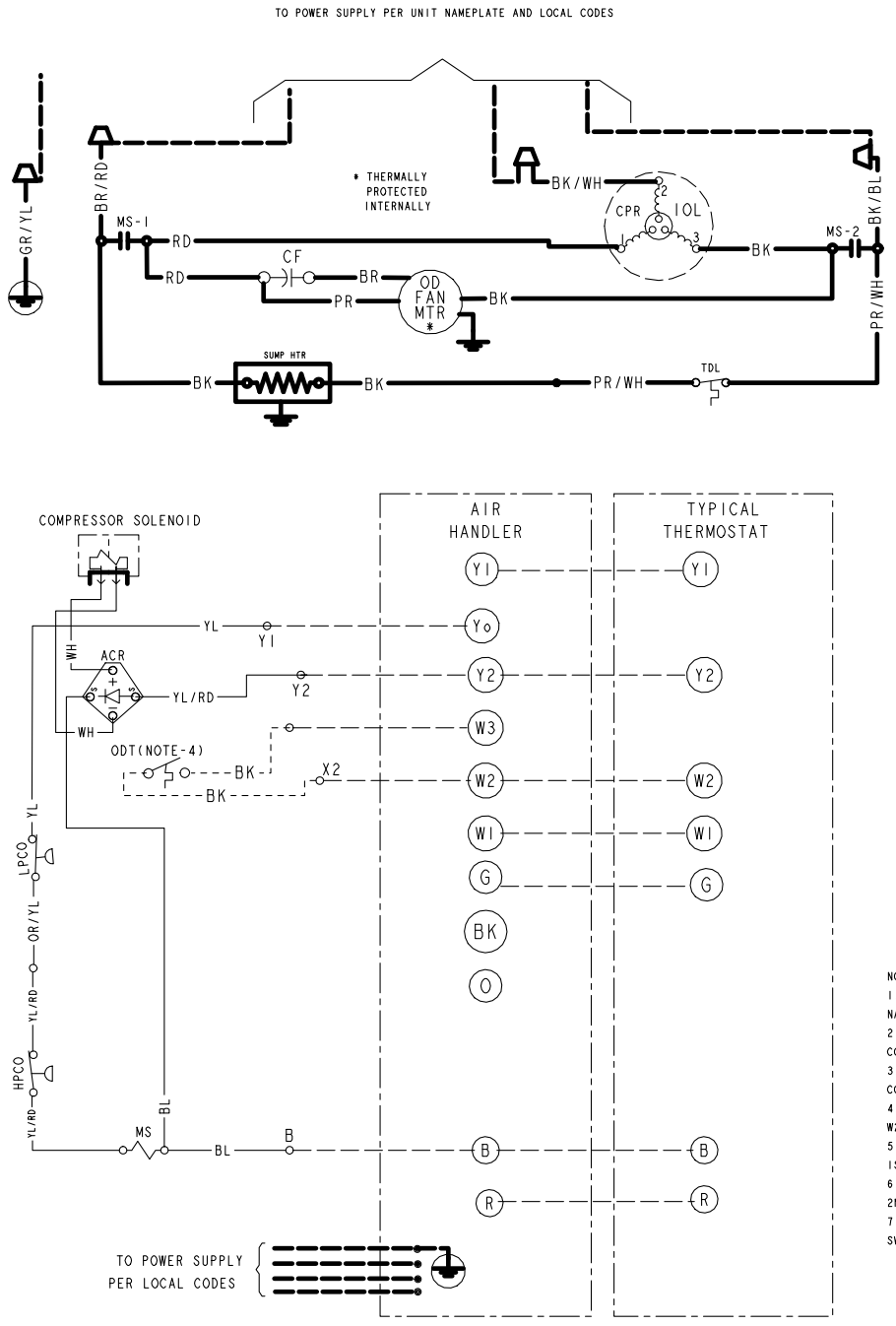
AHRI Standard 270 Rating Conditions — (Noise rating numbers are determiend with the unit in cooling operations.) Standard Noise Rating number is at 95°F outdoor air.

Model Nomenclature



SCHEMATIC

230V AC — D159205P02



COLOR OF WIRE
BK/BL
COLOR OF MARKER

BK	BLACK	RD	RED	OR	ORANGE
BL	BLUE	WH	WHITE	GR	GREEN
BR	BROWN	YL	YELLOW	PR	PURPLE
PK	PINK				

ACR	A/C RECTIFIER
CBS	COIL BOTTOM SENSOR
CF	FAN CAPACITOR
CN	WIRE CONNECTOR
CPR	COMPRESSOR
CR	RUN CAPACITOR
CS	STARTING CAPACITOR
CSR	CAPACITOR SWITCHING RELAY
F	INDOOR FAN RELAY
HPCO	HIGH PRESSURE CUTOUT SWITCH
IOL	INTERNAL OVERLOAD PROTECTOR
LPCO	LOW PRESSURE CUTOUT SWITCH
MS	COMPRESSOR MOTOR CONTACTOR
ODA	OUTDOOR ANTICIPATOR
ODF	OUTDOOR FAN RELAY
OFT	OUTDOOR FAN THERMOSTAT
ODS	OUTDOOR TEMPERATURE SENSOR
ODT	OUTDOOR THERMOSTAT
SC	SWITCH OVER VALVE SOLENOID
SHR	SUMP HEAT RELAY
SM	SYSTEM ON-OFF SWITCH
TDL	DISCHARGE LINE THERMOSTAT
TNS	TRANSFORMER
TEMP	SENSOR, TEMPERATURE

⚠WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRICAL POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

Failure to disconnect power before servicing can cause severe personal injury or death.

⚠CAUTION

USE COPPER CONDUCTORS ONLY!

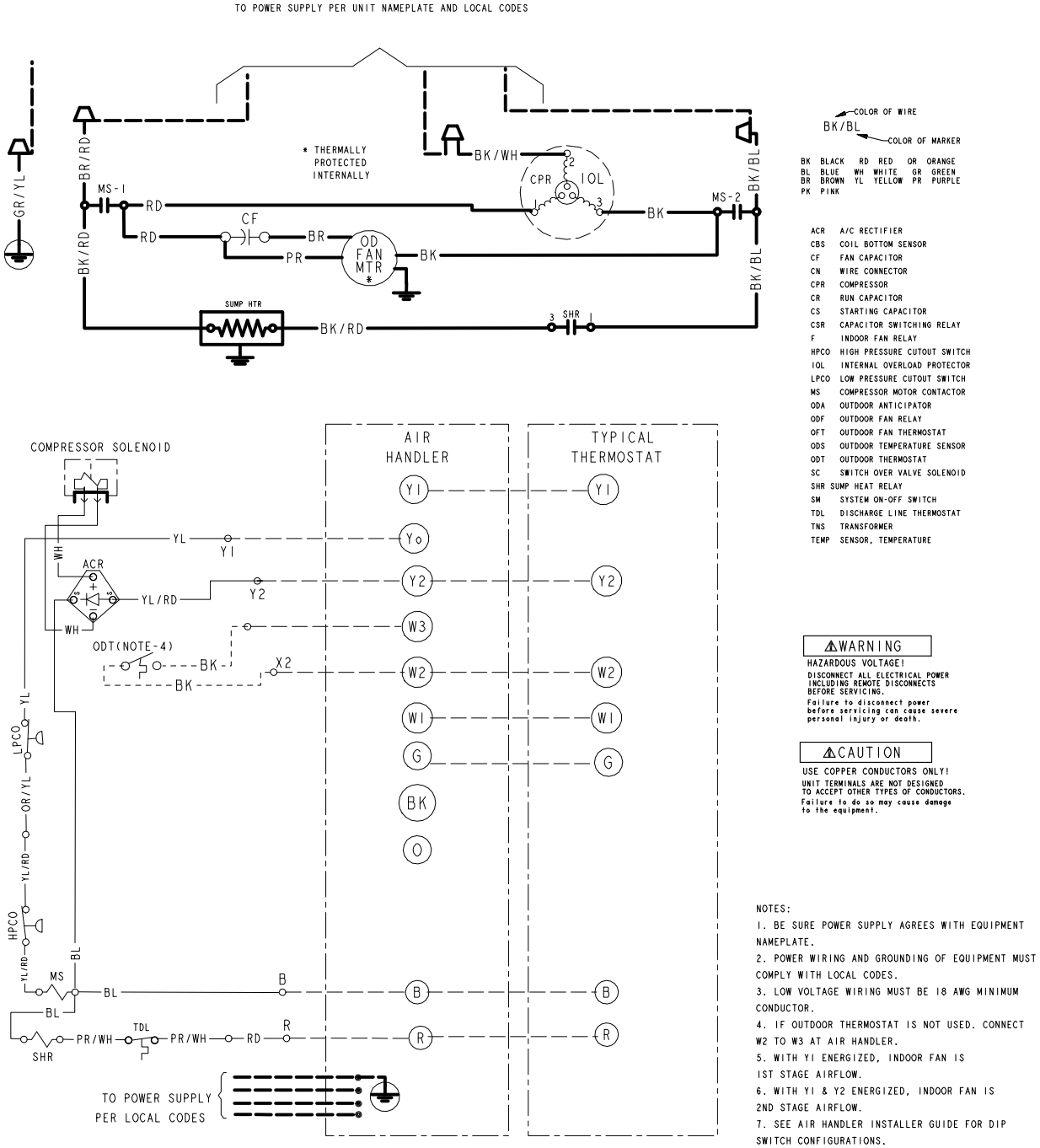
UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

Failure to do so may cause damage to the equipment.

NOTES:

1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
2. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
3. LOW VOLTAGE WIRING MUST BE 18 AWG MINIMUM CONDUCTOR.
4. IF OUTDOOR THERMOSTAT IS NOT USED. CONNECT W2 TO W3 AT AIR HANDLER.
5. WITH YI ENERGIZED, INDOOR FAN IS 1ST STAGE AIRFLOW.
6. WITH YI & Y2 ENERGIZED, INDOOR FAN IS 2ND STAGE AIRFLOW.
7. SEE AIR HANDLER INSTALLER GUIDE FOR DIP SWITCH CONFIGURATIONS.

460V AC — D159376P01



COLOR OF WIRE
BK/BL
COLOR OF MARKER

BK	BLACK	RD	RED	OR	ORANGE
BL	BLUE	WH	WHITE	GR	GREEN
BR	BROWN	YL	YELLOW	PR	PURPLE
PK	PINK				

ACR	A/C RECTIFIER
CBS	COIL BOTTOM SENSOR
CF	FAN CAPACITOR
CN	WIRE CONNECTOR
CPR	COMPRESSOR
CR	RUN CAPACITOR
CS	STARTING CAPACITOR
CSR	CAPACITOR SWITCHING RELAY
F	INDOOR FAN RELAY
HPCO	HIGH PRESSURE CUTOUT SWITCH
IOL	INTERNAL OVERLOAD PROTECTOR
LPCO	LOW PRESSURE CUTOUT SWITCH
MS	COMPRESSOR MOTOR CONTACTOR
ODA	OUTDOOR ANTICIPATOR
ODF	OUTDOOR FAN RELAY
OFT	OUTDOOR FAN THERMOSTAT
ODS	OUTDOOR TEMPERATURE SENSOR
ODT	OUTDOOR THERMOSTAT
SC	SWITCH OVER VALVE SOLENOID
SHR	SUMP HEAT RELAY
SM	SYSTEM ON-OFF SWITCH
TDL	DISCHARGE LINE THERMOSTAT
TNS	TRANSFORMER
TEMP	SENSOR, TEMPERATURE

⚠WARNING

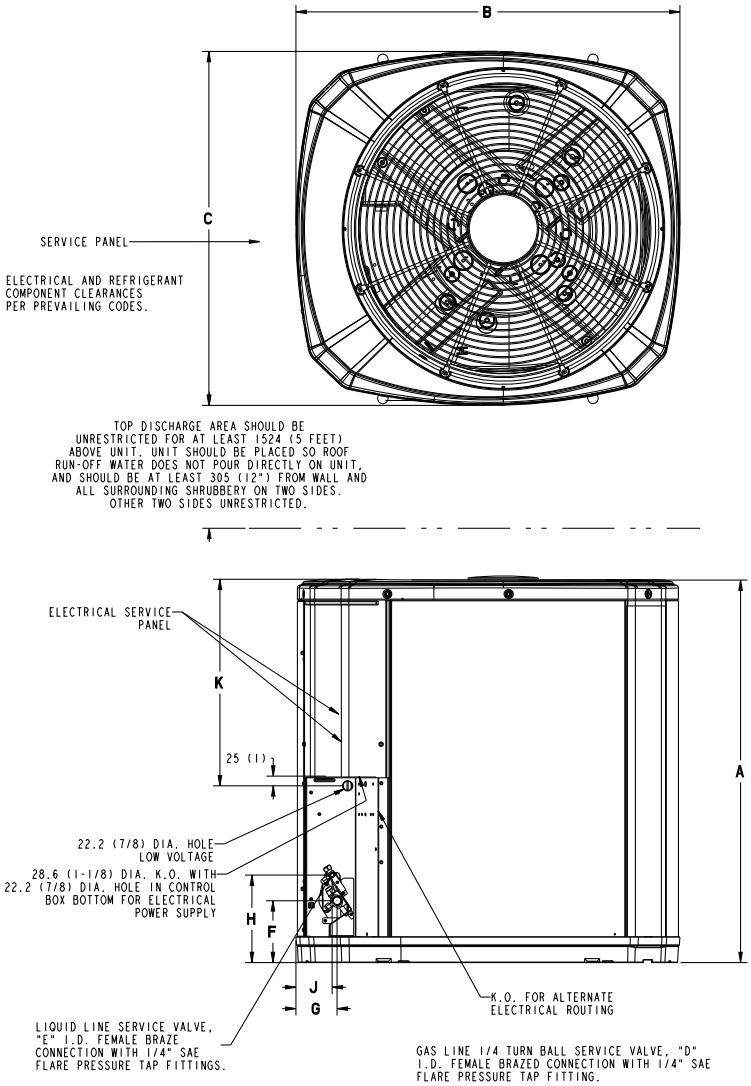
HAZARDOUS VOLTAGE!
DISCONNECT ALL ELECTRICAL POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.
Failure to disconnect power before servicing can cause severe personal injury or death.

⚠CAUTION

USE COPPER CONDUCTORS ONLY!
UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.
Failure to do so may cause damage to the equipment.

NOTES:
1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
2. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
3. LOW VOLTAGE WIRING MUST BE 18 AWG MINIMUM CONDUCTOR.
4. IF OUTDOOR THERMOSTAT IS NOT USED. CONNECT W2 TO W3 AT AIR HANDLER.
5. WITH Y1 ENERGIZED, INDOOR FAN IS 1ST STAGE AIRFLOW.
6. WITH Y1 & Y2 ENERGIZED, INDOOR FAN IS 2ND STAGE AIRFLOW.
7. SEE AIR HANDLER INSTALLER GUIDE FOR DIP SWITCH CONFIGURATIONS.

Outline Drawing



Model	Base	A	B	C	D	E	F	G	H	J	K
4TTA7036A	4	1147 (45-1/8)	946 (37-1/4)	870 (34-1/4)	3/4	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)
4TTA7048A	4	1147 (45-1/8)	946 (37-1/4)	870 (34-1/4)	7/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)
4TTA7060A	4	1147 (45-1/8)	946 (37-1/4)	870 (34-1/4)	1-1/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)

Mechanical Specification Options

General

The Outdoor Units are fully charged from the factory for up to 15 feet of piping. This unit is designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities are matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit is certified to UL 1995. Exterior is designed for outdoor application.

Casing

Unit casing is constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish on all louvered panels and the fan top panel. The corner panels are prepainted. All panels are subjected to our 1,000 hour salt spray test . The base is made of a CMBP-G30 weatherproof material to resist corrosion.

Refrigerant Controls

Refrigeration system controls include condenser fan, compressor contactor and high pressure switch. High and low pressure controls are inherent to the compressor. A factory supplied liquid line drier is standard. Some models may require field installation.

Compressor

The compressor features internal over temperature, pressure protection and total dipped hermetic motor. Other features include: Centrifugal oil pump and low vibration and noise.

Condenser Coil

The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

Low Ambient Cooling

As manufactured, this system has a cooling capacity to 55°F. The addition of an evaporator defrost control permits operation to 40°F. The addition of an evaporator defrost control with TXV permits low ambient cooling to 30°F.

Thermostats—Cooling only and heat/cooling (manual and automatic change over). Sub-base to match thermostat and locking thermostat cover.

Evaporator Defrost Control — See Low Ambient Cooling.







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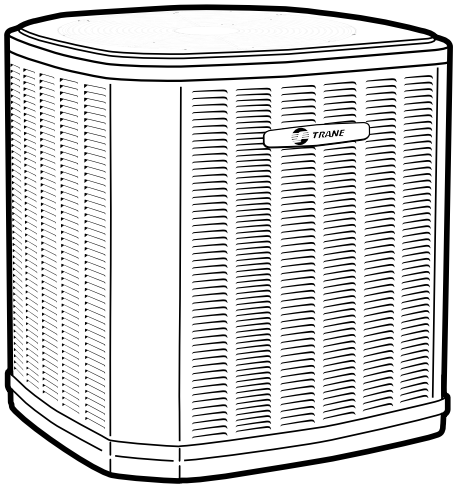
22-1924-1B-EN 19 Aug 2016
Supersedes 22-1924-1A-EN (May 2016)



Product Data

Split System Cooling

4TTR6018J1000A
4TTR6024J1000B
4TTR6030J1000A
4TTR6036J1000A
4TTR6042J1000A
4TTR6048J1000A
4TTR6049J1000A
4TTR6060J1000B
4TTR6061C1000B



Note: *"Graphics in this document are for representation only. Actual model may differ in appearance."*

November 2019

22-1916-1H-EN

Product Specifications

Model No. [a]	4TTR6018J1000A	4TTR6024J1000B	4TTR6030J1000A
POWER CONNS. — V/PH/HZ [b]	208/230/1/60	208/230/1/60	208/230/1/60
MIN. BRCH. CIR. AMPACITY	12	13	17
BR. CIR. PROT. RTG. — MAX. (AMPS)	20	20	25
COMPRESSOR	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
RL AMPS — LR AMPS	9 — 47.5	10.1 — 52	12.8 — 67.8
Outdoor Fan FL AMPS	0.64	0.64	0.64
Fan HP	1/8	1/8	1/8
Fan Dia (inches)	23.02 — 1	23.02	23.02
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A	4 LBS., 15 OZ	4 LBS., 11 OZ	5 LBS., 8 OZ
VALVE CONNECTION SIZE — IN. O.D. GAS	3/4	3/4	3/4
VALVE CONNECTION SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
LINE SIZE — IN. O.D. GAS [c]	3/4	3/4	3/4
LINE SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
Charge Spec. Subcooling	8°F	8°F	8°F
Dimensions H x W X D Crated (IN.)	34 x 30.1 x 33	34 x 30.1 x 33	42 x 30.1 x 33
Weight — Shipping (lbs.)	189	190	220
Weight — Net (lbs.)	161	162	184
Optional Accessories:			
Anti-short Cycle Timer	TAYASCT501A	TAYASCT501A	TAYASCT501A
Evaporator Defrost Control	AY28X079	AY28X079	AY28X079
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT023	BAYECMT023	BAYECMT023
Start Kit	BAYKSKT263	BAYKSKT263	BAYKSKT263
Crankcase Heater Kit	BAYCCHT302	BAYCCHT302	BAYCCHT302
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM103	BAYLOAM103	BAYLOAM103
Refrigerant Lineset [d]	TAYREFLN7*	TAYREFLN7*	TAYREFLN7*
Service Valve Panel Cover	TAYSVPANL0032AA	TAYSVPANL0032AA	TAYSVPANL0044AA

[a] Certified in accordance with the Unitary Air-conditioner equipment certification program which is based on AHRI standard 210/240.
[b] Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
[c] Standard line lengths — 60', Standard lift — 60' Suction and Liquid line. For Greater lengths and lifts refer to refrigerant piping software Pub#32–3312–0* (* denotes latest revision).
[d] * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Model No. [a]	4TTR6036J1000A	4TTR6042J1000A	4TTR6048J1000A
POWER CONNS. — V/PH/HZ [b]	208/230/1/60	208/230/1/60	208/230/1/60
MIN. BRCH. CIR. AMPACITY	18	21	24
BR. CIR. PROT. RTG. — MAX. (AMPS)	30	35	40
COMPRESSOR	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
RL AMPS — LR AMPS	13.6 — 79	16.7— 109	18.5 — 124
Outdoor Fan FL AMPS	0.77	0.64	0.93
Fan HP	1/8	1/8	1/5
Fan Dia (inches)	24	27.5	27.5
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A	6 LBS., 8 OZ	8 LBS., 2 OZ	7 LBS., 2 OZ
VALVE CONNECTION SIZE — IN. O.D. GAS	3/4	7/8	7/8
VALVE CONNECTION SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
LINE SIZE — IN. O.D. GAS [c]	7/8	7/8	7/8
LINE SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
Charge Spec. Subcooling	8°F	8°F	8°F
Dimensions H x W X D Crated (IN.)	42 x 35.1 x 38.7	50.4 x 35.1 x 38.7	50.4 x 35.1 x 38.7
Weight — Shipping (lbs.)	246	302	306
Weight — Net (lbs.)	212	252	256
Optional Accessories:			
Anti-short Cycle Timer	TAYASCT501A	TAYASCT501A	TAYASCT501A
Evaporator Defrost Control	AY28X079	AY28X079	AY28X079
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT004	BAYECMT004	BAYECMT004
Start Kit	BAYKSKT263	BAYKSKT263	BAYKSKT263
Crankcase Heater Kit	BAYCCHT302	BAYCCHT302	BAYCCHT302
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM103	BAYLOAM103	BAYLOAM103
Refrigerant Lineset [d]	TAYREFLN3*	TAYREFLN3*	TAYREFLN3*
Service Valve Panel Cover	TAYSVPANL0044AA	TAYSVPANL0046AA	TAYSVPANL0046AA

[a] Certified in accordance with the Unitary Air-conditioner equipment certification program which is based on AHRI standard 210/240.
[b] Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
[c] Standard line lengths — 60', Standard lift — 60' Suction and Liquid line. For Greater lengths and lifts refer to refrigerant piping software Pub#32–3312–0* (* denotes latest revision).
[d] * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Model No. [a]	4TTR6049J1000A	4TTR6060J1000B	4TTR6061C1000B
POWER CONNS. — V/PH/HZ [b]	208/230/1/60	208/230/1/60	208/230/1/60
MIN. BRCH. CIR. AMPACITY	26	27	29
BR. CIR. PROT. RTG. — MAX. (AMPS)	40	45	45
COMPRESSOR	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL	CLIMATUFF®- SCROLL
RL AMPS — LR AMPS	18.5 — 124	20.8 — 127.1	20.8 — 127.1
Outdoor Fan FL AMPS	2.80	1.05	1.05
Fan HP	1/3	1/5	1/5
Fan Dia (inches)	27.5	27.5	27.6
Coil	SPINE FIN™	SPINE FIN™	SPINE FIN™
Refrigerant R-410A	10 LBS., 10 OZ	10 LBS., 6 OZ	11 LBS., 13 OZ
VALVE CONNECTION SIZE — IN. O.D. GAS	7/8	7/8	7/8
VALVE CONNECTION SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
LINE SIZE — IN. O.D. GAS [c]	7/8	1–1/8	1–1/8
LINE SIZE — IN. O.D. LIQ.	3/8	3/8	3/8
Charge Spec. Subcooling	10°F	10°F	10°F
Dimensions H x W X D Crated (IN.)	50.4 x 35.1 x 38.7	50.4 x 35.1 x 38.7	50.4 x 35.1 x 38.7
Weight — Shipping (lbs.)	322	327	327
Weight — Net (lbs.)	272	277	277
Optional Accessories:			
Anti-short Cycle Timer	TAYASCT501A	TAYASCT501A	TAYASCT501A
Evaporator Defrost Control	AY28X079	AY28X079	AY28X079
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101
Extreme Condition Mount Kit	BAYECMT004	BAYECMT004	BAYECMT004
Start Kit	BAYKSKT263	BAYKSKT263	BAYKSKT263
Crankcase Heater Kit	BAYCCHT302	BAYCCHT302	BAYCCHT302
Seacoast Kit	BAYSEAC001	BAYSEAC001	BAYSEAC001
Low Ambient Kit	BAYLOAM103	BAYLOAM103	BAYLOAM103
Refrigerant Lineset [d]	TAYREFLN3*	TAYREFLN3*	TAYREFLN3*
Service Valve Panel Cover	TAYSVPANL0046AA	TAYSVPANL0046AA	TAYSVPANL0046AA

(a) Certified in accordance with the Unitary Air-conditioner equipment certification program which is based on AHRI standard 210/240.
(b) Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
(c) Standard line lengths — 60', Standard lift — 60' Suction and Liquid line. For Greater lengths and lifts refer to refrigerant piping software Pub#32–3312–0* (* denotes latest revision).
(d) * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Sound Power Level

MODEL	A-Weighted Sound Power Level [dB(A)]	Full Octave Sound Power(dB)							
		63 Hz*	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
4TTR6018J	73	79	69	67	70	70	64	59	53
4TTR6024J	73	79	69	67	70	70	64	59	53
4TTR6030J	73	79	69	67	70	70	64	59	53
4TTR6036J	71	78	72	69	68	66	61	58	53
4TTR6042J	72	81	75	71	70	68	63	58	53
4TTR6048J	72	81	75	71	70	68	63	58	53
4TTR6049J	72	81	75	71	70	68	63	58	53
4TTR6060J	72	81	75	71	70	68	63	58	53
4TTR6061C	74	68	56	63	73	69	64	59	51

Note: Rated in accordance with AHRI Standard 270–2008 *For Reference Only

Accessory Description and Usage

Anti-Short Cycle Timer — Solid state timing device that prevents compressor recycling until five (5) minutes have elapsed after satisfying call or power interruptions. Use in area with questionable power delivery, commercial applications, long lineset, etc.

Evaporation Defrost Control — SPST Temperature actuated switch that cycles the condenser off as indoor coil reaches freeze-up conditions. Used for low ambient cooling to 30°F with TXV.

Rubber Isolators — Five (5) large rubber donuts to isolate condensing unit from transmitting energy into mounting frame or pad. Use on any application where sound transmission needs to be minimized.

Hard Start Kit — Start capacitor and relay to assist compressor motor startup. Use in areas with marginal power supply, on long linesets, low ambient conditions, etc.

Extreme Condition Mount Kit — Bracket kits to securely mount condensing unit to a frame or pad without removing any panels. Use in areas with high winds, or on commercial roof tops, etc.

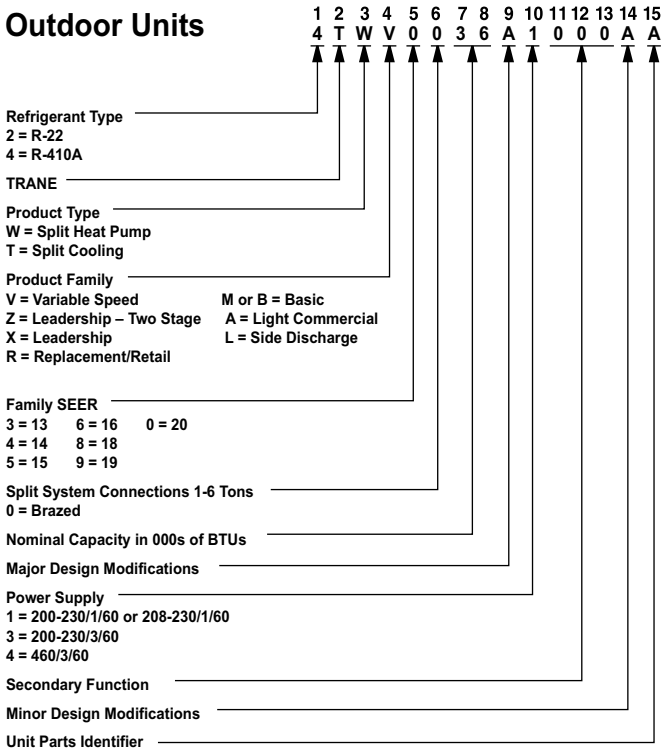
AHRI Standard Capacity Rating Conditions

AHRI Standard 210/240 Rating Conditions

1. Cooling 80°F DB, 67°F WB air entering indoor coil, 95°F DB air entering outdoor coil.
2. High Temperature Heating 47°F DB, 43°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
3. Low Temperature Heating 17°F DB air entering indoor coil.
4. Rated indoor airflow for heating is the same as for cooling.

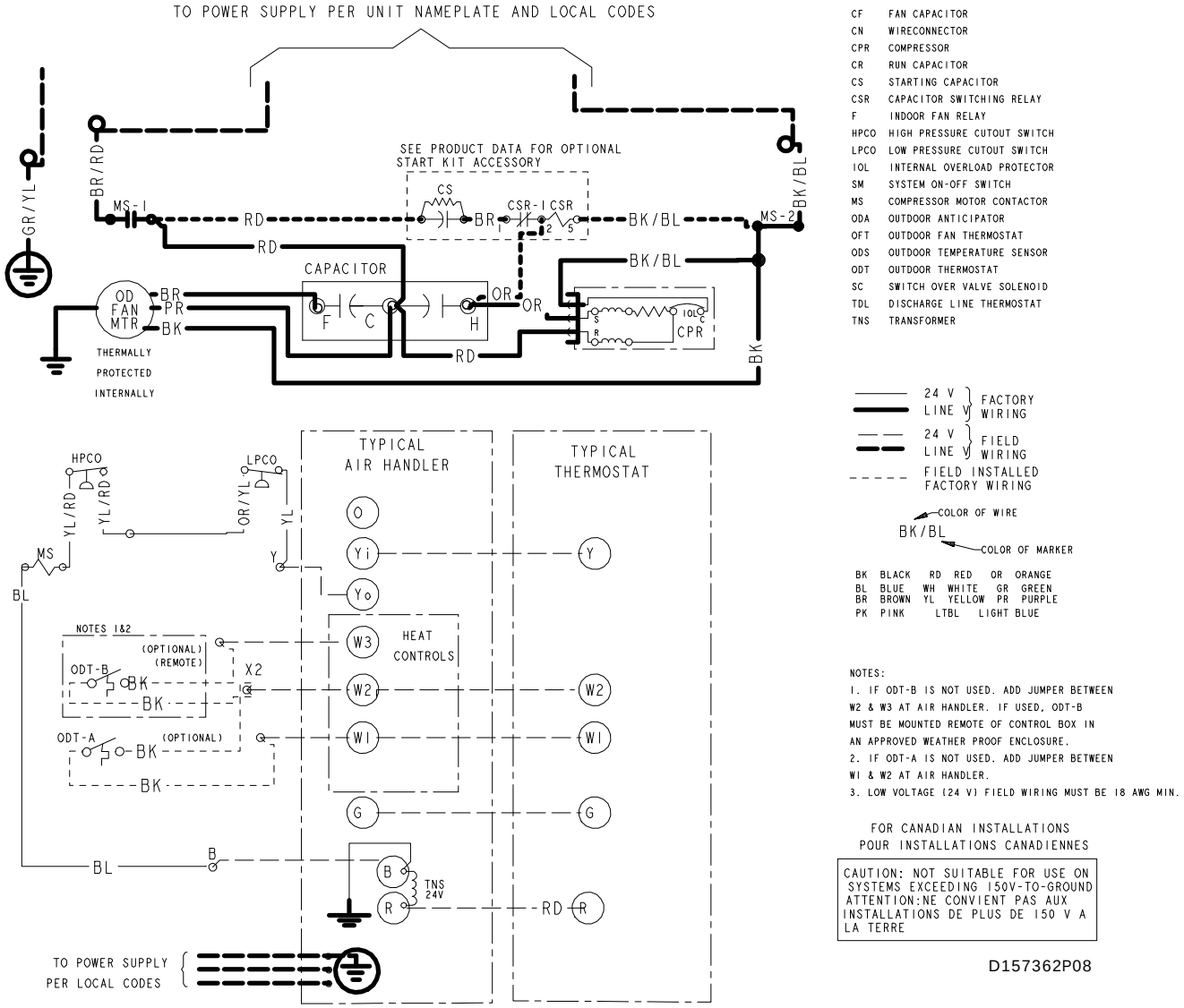
AHRI Standard 270 Rating Conditions — (Noise rating numbers are determiend with the unit in cooling operations.) Standard Noise Rating number is at 95°F outdoor air.

Model Nomenclature



Schematic Diagrams

Figure 1. 018 — 048 Models



CF	FAN CAPACITOR
CN	WIRECONNECTOR
CPR	COMPRESSOR
CR	RUN CAPACITOR
CS	STARTING CAPACITOR
CSR	CAPACITOR SWITCHING RELAY
F	INDOOR FAN RELAY
HPCO	HIGH PRESSURE CUTOUT SWITCH
LPCO	LOW PRESSURE CUTOUT SWITCH
IOL	INTERNAL OVERLOAD PROTECTOR
SM	SYSTEM ON-OFF SWITCH
MS	COMPRESSOR MOTOR CONTACTOR
ODA	OUTDOOR ANTICIPATOR
OFT	OUTDOOR FAN THERMOSTAT
ODS	OUTDOOR TEMPERATURE SENSOR
ODT	OUTDOOR THERMOSTAT
SC	SWITCH OVER VALVE SOLENOID
TDL	DISCHARGE LINE THERMOSTAT
TNS	TRANSFORMER

24 V LINE V } FACTORY WIRING

24 V LINE V } FIELD WIRING

FIELD INSTALLED FACTORY WIRING

COLOR OF WIRE
BK/BL
COLOR OF MARKER

BK	BLACK	RD	RED	OR	ORANGE
BL	BLUE	WH	WHITE	GR	GREEN
BR	BROWN	YL	YELLOW	PR	PURPLE
PK	PINK	LTBL	LIGHT BLUE		

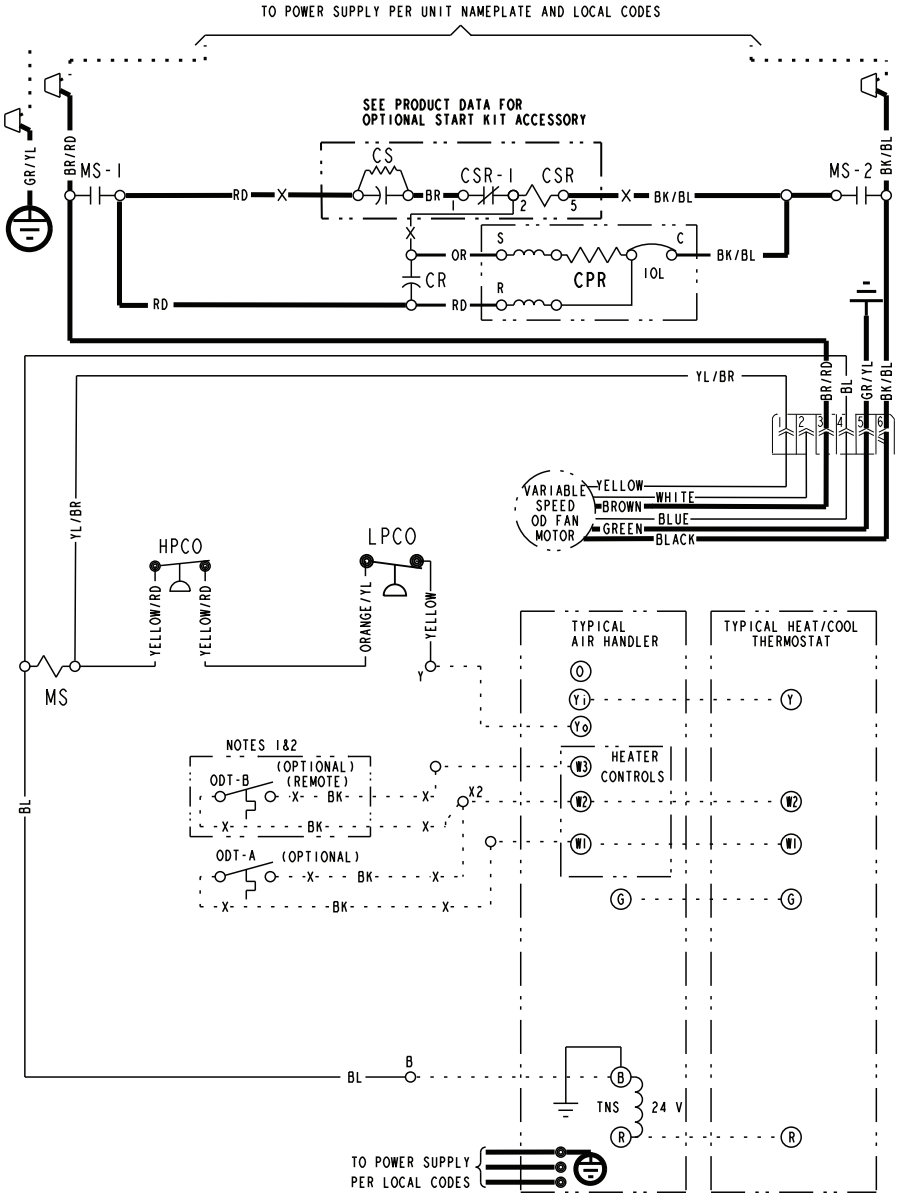
NOTES:
1. IF ODT-B IS NOT USED. ADD JUMPER BETWEEN W2 & W3 AT AIR HANDLER. IF USED, ODT-B MUST BE MOUNTED REMOTE OF CONTROL BOX IN AN APPROVED WEATHER PROOF ENCLOSURE.
2. IF ODT-A IS NOT USED. ADD JUMPER BETWEEN W1 & W2 AT AIR HANDLER.
3. LOW VOLTAGE (24 V) FIELD WIRING MUST BE 18 AWG MIN.

FOR CANADIAN INSTALLATIONS
POUR INSTALLATIONS CANADIENNES

CAUTION: NOT SUITABLE FOR USE ON SYSTEMS EXCEEDING 150V-TO-GROUND
ATTENTION:NE CONVIENT PAS AUX INSTALLATIONS DE PLUS DE 150 V A LA TERRE

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Figure 2. 049 & 061 Models



CA COOLING ANTICIPATOR
CBS COIL BOTTOM SENSOR
CF FAN CAPACITOR
CN WIRE CONNECTOR
CPR COMPRESSOR
CR RUN CAPACITOR
CS STARTING CAPACITOR
CSR CAPACITOR SWITCHING RELAY
DFC DEFROST CONTROL
F INDOOR FAN RELAY
HA HEATING ANTICIPATOR
HPCO HIGH PRESSURE CUTOUT SW.
IOL INTERNAL OVERLOAD PROTECTOR
ACR A/C RECTIFIER
LPCO LOW PRESSURE CUTOUT SW.
MS COMPRESSOR MOTOR CONTACTOR
ODA OUTDOOR ANTICIPATOR
OFT OUTDOOR FAN THERMOSTAT
ODS OUTDOOR TEMPERATURE SENSOR
ODT OUTDOOR THERMOSTAT
RHS RESISTANCE HEAT SWITCH
SC SWITCHOVER VALVE SOLENOID
SM SYSTEM "ON-OFF" SWITCH
TDL DISCHARGE LINE THERMOSTAT
TNS TRANSFORMER
TS HEATING-COOLING THERMOSTAT
TSH HEATING THERMOSTAT
R OFT SHUNT RESISTOR

COLOR OF WIRE
BK/BL BLACK WIRE WITH BLUE MARKER
COLOR OF MARKER

BK	BLACK	OR	ORANGE	YL	YELLOW
BL	BLUE	RD	RED	GR	GREEN
BR	BROWN	WH	WHITE	PR	PURPLE

NOTES:

1. IF ODT-B IS NOT USED, ADD JUMPER BETWEEN W2 & W3 AT AIR HANDLER. IF USED, ODT-B MUST BE MOUNTED REMOTE OF CONTROL BOX IN AN APPROVED WEATHER PROOF ENCLOSURE.
2. IF ODT-A IS NOT USED, ADD JUMPER BETWEEN W1 & W2 AT AIR HANDLER.
3. LOW VOLTAGE (24 V.) FIELD WIRING MUST BE 18 AWG MIN.

FOR CANADIAN INSTALLATIONS
POUR INSTALLATIONS CANADIENNES

CAUTION: NOT SUITABLE FOR USE ON SYSTEMS EXCEEDING 150V-TO-GROUND.
ATTENTION: NE CONVIENT PAS AUX INSTALLATIONS DE PLUS DE 150 V A LA TERRE.

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Figure 3. 060 Models

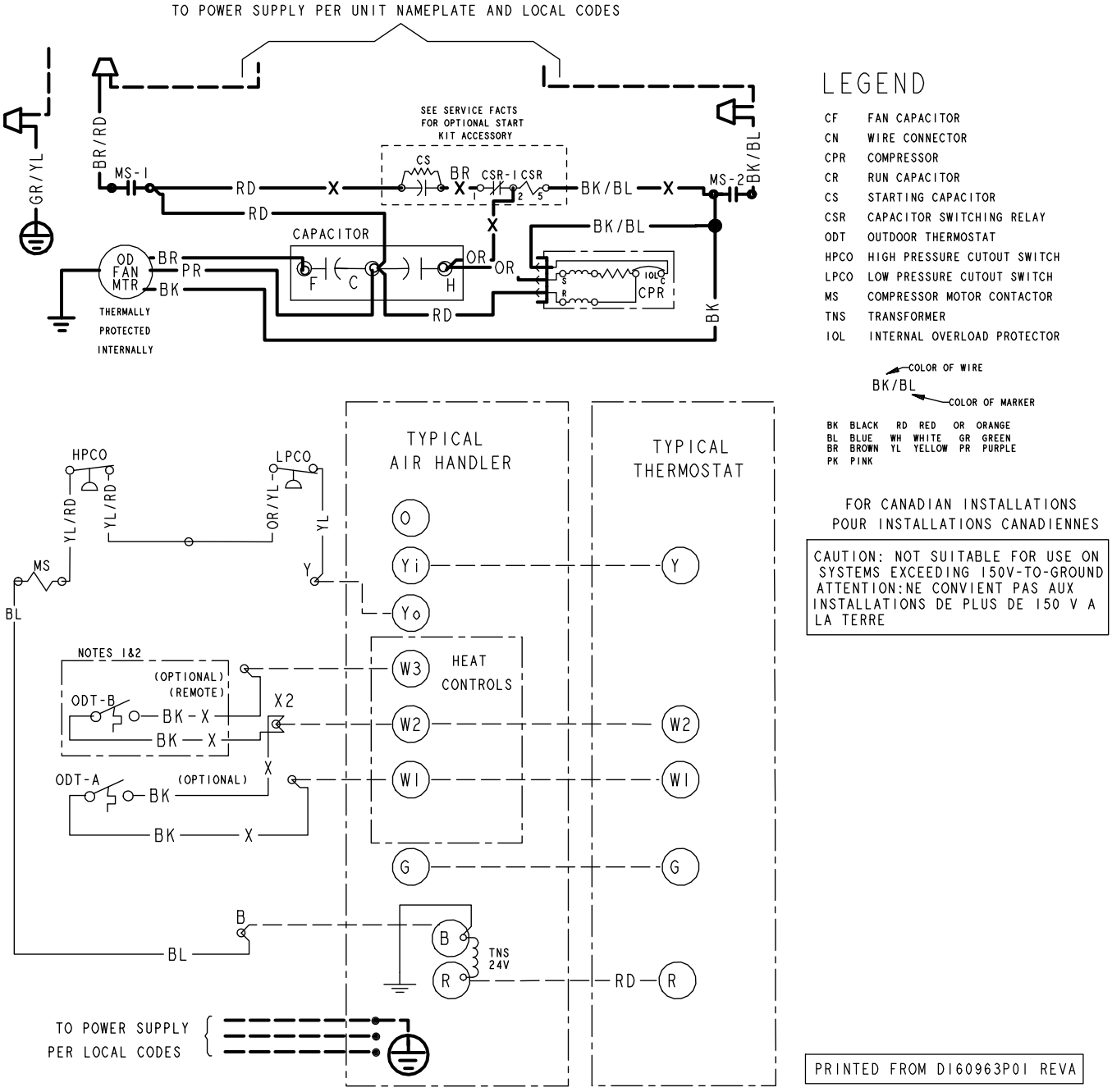
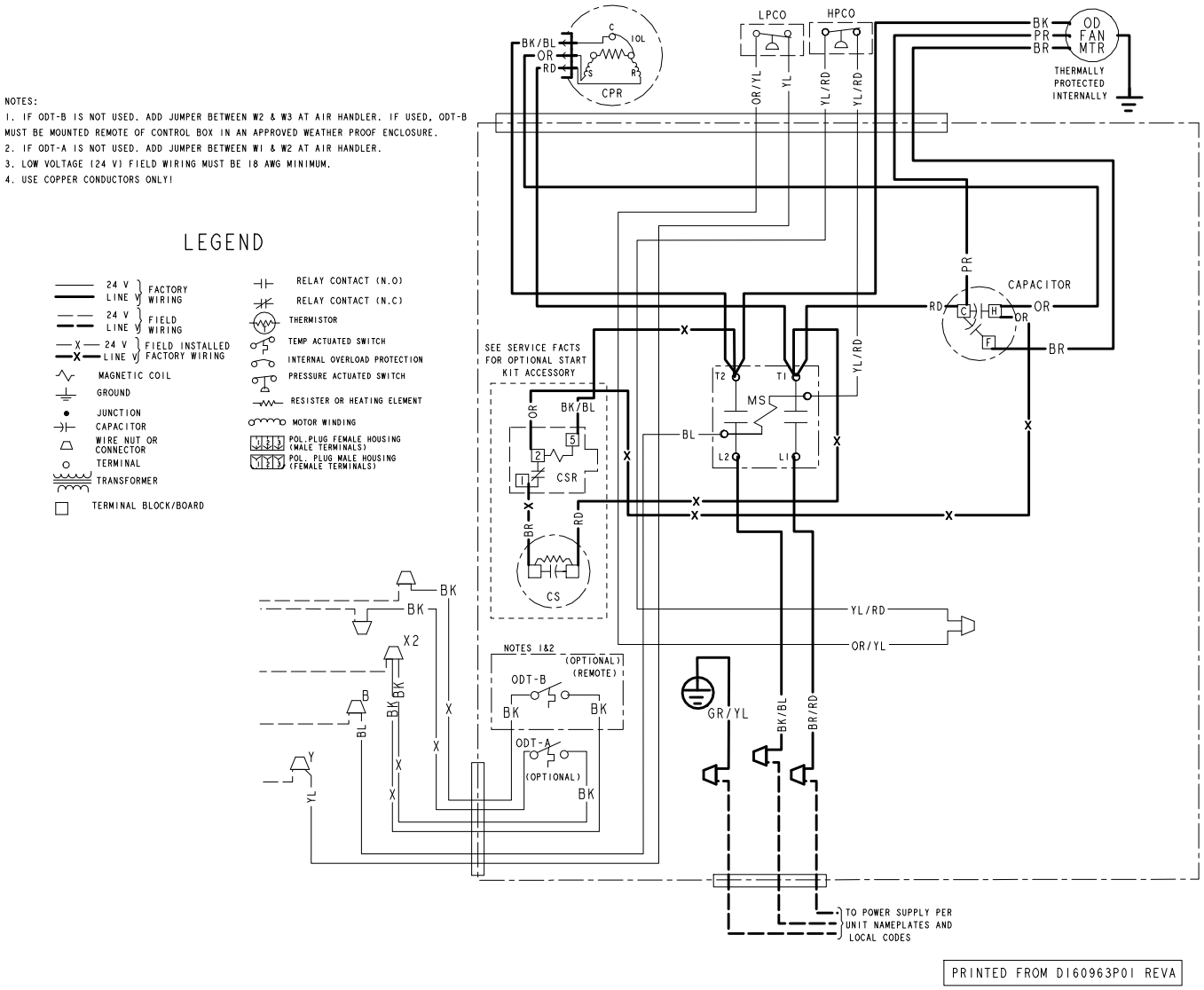
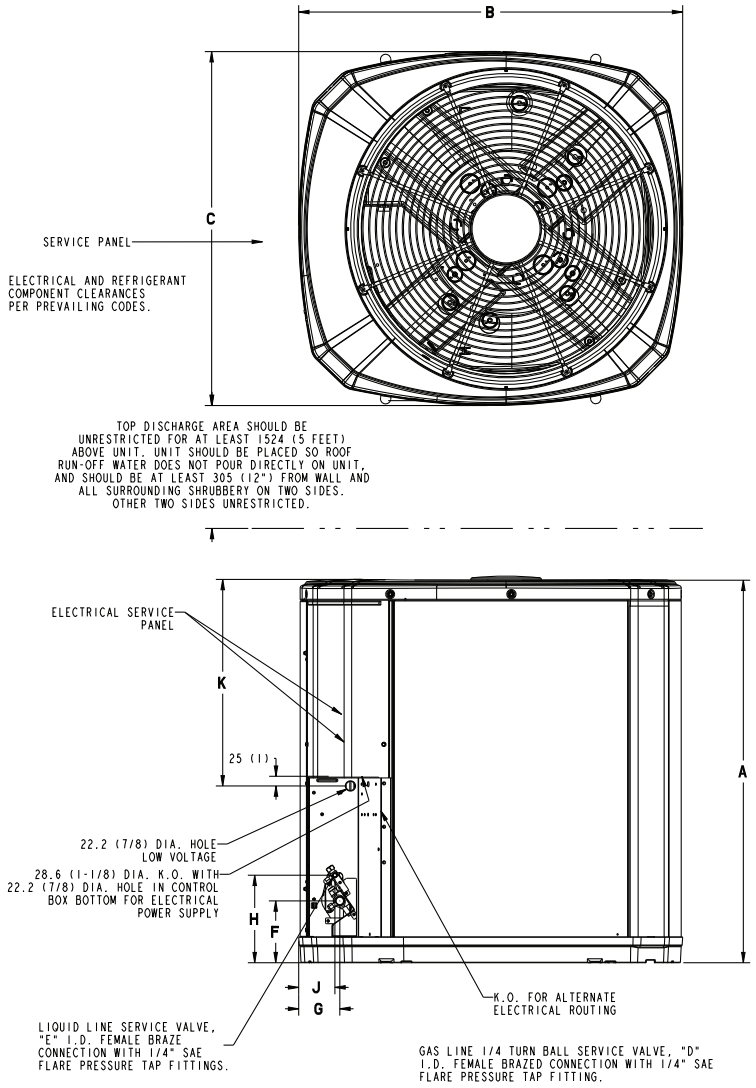


Figure 4. 060 Models



Outline Drawing



Model	Base	A	B	C	D	E	F	G	H	J	K
4TTR6018J	3	730 (28–3/4)	829 (32–5/8)	756 (29–3/4)	3/4	3/8	127 (5)	76 (3)	197 (7–3/4)	60 (2–3/8)	508 (20)
4TTR6024J	3	730 (28–3/4)	829 (32–5/8)	756 (29–3/4)	3/4	3/8	127 (5)	76 (3)	197 (7–3/4)	60 (2–3/8)	508 (20)
4TTR6030J	3	933 (36–3/4)	829 (32–5/8)	756 (29–3/4)	3/4	3/8	143 (5–5/8)	92 (3–5/8)	210 (8–1/4)	79 (3–1/8)	508 (20)
4TTR6036J	4	943 (37–1/8)	946 (37–1/4)	870 (34–1/4)	3/4	3/8	143 (5–5/8)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	508 (20)
4TTR6042J	4	1147 (45–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	152 (6)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	813 (32)
4TTR6048J	4	1147 (45–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	152 (6)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	813 (32)
4TTR6049J	4	1147 (45–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	152 (6)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	813 (32)
4TTR6060J	4	1147 (45–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	152 (6)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	813 (32)
4TTR6061C	4	1147 (45–1/8)	946 (37–1/4)	870 (34–1/4)	7/8	3/8	152 (6)	98 (3–7/8)	219 (8–5/8)	86 (3–3/8)	813 (32)

Mechanical Specification Options

General

The outdoor condensing units are factory charged with the system charge required for the outdoor condensing unit, ten (10) feet of tested connecting line, and the smallest rated indoor evaporative coil match. This unit is designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities are matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit is certified to UL 1995. Exterior is designed for outdoor application.

Casing

Unit casing is constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish. The corner panels are prepainted. All panels are subjected to our 1,000 hour salt spray test.

Refrigerant Controls

Refrigeration system controls include condenser fan, compressor contactor and low and high pressure switches. A factory supplied, field installed liquid line drier is standard.

Compressor

The compressor features internal over temperature and pressure protection. Other features include: Centrifugal oil pump and low vibration and noise.

Condenser Coil

The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

Low Ambient Cooling

As manufactured, this system has a cooling capacity to 55°F. The addition of an evaporator defrost control permits operation to 40°F. The addition of an evaporator defrost control with TXV permits low ambient cooling to 30°F.

The addition of the BAYLOAM107A low ambient kit permits ambient cooling to 20°F.

Thermostats—Cooling only and heat/cooling (manual and automatic change over). Sub-base to match thermostat and locking thermostat cover.

Notes

Ingersoll Rand (NYSE: IR) advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands — including Club Car®, Ingersoll Rand®, Thermo King® and Trane® — work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a global business committed to a world of sustainable progress and enduring results.

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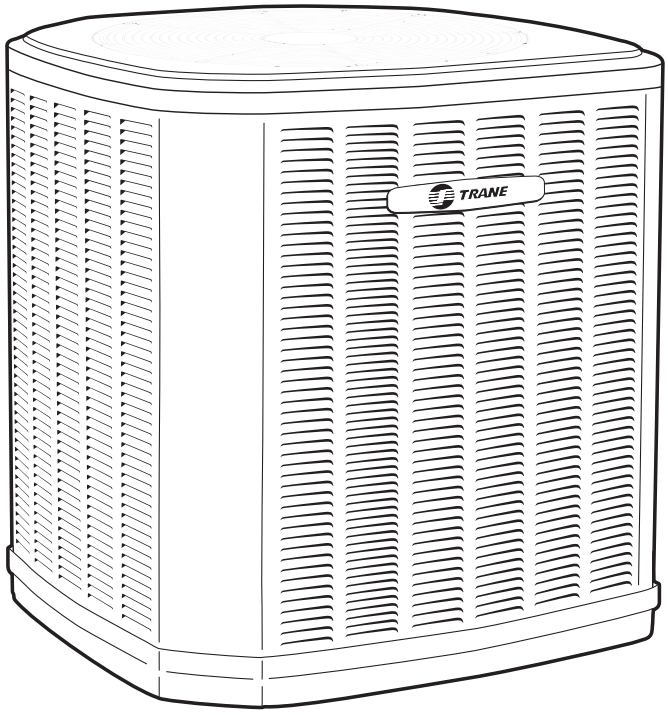
22-1916-1H-EN 08 Nov 2019
Supersedes 22-1916-1G-EN (July 2019)

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Split System Cooling Product Data

XR17
4TTR7

2, 3, 4 & 5 Tons



PUB. NO. 22-1884-2A-EN

Features and Benefits

- **CLIMATUFF**™ 2-stage scroll compressor
- Efficiency up to **18.0 SEER**
- All Aluminum **SPINE FIN**™ coil
- **DURATUFF**™ weather proof and rust proof base
- **COMFORT "R"**™ mode approved for better comfort indoors
- **QUICK-SESS**™ cabinet, service access and refrigerant connections with full coil protection
- **WEATHERGUARD**™ fasteners
- Glossy corrosion resistant finish tarpaulin gray cabinet with anthracite gray top
- Internal compressor high/low pressure & temperature protection
- Liquid line filter/drier
- Low sound with advanced PSC fan motor
- Service valve cover
- R-410A refrigerant
- From 70 to 100% capacity modulation
- 100% run test in the factory
- Low ambient cooling to 55° as shipped

- **Extended warranties available**

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- Accessory Description and Usage 5
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General Data

Product Specifications

Model No. ①	4TTR7024A1000B	4TTR7036A1000B	4TTR7048A1000A	4TTR7060A1000A
Electrical Data V/Ph/Hz ②	208/230/1/60	208/230/1/60	208/230/1/60	208/230/1/60
Min Cir Ampacity	18	24	28	41
Max Fuse Size (Amps)	20	35	45	60
Compressor	CLIMATUFF® - SCROLL	CLIMATUFF® - SCROLL	CLIMATUFF® - SCROLL	CLIMATUFF® - SCROLL
No. Compress. – No. Stages	1 -2	1-2	1-2	1-2
RL AMPS - LR AMPS	13.0 - 52	17.0 - 82	21.2 - 104	32.1 - 152.9
Outdoor Fan FL Amps	0.71	0.71	1.00	1.30
Fan HP	1/8	1/8	1/5	1/4
Fan Dia (inches)	27.6	27.6	27.6	27.6
Coil	Spine Fin™	Spine Fin™	Spine Fin™	Spine Fin™
Refrigerant R-410A	9/4-LB/OZ	8/12-LB/OZ	12/9-LB/OZ	12/9-LB/OZ
Line Size - (in.) O.D. Gas ③	5/8	3/4	7/8	1-1/8
Line Size - (in.) O.D. Liquid ③	3/8	3/8	3/8	3/8
Dimensions H x W x D (Crated)	46.4 x 35.1 x 38.7	51.0 x 35.1 x 38.7	51.0 x 35.1 x 38.7	51.0 x 35.1 x 38.7
Weight - Shipping	276	283	308	312
Weight - Net	240	245	271	275
Start Components	NO	NO	NO	NO
Sound Enclosure	NO	NO	NO	NO
Compressor Sump Heat	NO	NO	NO	NO
Optional Accessories: ④				
Rubber Isolator Kit	BAYISLT101	BAYISLT101	BAYISLT101	BAYISLT101
Snow Leg - Base & Cap 4" High	BAYLEGS002	BAYLEGS002	BAYLEGS002	BAYLEGS002
Snow Leg - 4" Extension	BAYLEGS003	BAYLEGS003	BAYLEGS003	BAYLEGS003
Hard Start Kit Scroll	BAYKSKT263	BAYKSKT263	BAYKSKT266	BAYKSKT266
Crankcase Heater Kit	BAYCCHT301	BAYCCHT301	BAYCCHT301	BAYCCHT301
Extreme Condition Mounting Kit	BAYECMT004	BAYECMT004	BAYECMT004	BAYECMT004
Vertical Discharge Air Kit Base 4	BAYVDTA003	BAYVDTA004	BAYVDTA004	BAYVDTA004
Auto Charge Solenoid Kit	BAYCAKT001	BAYCAKT001	BAYCAKT001	BAYCAKT001
Refrigerant Lineset ⑤	TAYREFLN9*	TAYREFLN7*	TAYREFLN3*	TAYREFLN4*

① Certified in accordance with the Air-Source Unitary Heat Pump Equipment certification program which is based on AHRI Standard 210/240.
② Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
③ Standard line lengths - 60'. Standard lift - 25' Suction and Liquid line.
For Greater lengths and lifts refer to refrigerant piping software Pub# 32-3312-0†. (†denotes latest revision)
④ For accessory description and usage, see page 5.
⑤ * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Sound Power Level

Model	A-Weighted Sound Power Level [dB(A)]	Full Octave Sound Power [dB]							
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
4TTR7024A1	72	70	69	63	66	60	56	53	48
4TTR7036A1	72	64	67	65	64	60	56	54	50
4TTR7048A1	73	70	67	68	66	63	56	53	49
4TTR7060A1	74	68	70	66	69	66	57	57	53

Note: Rated in accordance with AHRI Standard 270-2008

General Data

Accessory Description and Usage

Rubber Isolators — 5 rubber donuts to isolate condensing unit from mounting frame or pad. Use on any application where sound transmission needs to be minimized.

Extreme Conditions Mounting Kit — Bracket kits to securely mount condensing unit to a frame or pad without removing any panels. Use in areas with high winds, or on commercial rooftops, etc.

Low Ambient Cooling — For low ambient cooling below 55° see Application Guide APP-APG013-EN.

AHRI Standard Capacity Rating Conditions

AHRI STANDARD 210/240 RATING CONDITIONS —
(A) Cooling 80°F DB, 67°F WB air entering indoor coil, 95°F DB air entering outdoor coil.
(B) High Temperature Heating 47°F DB, 43°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
(C) Low Temperature Heating 17°F DB, 15°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
(D) Rated indoor airflow for heating is the same as for cooling.

AHRI STANDARD 270 RATING CONDITIONS — (Noise rating numbers are determined with the unit in cooling operation.) Standard Noise Rating number is at 95°F outdoor air.





Model Nomenclature

Outdoor Units

4 T T R 7 0 3 6 A 1 0 0 0 A A

Refrigerant Type
4 = R-410A

TRANE

Product Type
W = Split Heat Pump
T = Split Cooling

Product Family
Z = Leadership – Two Stage
X = Leadership
R = Replacement/Retail
M or B = Basic
A = Light Commercial

Family SEER
3 = 13 6 = 16 0 = 20
4 = 14 8 = 18
5 = 15 9 = 19

Split System Connections 1-6 Tons
0 = Brazed

Nominal Capacity in 000s of BTUs

Major Design Modifications

Power Supply
1 = 200-230/1/60 or 208-230/1/60
3 = 200-230/3/60
4 = 460/3/60

Secondary Function

Minor Design Modifications

Unit Parts Identifier

Air Handler

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
G A M 5 A 0 B 3 6 M 3 1 S A A

Brand
T = Better
G = Good

Product Type
A = Air Handler

Convertability
M = Multi-poise 4-way
F = Upflow Front Return, 3-way
T = 3-way

Product Tier
2 = Good, Entry Level Feature Set
4 = Better, Retail Replacement Mid Effy.
5 = Better, Entry Level High Effy., Multi-Speed
7 = Best, Retail Replacement High Effy., Variable-Speed
8 = Best, Retail Ultimate High Effy., Variable-Speed

Major Design Change

No Descriptor
0 = Air Handler / Coil

Size (Footprint)
A = 17.5 x 21.5
B = 21.0 x 21.5
C = 23.5 x 21.5

Cooling Size: Air Handler or Coil
0-9 = AH Coil - 1000 BTU's (18, 24, 30, 36, 42, 48, 60)

Airflow Type & Capability
S = Low Effy PSC, 1-5 - nom. Tonnage (cfm/ton)
M = Mid Effy Multi-Speed, 1-5 - nom. Tonnage (cfm/ton)
H = High Effy Multi-Speed, 1-5 - nom. Tonnage (cfm/ton)
V = High Effy Variable, 1-5 - nom. Tonnage (cfm/ton)

Power Supply
1 = 208-230/1/60

System Control Type
S = Standard - 24 VAC
C = CLII 13.8 VDC

Minor Design Change

Unit Parts Identifier

Gas Furnaces

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
T U D 1 B 0 8 0 A 9 H 3 1 A A

Furnace Configuration
TU = Upflow/Horizontal
TD = Downflow/Horizontal

Type
E = 80% Induced Draft Standard
D = 80% Induced Draft Premium
C = 90% Condensing Standard
X = 90% Condensing Premium
H = 95% Condensing Premium

Number of Heating Stages
1 = Single Stage
2 = Two Stage
M = Modulating

Cabinet Width
A = 14.5" Cabinet Width
B = 17.5" Cabinet Width
C = 21.0" Cabinet Width
D = 24.5" Cabinet Width

Heating Input in 1000's (BTUH)
080 = 80,000 BTUH

Major Design Change

Voltage
9 = 115 Volts / 60 Hertz / Natural Gas
A = 115 Volts / 50 Hertz / Natural Gas
C = 115 Volts / Natural Gas with Communicating System Control
F = 115 Volts / Natural Gas with Integrated Electronic Filter
D = 115 Volts / Natural Gas with Communicating System Control and Integrated Electronic Filter

Air Capacity for Cooling

Standard PSC	Variable Speed	High Efficiency
24 = 2 Tons	V3 = 3 Tons	H3 = 3 Tons
36 = 3 Tons	V4 = 4 Tons	H4 = 4 Tons
42 = 3.5 Tons	V5 = 5 Tons	H5 = 5 Tons
45 = 4 Tons		
48 = 4 Tons		
54 = 5 Tons		
60 = 5 Tons		
72 = 6 Tons		

Draft Inducer Speeds
1 = Single Speed
2 = Two Speed
V = Variable Speed

Minor Design Change

Service Digit - Not Orderable

Heat Pump/ Cooling Coils

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
4 T X C B 0 3 6 A C 3 H C A A

Refrigerant Type
4 = R-410A

Series
T = Premium (Heat Pump or Convertible Coil)
C = Standard (Cooling Only)

Coil Design
X = Direct Expansion Evaporator Coil

Coil Feature
C = Cased A Coil
A = Uncased A Coil
F = Cased Horizontal Flat Coil

Coil Width (Cased/Uncased)
A = 14.5" /13.3"
B = 17.5" / 16.3"
C = 21.0" / 19.8"
D = 24.5" / 23.3"
H = 10.5"

Refrigerant Line Coupling
0 = Brazed

Nominal Capacity in 1000's (BTUH)

Major Design Change

Efficiency
C = Standard
S = Hi Efficiency (derived from 10 SEER products)

Refrigerant Control
3 = TXV - Non-Bleed

Coil Circuitry
H = Heat Pump
C = Cooling

Airflow Configuration
A = Upflow Only
U = Upflow / Downflow
H = Horizontal Only
C = Convertible - Upflow, Downflow, Left or Right Airflow

Minor Design Change

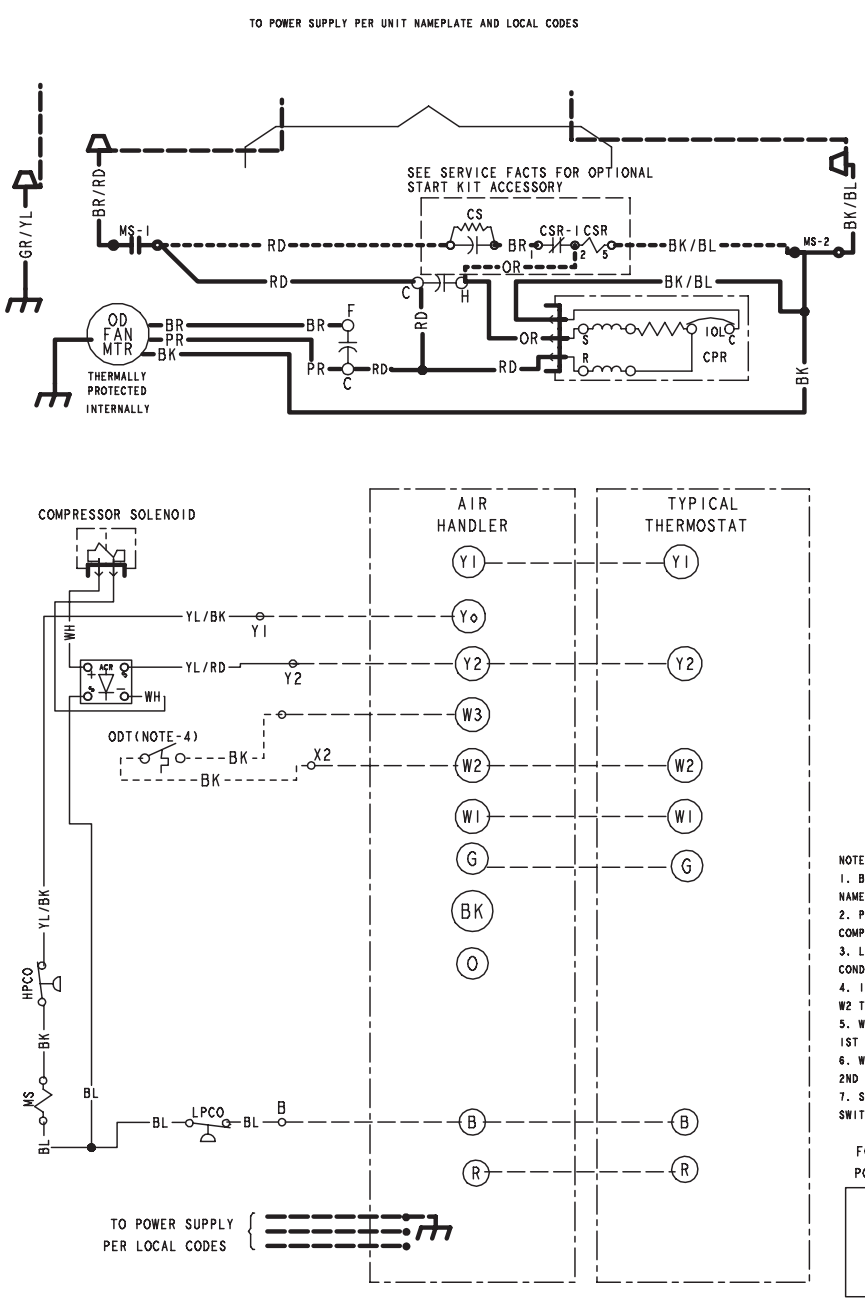
Service Digit - Not Orderable

Electrical Data

Schematic Diagrams

(SEE LEGEND)

4TTR7024A, 036A



ACR	A/C RECTIFIER
CF	FAN CAPACITOR
CN	WIRECONNECTOR
CPR	COMPRESSOR
CR	RUN CAPACITOR
CS	STARTING CAPACITOR
CSR	CAPACITOR SWITCHING RELAY
F	INDOOR FAN RELAY
HPCO	HIGH PRESSURE CUTOUT SWITCH
IOL	INTERNAL OVERLOAD PROTECTOR
LPCO	LOW PRESSURE CUTOUT SWITCH
SM	SYSTEM ON-OFF SWITCH
MS	COMPRESSOR MOTOR CONTACTOR
ODA	OUTDOOR ANTICIPATOR
OFT	OUTDOOR FAN THERMOSTAT
ODS	OUTDOOR TEMPERATURE SENSOR
ODT	OUTDOOR THERMOSTAT
SC	SWITCH OVER VALVE SOLENOID
TDL	DISCHARGE LINE THERMOSTAT
TDR	TIME DELAY RELAY(5 SEC DELAY ON)
TNS	TRANSFORMER

COLOR OF WIRE
BK/BL
COLOR OF MARKER

BK	BLACK	RD	RED	OR	ORANGE
BL	BLUE	WH	WHITE	GR	GREEN
BR	BROWN	YL	YELLOW	PR	PURPLE
PK	PINK				

⚠WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRICAL POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

Failure to disconnect power before servicing can cause severe personal injury or death.

⚠CAUTION

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

Failure to do so may cause damage to the equipment.

NOTES:

1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
2. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
3. LOW VOLTAGE WIRING MUST BE 18 AWG MINIMUM CONDUCTOR.
4. IF OUTDOOR THERMOSTAT IS NOT USED. CONNECT W2 TO W3.
5. WITH Y1 ENERGIZED, INDOOR FAN IS 1ST STAGE AIRFLOW.
6. WITH Y1 & Y2 ENERGIZED, INDOOR FAN IS 2ND STAGE AIRFLOW.
7. SEE AIR HANDLER INSTALLER GUIDE FOR DIP SWITCH CONFIGURATIONS.

FOR CANADIAN INSTALLATIONS
POUR INSTALLATIONS CANADIENNES

CAUTION: NOT SUITABLE FOR USE ON SYSTEMS EXCEEDING 150V-TO-GROUND
ATTENTION:NE CONVIENT PAS AUX INSTALLATIONS DE PLUS DE 150 V A LA TERRE

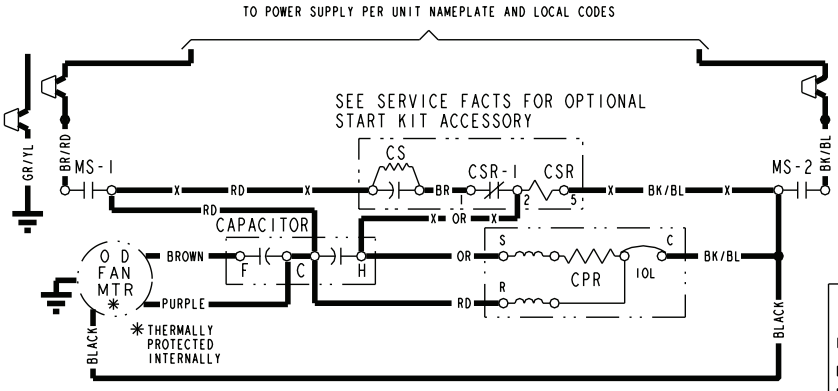
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Electrical Data

Schematic Diagrams

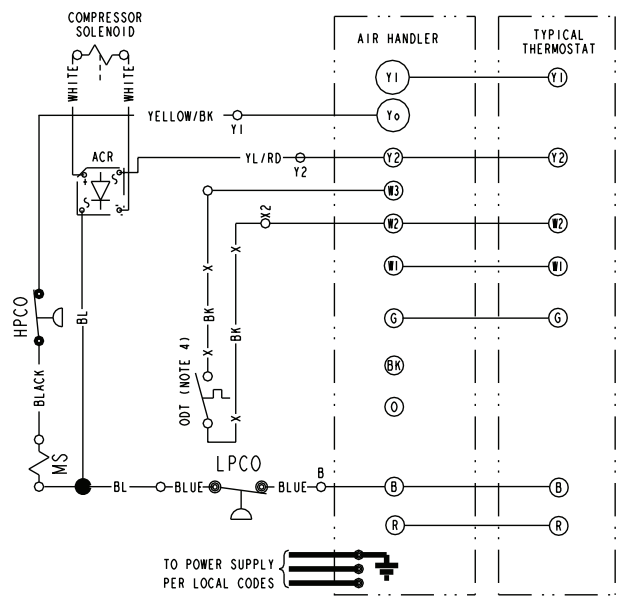
(SEE LEGEND)

4TTR7048A, 060A



CA	COOLING ANTICIPATOR	LPCO	LOW PRESSURE CUTOUT SW.
CBS	COIL BOTTOM SENSOR	MS	COMPRESSOR MOTOR CONTACTOR
CF	FAN CAPACITOR	ODA	OUTDOOR ANTICIPATOR
CN	WIRE CONNECTOR	OFT	OUTDOOR FAN THERMOSTAT
CPR	COMPRESSOR	ODS	OUTDOOR TEMPERATURE SENSOR
CR	RUN CAPACITOR	ODT	OUTDOOR THERMOSTAT
CS	STARTING CAPACITOR	RHS	RESISTANCE HEAT SWITCH
CSR	CAPACITOR SWITCHING RELAY	SC	SWITCHOVER VALVE SOLENOID
DFC	DEFROST CONTROL	SM	SYSTEM "ON-OFF" SWITCH
F	INDOOR FAN RELAY	TDL	DISCHARGE LINE THERMOSTAT
HA	HEATING ANTICIPATOR	TDR	TIME DELAY RELAY (5 SEC DELAY ON)
HPCO	HIGH PRESSURE CUTOUT SW.	TNS	TRANSFORMER
IOL	INTERNAL OVERLOAD PROTECTOR	TS	HEATING-COOLING THERMOSTAT
ACR	A/C RECTIFIER	TSH	HEATING THERMOSTAT

⚠ WARNING	⚠ CAUTION
HAZARDOUS VOLTAGE! DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING. FAILURE TO DISCONNECT POWER BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH!	USE COPPER CONDUCTORS ONLY! UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS. FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT!



COLOR OF WIRE
BK/BL BLACK WIRE WITH BLUE MARKER
COLOR OF MARKER

BK	BLACK	OR	ORANGE	YL	YELLOW
BL	BLUE	RD	RED	GR	GREEN
BR	BROWN	WH	WHITE	PR	PURPLE

NOTES:

1. BE SURE POWER SUPPLY AGREES WITH EQUIPMENT NAMEPLATE.
2. POWER WIRING AND GROUNDING OF EQUIPMENT MUST COMPLY WITH LOCAL CODES.
3. LOW VOLTAGE WIRING TO BE NO. 18 AWG MINIMUM CONDUCTOR.
4. IF OUTDOOR THERMOSTAT (ODT) IS NOT USED, CONNECT W2 TO W3.
5. WITH Y1 ENERGIZED, INDOOR FAN IS 1ST STAGE AIRFLOW.
6. WITH Y1 & Y2 ENERGIZED, INDOOR FAN IS 2ND STAGE AIRFLOW.
7. SEE AIR HANDLER INSTALLER GUIDE FOR DIP SWITCH CONFIGURATIONS.

FOR CANADIAN INSTALLATIONS
POUR INSTALLATIONS CANADIENNES

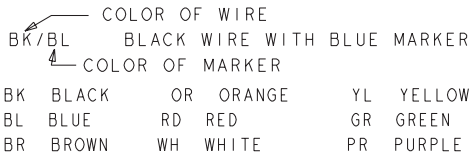
CAUTION: NOT SUITABLE FOR USE ON SYSTEMS EXCEEDING 150V-TO-GROUND.
ATTENTION: NE CONVIENT PAS AUX INSTALLATIONS DE PLUS DE 150 V A LA TERRE.

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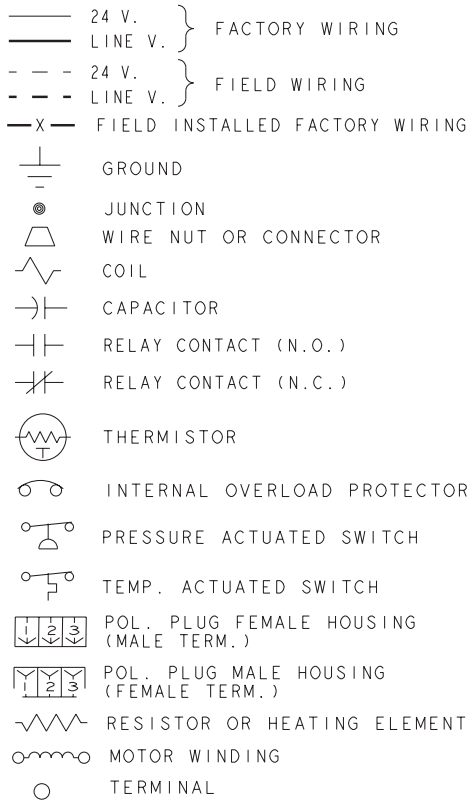
Electrical Data

Schematic Diagrams

LEGEND



BK	BLACK	OR	ORANGE	YL	YELLOW
BL	BLUE	RD	RED	GR	GREEN
BR	BROWN	WH	WHITE	PR	PURPLE

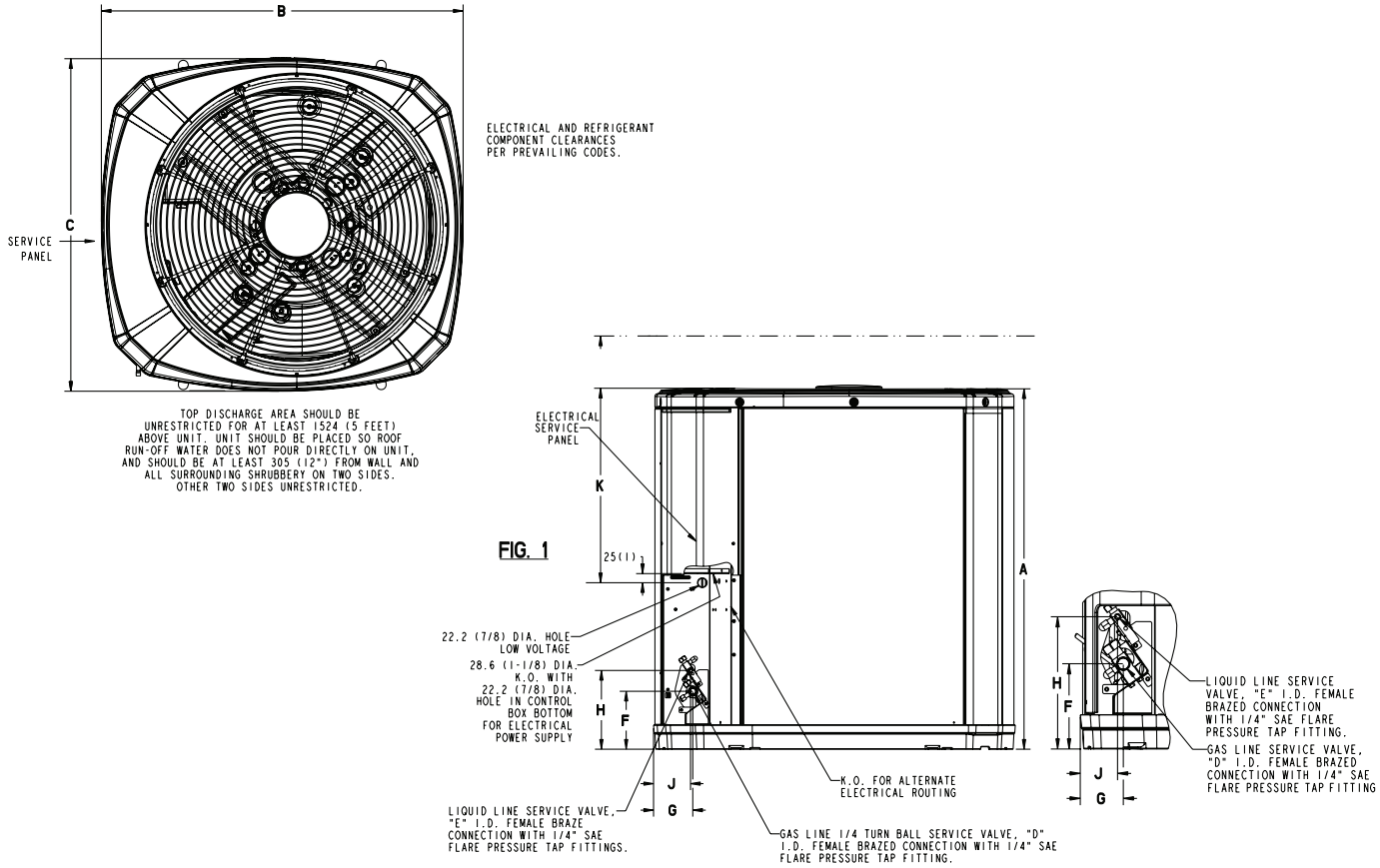


CA	COOLING ANTICIPATOR	LPCO	LOW PRESSURE CUTOUT SW.
CBS	COIL BOTTOM SENSOR	MS	COMPRESSOR MOTOR CONTACTOR
CF	FAN CAPACITOR	ODA	OUTDOOR ANTICIPATOR
CN	WIRE CONNECTOR	OFT	OUTDOOR FAN THERMOSTAT
CPR	COMPRESSOR	ODS	OUTDOOR TEMPERATURE SENSOR
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CS	STARTING CAPACITOR	RHS	RESISTANCE HEAT SWITCH
CSR	CAPACITOR SWITCHING RELAY	SC	SWITCHOVER VALVE SOLENOID
DFC	DEFROST CONTROL	SM	SYSTEM "ON-OFF" SWITCH
F	INDOOR FAN RELAY	TDL	DISCHARGE LINE THERMOSTAT
HA	HEATING ANTICIPATOR	TNS	TRANSFORMER
HPCO	HIGH PRESSURE CUTOUT SW.	TS	HEATING-COOLING THERMOSTAT
IOL	INTERNAL OVERLOAD PROTECTOR	TSH	HEATING THERMOSTAT

Dimensions

4TTR7 Outline Drawing

Note: All dimensions are in MM (Inches).



MODELS	BASE	A	B	C	D	E	F	G	H	J	K
4TTR7024A	4	1045 (41 1/8)	946 (37-1/4)	870 (34-1/4)	5/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	711 (28)
4TTR7036A	4	1147 (45 1/8)	946 (37-1/4)	870 (34-1/4)	3/4	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)
4TTR7048A	4	1147 (45 1/8)	946 (37-1/4)	870 (34-1/4)	7/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)
4TTR7060A	4	1147 (45 1/8)	946 (37-1/4)	870 (34-1/4)	1-1/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)

From Dwg. D152635

Mechanical Specifications

General
The 4TTR7 is fully charged from the factory for matched indoor section and up to 15 feet of piping. This unit is designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities are matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit shall be certified to UL 1995. Exterior is designed for outdoor application.

Casing
Unit casing is constructed of heavy gauge, G60 galvanized steel and painted with a weather-resistant powder paint on all louvers and panels. Corrosion and weatherproof CMBP-G30 DuraTuff™ base.

Refrigerant Controls
Refrigeration system controls include condenser fan, compressor contactor and high pressure switch. High and low pressure controls are inherent to the compressor. A factory installed liquid line drier is standard.

Compressor
The Climatuff® 2-stage compressor features internal over temperature and pressure protection and hermetic motor. Other features include: centrifugal oil pump and modular plugs for electrical connections.

Condenser Coil
The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

Low Ambient Cooling
As manufactured, this unit has a cooling capability to 55°F. For low ambient cooling below 55° see Application Guide.







05/19

Trane *has a policy of continuous product and product data improvement* ***and*** *it reserves the right to change design and specifications without notice.*

Trane
www.trane.com

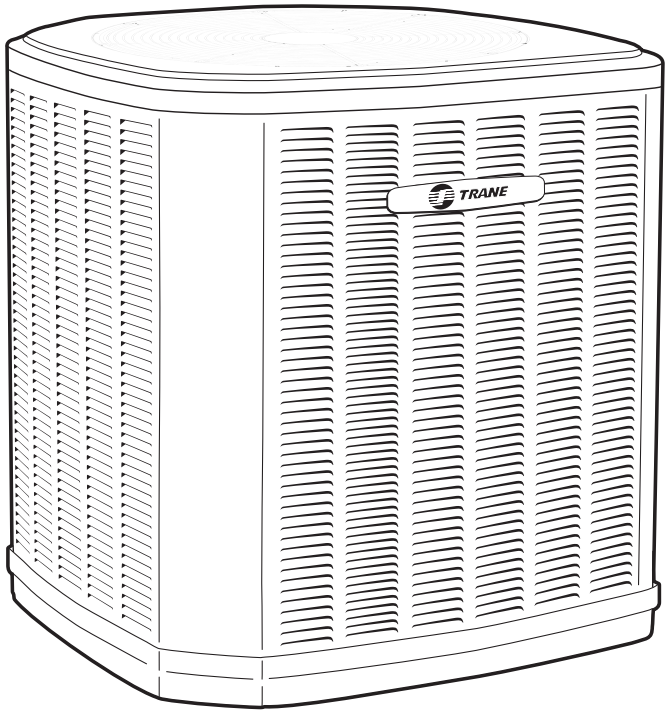
TRANE®

Split System Cooling Product Data

XR17

4TTR7048B

4 Ton



PUB. NO. 22-1942-1B-EN

Features and Benefits

- **CLIMATUFF**™ 2-stage scroll compressor
- Efficiency up to **18.0 SEER**
- All Aluminum **SPINE FIN**™ coil
- **DURATUFF**™ weather proof and rust proof base
- **COMFORT "R"**™ mode approved for better comfort indoors
- **QUICK-SESS**™ cabinet, service access and refrigerant connections with full coil protection
- **WEATHERGUARD**™ fasteners
- Glossy corrosion resistant finish tarpaulin gray cabinet with anthracite gray top
- Internal compressor high/low pressure & temperature protection
- Liquid line filter/drier
- Low sound with advanced PSC fan motor
- Service valve cover
- R-410A refrigerant
- From 70 to 100% capacity modulation
- 100% run test in the factory
- Low ambient cooling to 55° as shipped

- **Extended warranties available**

Contents

Features and Benefits 2

General Data 4

- Product Specifications 4
- A-weighted Sound Power Level [dB(A)] 4
- Accessory Description and Usage 5
- AHRI Standard Capacity Rating Conditions 5

Model Nomenclature 6

Electrical Data 7

Dimensions 8

Mechanical Specifications 9

General Data

Product Specifications

Model No. ①	4TTR7048B1000A
Electrical Data V/Ph/Hz ②	208/230/1/60
Min Cir Ampacity	28
Max Fuse Size (Amps)	45
Compressor	CLIMATUFF® - SCROLL
No. Compress. – No. Stages	1-2
RL AMPS - LR AMPS	20.4 - 122
Outdoor Fan FL Amps	2.8
Fan HP	1/3
Fan Dia (inches)	27.6
Coil	Spine Fin™
Refrigerant R-410A	13/3-LB/OZ
Line Size - (in.) O.D. Gas ③	7/8
Line Size - (in.) O.D. Liquid ③	3/8
Dimensions H x W x D (Crated)	51.0 x 35.1 x 38.7
Weight - Shipping	296
Weight - Net	259
Start Components	NO
Sound Enclosure	NO
Compressor Sump Heat	NO
Optional Accessories: ④	
Rubber Isolator Kit	BAYISLT101
Snow Leg - Base & Cap 4" High	BAYLEGS002
Snow Leg - 4" Extension	BAYLEGS003
Hard Start Kit Scroll	BAYKSKT266
Crankcase Heater Kit	BAYCCHT301
Extreme Condition Mounting Kit	BAYECMT004
Vertical Discharge Air Kit Base 4	BAYVDTA004
Auto Charge Solenoid Kit	BAYCAKT001
Refrigerant Lineset ⑤	TAYREFLN3*

① Certified in accordance with the Air-Source Unitary Heat Pump Equipment certification program which is based on AHRI Standard 210/240.
② Calculated in accordance with N.E.C. Only use HACR circuit breakers or fuses.
③ Standard line lengths - 60'. Standard lift - 25' Suction and Liquid line.
For Greater lengths and lifts refer to refrigerant piping software Pub# 32-3312-0†. (†denotes latest revision)
④ For accessory description and usage, see page 5.
⑤ * = 15, 20, 25, 30, 40 and 50 foot lineset available.

Accessory Description and Usage

Rubber Isolators — 5 rubber donuts to isolate condensing unit from mounting frame or pad. Use on any application where sound transmission needs to be minimized.

Extreme Conditions Mounting Kit — Bracket kits to securely mount condensing unit to a frame or pad without removing any panels. Use in areas with high winds, or on commercial rooftops, etc.

Low Ambient Cooling — For low ambient cooling below 55° see Application Guide APP-APG013-EN.

AHRI Standard Capacity Rating Conditions

AHRI STANDARD 210/240 RATING CONDITIONS —
(A) Cooling 80°F DB, 67°F WB air entering indoor coil, 95°F DB air entering outdoor coil.
(B) High Temperature Heating 47°F DB, 43°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
(C) Low Temperature Heating 17°F DB, 15°F WB air entering outdoor coil, 70°F DB air entering indoor coil.
(D) Rated indoor airflow for heating is the same as for cooling.

AHRI STANDARD 270 RATING CONDITIONS — (Noise rating numbers are determined with the unit in cooling operation.) Standard Noise Rating number is at 95°F outdoor air.

Sound Power Level

Model	A-Weighted Sound Power Level [dB(A)]	Full Octave Sound Power [dB]							
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
4TTR7048B	73	70	67	68	66	63	56	53	49

Note: Rated in accordance with AHRI Standard 270-2008

Dimensions

4TTR7 Outline Drawing

Note: All dimensions are in MM (Inches).

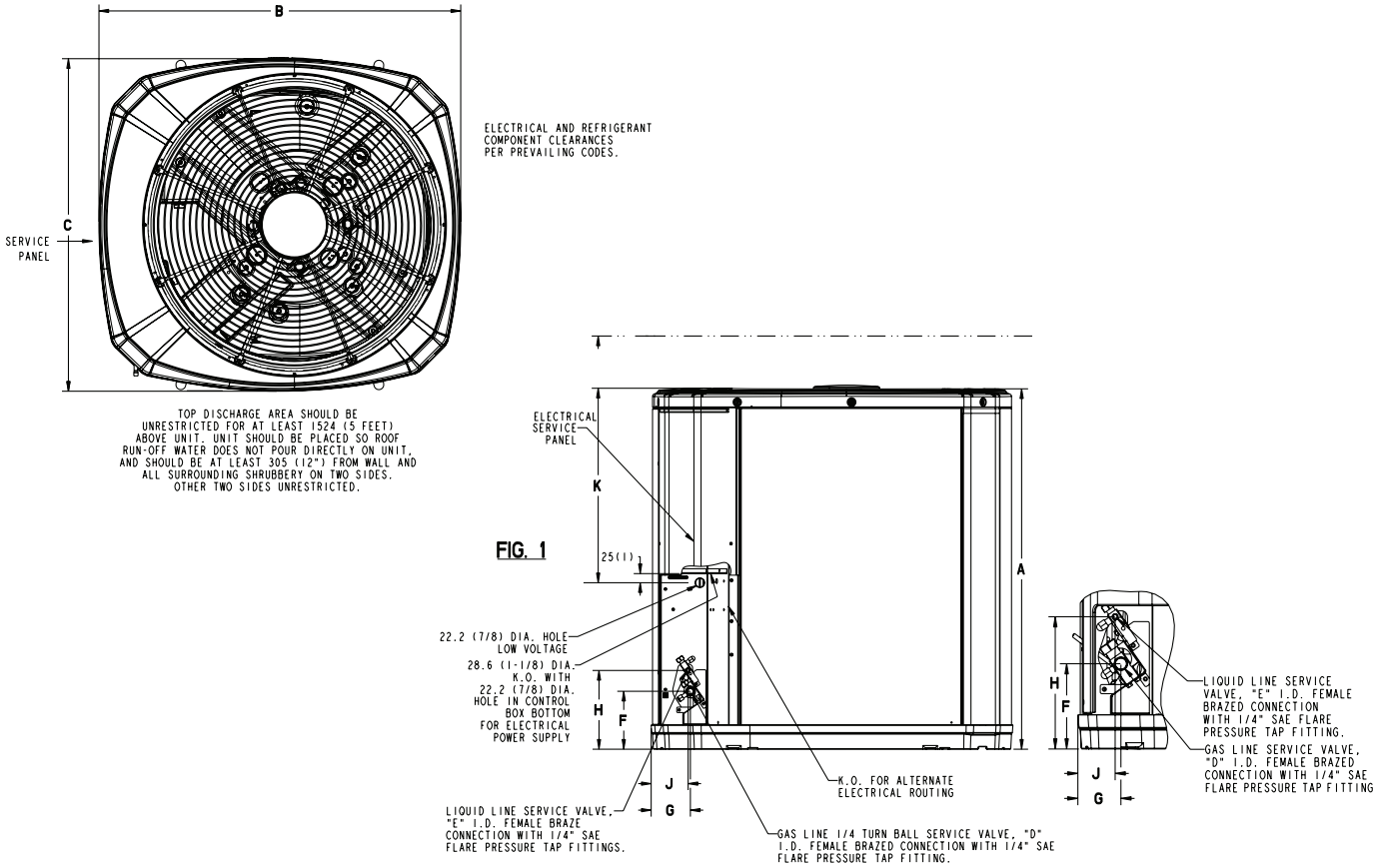


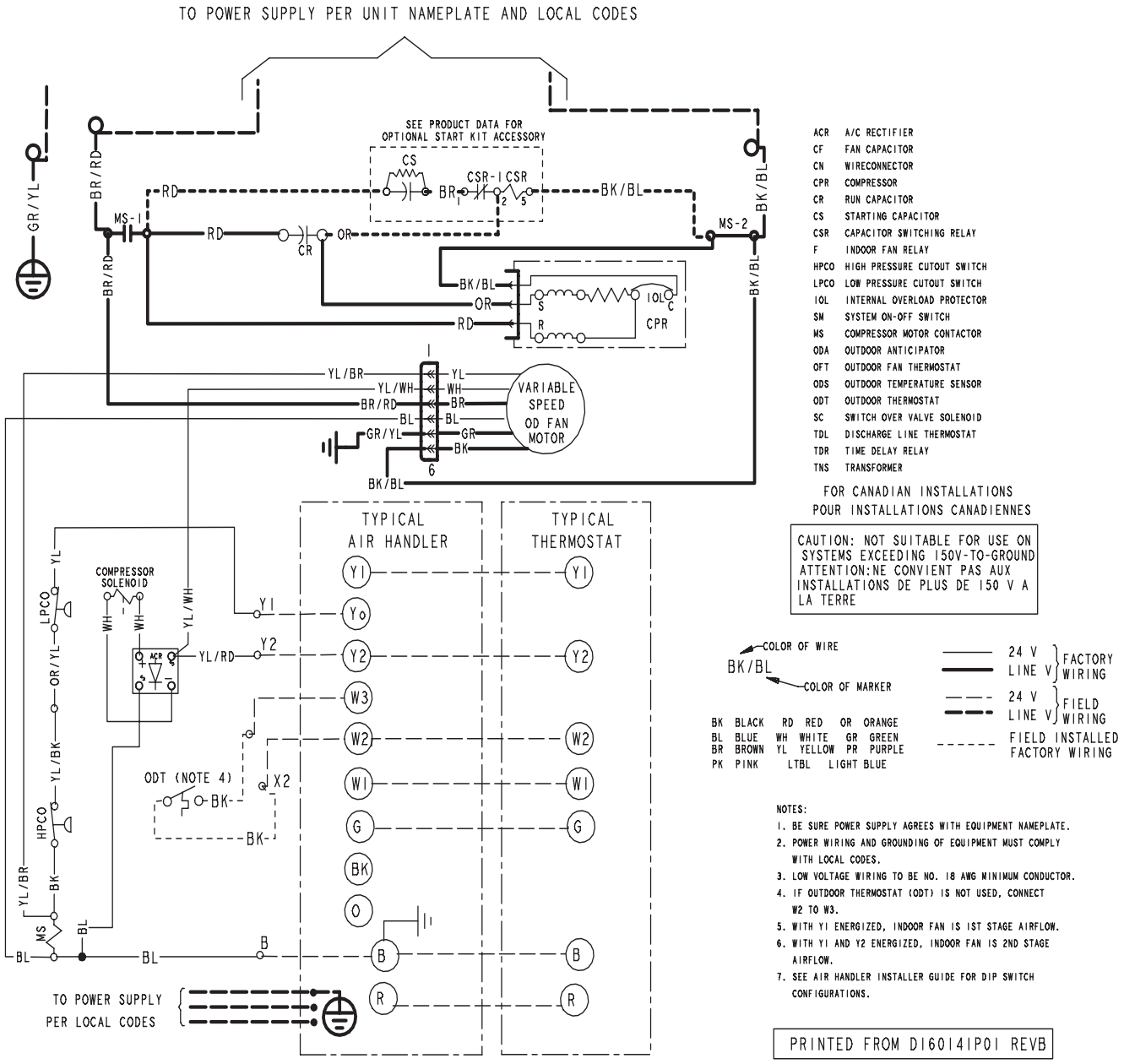
FIG. 1

MODELS	BASE	A	B	C	D	E	F	G	H	J	K
4TTR7048B	4	1147 (45 1/8)	946 (37-1/4)	870 (34-1/4)	7/8	3/8	152 (6)	98 (3-7/8)	219 (8-5/8)	86 (3-3/8)	813 (32)

From Dwg. D152635

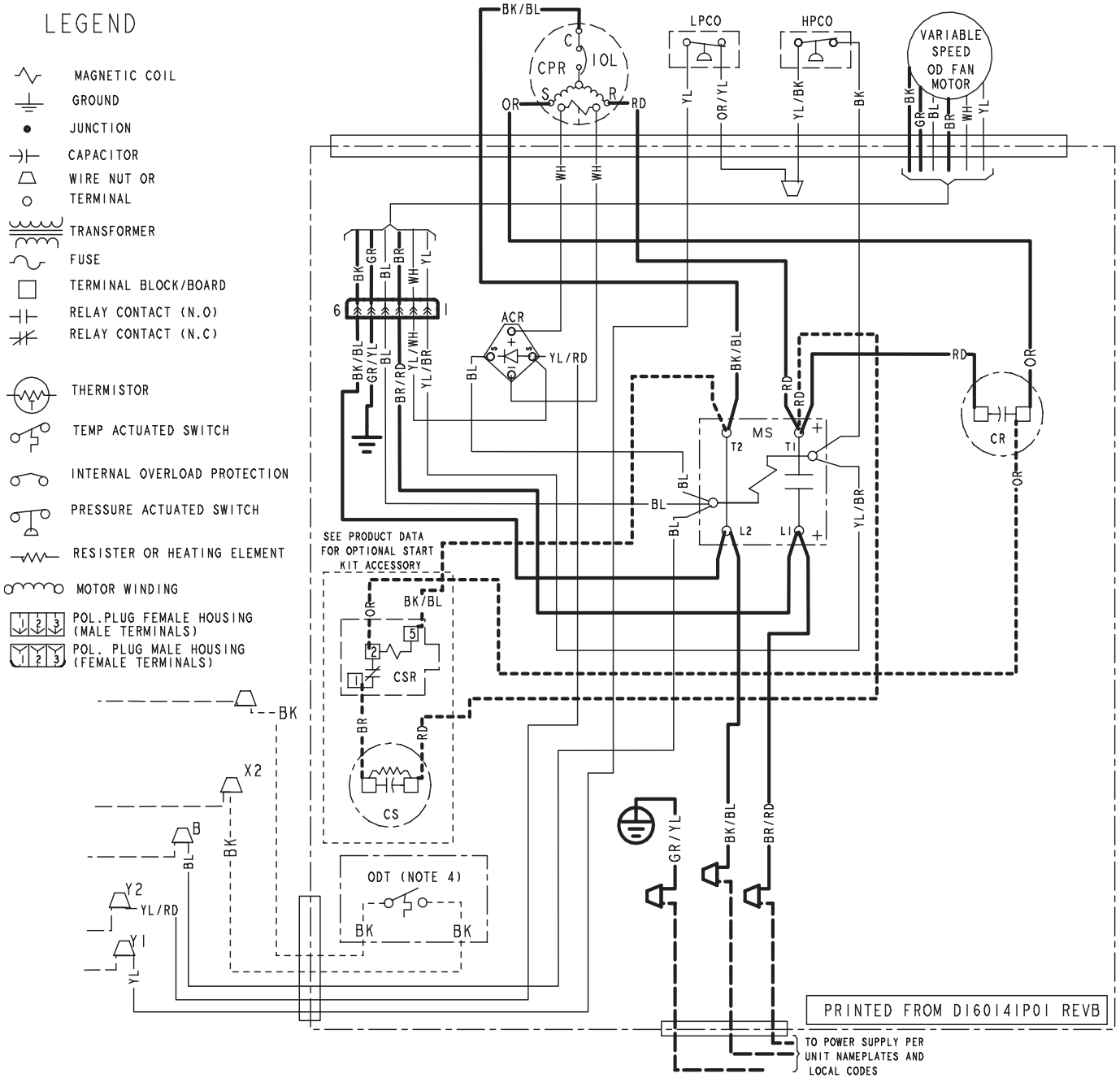
Electrical Data

Schematic Diagram



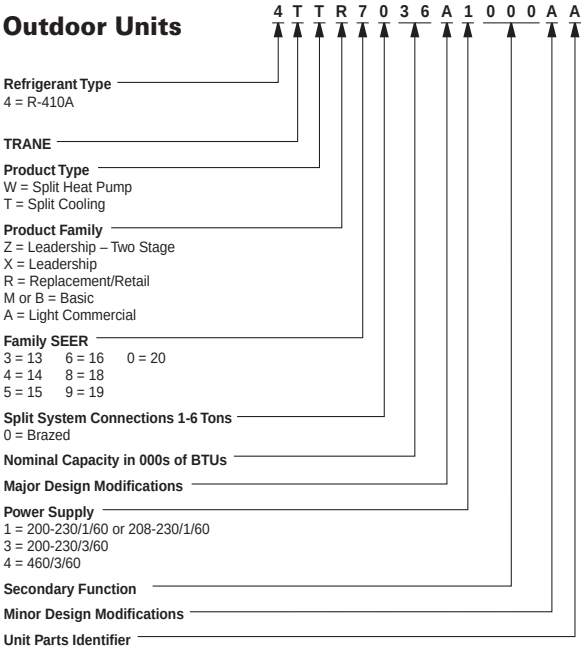
Electrical Data

Wiring Diagram

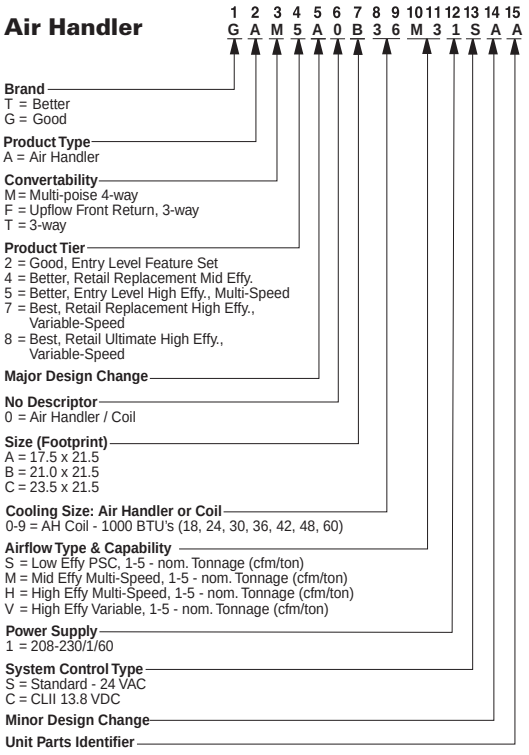


Model Nomenclature

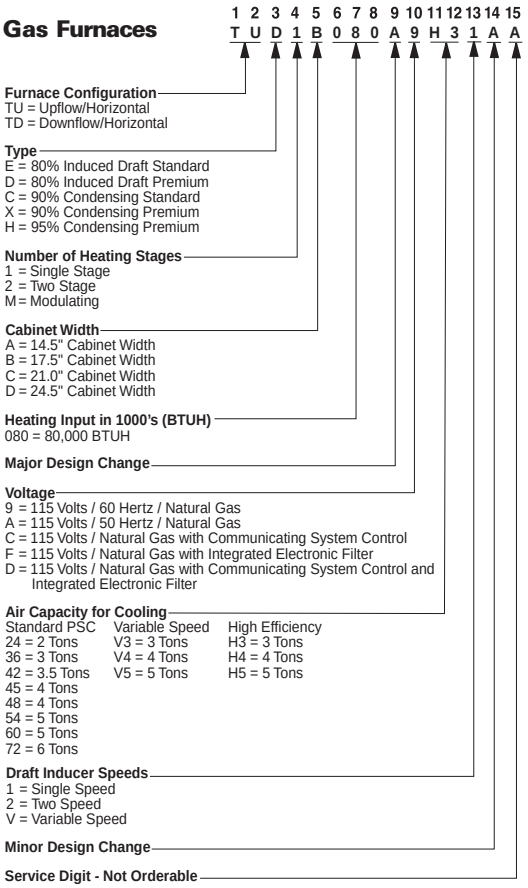
Outdoor Units



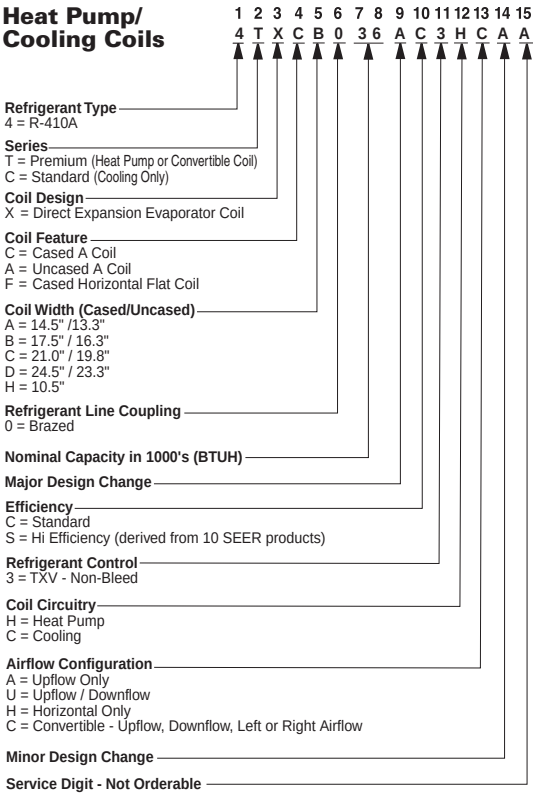
Air Handler



Gas Furnaces



Heat Pump/ Cooling Coils



General
The 4TTR7 is fully charged from the factory for matched indoor section and up to 15 feet of piping. This unit is designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities are matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit shall be certified to UL 1995. Exterior is designed for outdoor application.

Casing
Unit casing is constructed of heavy gauge, G60 galvanized steel and painted with a weather-resistant powder paint on all louvers and panels. Corrosion and weatherproof CMBP-G30 DuraTuff™ base.

Refrigerant Controls
Refrigeration system controls include condenser fan, compressor contactor and high pressure switch. High and low pressure controls are inherent to the compressor. A factory installed liquid line drier is standard.

Compressor
The Climatuff® 2-stage compressor features internal over temperature and pressure protection and hermetic motor. Other features include: centrifugal oil pump and modular plugs for electrical connections.

Condenser Coil
The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

Low Ambient Cooling
As manufactured, this unit has a cooling capability to 55°F. For low ambient cooling below 55° see Application Guide.

AHRI CERTIFIED™ www.ahridirectory.org
Unitary Small AC
AHRI Standard 210/240
Certification applies only when the complete system is listed with AHRI.

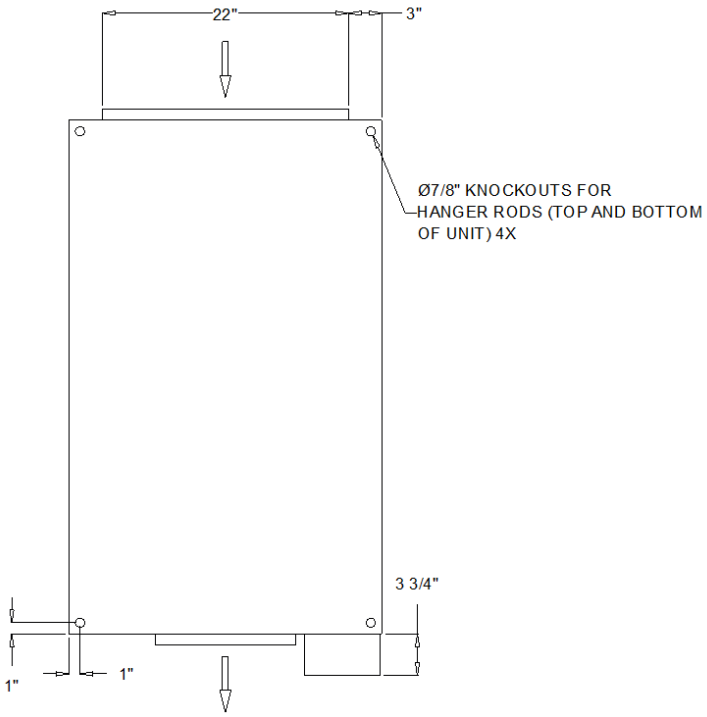
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Intertek

TRANE®

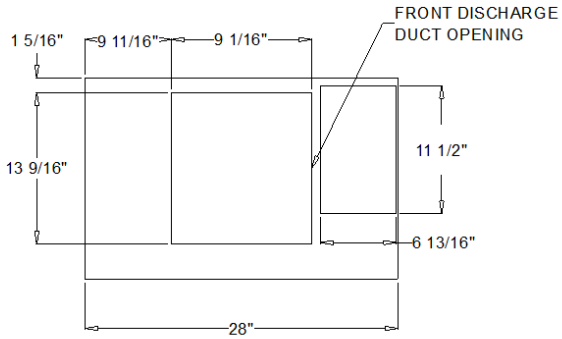
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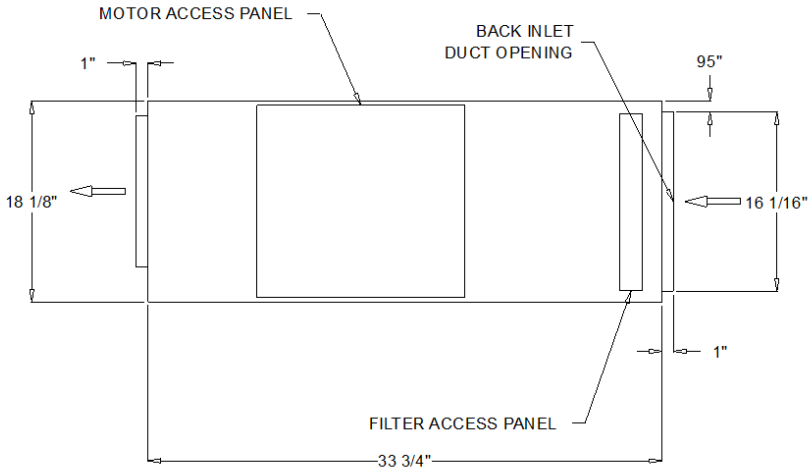
Trane *has a policy of continuous product and product data improvement* ***and*** *it reserves the right to change design and specifications without notice.*



TOP VIEW



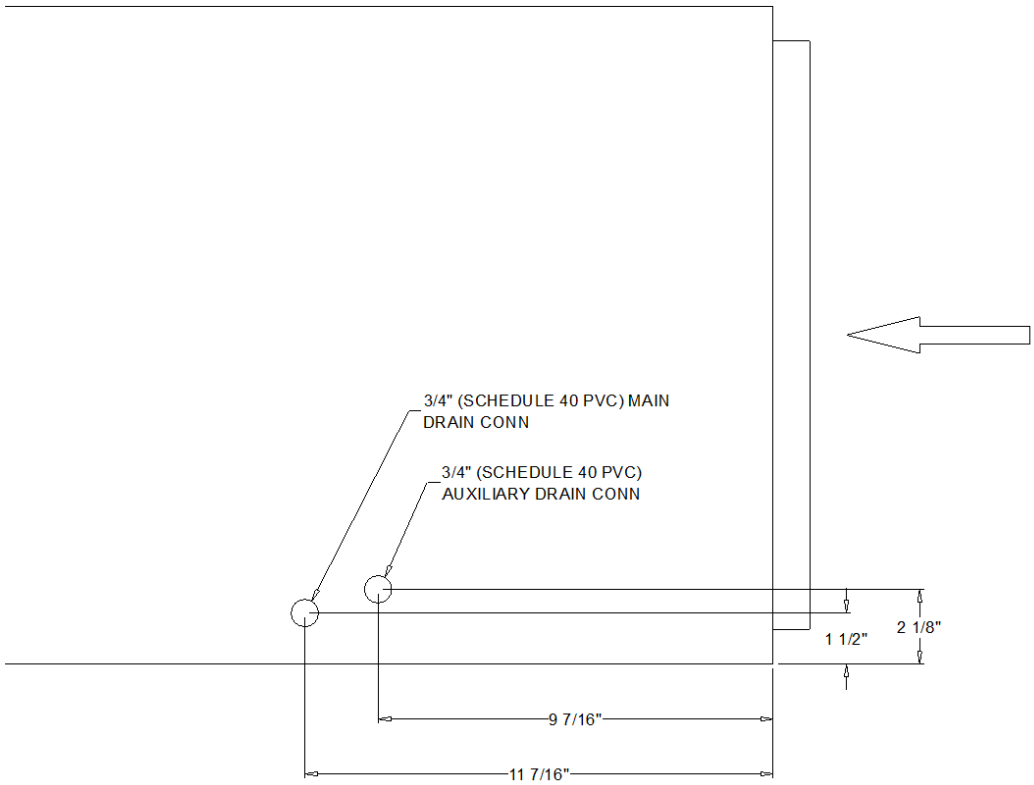
FRONT VIEW



RIGHT VIEW

NOTES:
1. ACCESS PANELS ARE LOCATED ON BOTH SIDES OF THE UNIT TO PROVIDE ACCESS TO THE UNIT'S INTERNAL COMPONENTS.

2. CONTROL BOX IS FACTORY MOUNTED ON DRIVE SIDE AND PROVIDED WITH 7/8" DIAMETER KNOCKOUTS FOR FIELD WIRING.
3. ARROWS INDICATE THE DIRECTION OF AIRFLOW.



RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE SHOWN FROM THE BOTTOM REAR CORNER OF UNIT.
2. STUBOUTS PROTRUDE 2 1/8" FROM EXTERIOR CASING OF UNIT.
3. ARROW INDICATES THE DIRECTION OF AIRFLOW.
4. DRAIN CONNECTIONS ARE UNTHREADED.

NOTES:

1. WEIGHT OF BASIC UNIT INCLUDES ONLY CABINET, FAN, AVERAGE DRIVE, WIRING AND AVERAGE FILTER.

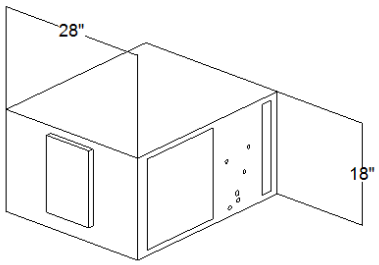
2. WEIGHT OF STEAM COIL MODULE INCLUDES ONLY CABINET WITH AVERAGE FILTER.

3. BEFORE PREPARING ANY UNIT OR ACCESSORY MODULE FOR LIFTING, ESTIMATE THE APPROXIMATE CENTER OF GRAVITY AND TEST LIFT THE UNIT OR ACCESSORY MODULE TO DETERMINE BALANCE AND STABILITY. USE A PROPER RIGGING METHOD SUCH AS STRAPS, SLINGS OR SPREADER BARS FOR PROTECTION AND SAFETY BEFORE HOISTING THE UNIT OR ACCESSORY MODULE.

4. DO NOT LIFT UNITS OR ACCESSORY MODULES IN WINDY CONDITIONS OR ABOVE INSTALLATION PERSONNEL. FAILURE TO PROPERLY LIFT UNIT OR ACCESSORY MODULE COULD RESULT IN DEATH, SERIOUS INJURY, EQUIPMENT DAMAGE OR PROPERTY-ONLY DAMAGE.

5. DO NOT RIG OR LIFT UNITS OR ACCESSORY MODULES WITH FORK LIFT FORKS.

6. ASSEMBLY OF THE UNIT MUST BE PERFORMED AT THE INSTALLATION SITE. ALWAYS RIG UNITS AND ACCESSORY MODULES AS SHIPPED FROM THE FACTORY.



ISO1 VIEW

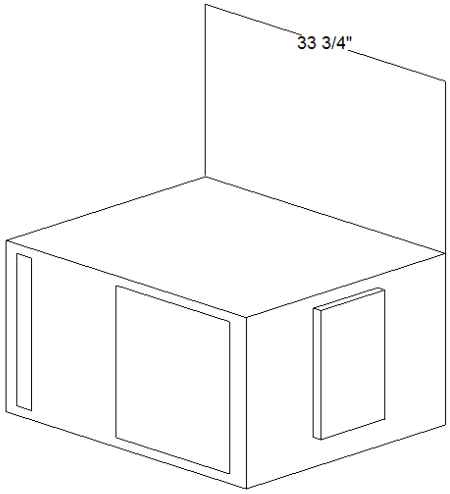
UNIT, COIL & ACCESSORY MODULE WEIGHTS

BASIC UNIT	COIL 1 DRY	COIL 1 WET	COIL 2 DRY	COIL 2 WET	MOTOR	ELECTRIC HEATER	MIXING BOX	ANGLED FILTER BOX	ANGLED FILTER MIXING BOX
89.6 lb	6.6 lb	7.8 lb	24.7 lb		14.0 lb				

FILTER ACCESS MODULE	STEAM COIL MODULE

STEAM COIL DRY	STEAM COIL WET

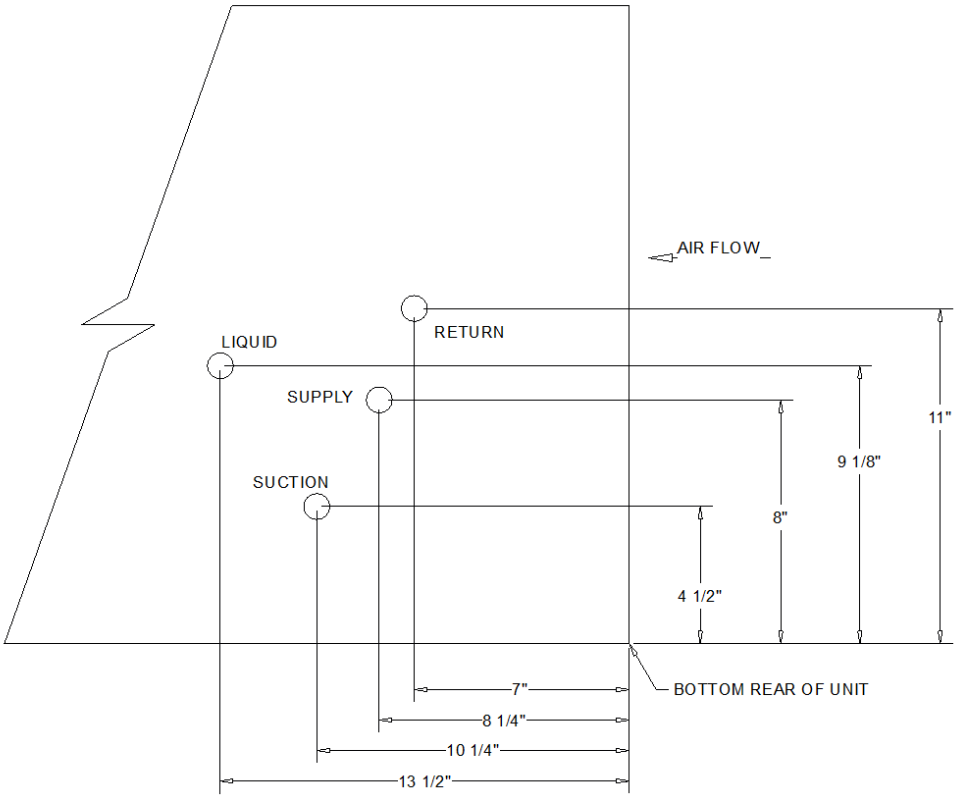
UNIT SIZE	SERVICE CLEARANCE
24	25"



ISO2 VIEW

MAIN UNIT COIL CONNECTIONS

RETURN	5/8"
SUPPLY	5/8"
SUCTION	7/8"
LIQUID	5/8"



NOTES:

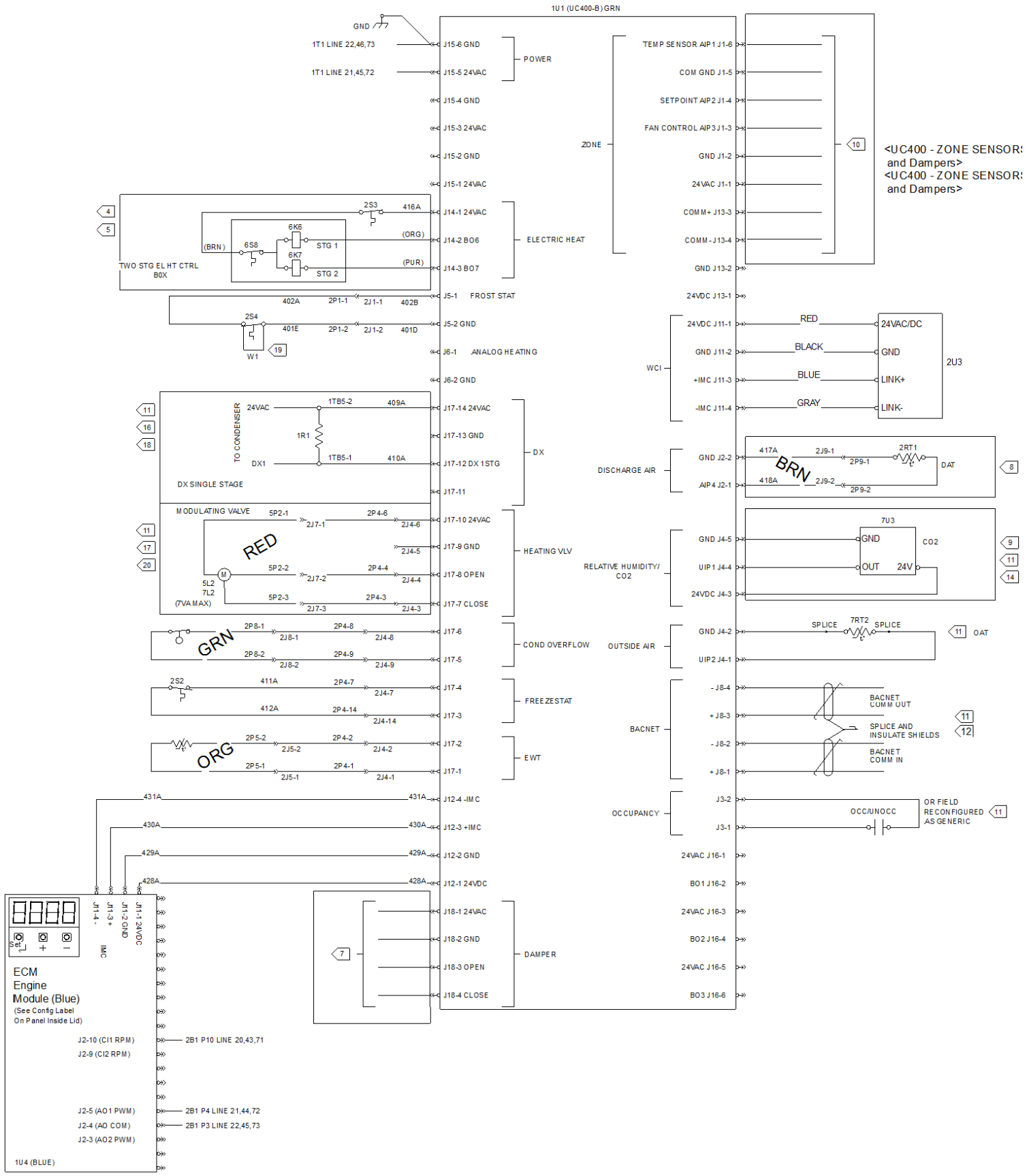
1. PICTORIAL HEADER STUBOUT LOCATIONS RELATIVE TO EACH OTHER MAY NOT BE ACCURATE.

2. LOCATING DIMENSIONS HAVE A PLUS / MINUS 2" TOLERANCE.

3. FOR UNITS WITH A FILTER ACCESS MODULE, ADD 7 3/16" TO HORIZONTAL DIMENSIONS SHOWN.

4. PIPING CONNECTIONS ARE SPECIFIED AS OUTSIDE DIAMETER (O.D.).

5. THERMAL EXPANSION VALVE IS TO BE FIELD SUPPLIED FOR DX COOLING.

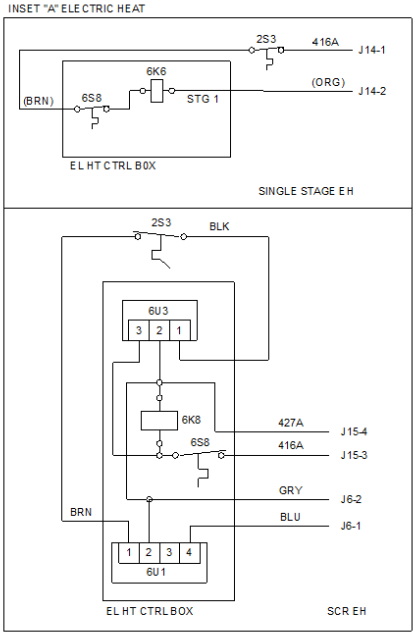

1U1 (UC400-B) GRN
GND
1T1 LINE 22,46,73
1T1 LINE 21,45,72
J15-6 GND
J15-5 24VAC
POWER
J15-4 GND
J15-3 24VAC
J15-2 GND
J15-1 24VAC
ZONE
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
GND J1-2
24VAC J1-1
COMM+ J13-3
COMM- J13-4
GND J13-2
24VDC J13-1
<UC400 - ZONE SENSORS and Dampers>
<UC400 - ZONE SENSORS and Dampers>
2S3
416A
J14-1 24VAC
(ORG)
J14-2 BO6
ELECTRIC HEAT
(PUR)
J14-3 BO7
6K6
6K7
6S8
(BRN)
STG 1
STG 2
TWO STG EL HT CTRL B0X
402A
2P1-1
2J1-1
402B
J5-1 FROST STAT
2S4
401E
2P1-2
2J1-2
401D
J5-2 GND
W1
J6-1 ANALOG HEATING
J6-2 GND
WCI
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
RED
BLACK
BLUE
GRAY
24VAC/DC
GND
LINK+
LINK-
2U3
TO CONDENSER
24VAC
1TB5-2
409A
1R1
DX1
1TB5-1
410A
J17-14 24VAC
J17-13 GND
J17-12 DX 1STG
J17-11
DX
DX SINGLE STAGE
DISCHARGE AIR
GND J2-2
AIP4 J2-1
417A
418A
2J9-1
2J9-2
2P9-1
2P9-2
2RT1
BRN
DAT
MODULATING VALVE
5P2-1
2J7-1
2P4-6
2J4-6
J17-10 24VAC
RED
2J4-5
J17-9 GND
5P2-2
2J7-2
2P4-4
2J4-4
J17-8 OPEN
5L2
7L2
(7VA MAX)
5P2-3
2J7-3
2P4-3
2J4-3
J17-7 CLOSE
HEATING VLV
7U3
GND
OUT
24V
CO2
RELATIVE HUMIDITY/ CO2
GND J4-5
UIP1 J4-4
24VDC J4-3
2P8-1
2J8-1
2P4-8
2J4-8
J17-6
GRN
2P8-2
2J8-2
2P4-9
2J4-9
J17-5
COND OVERFLOW
SPLICE
7RT2
SPLICE
OAT
OUTSIDE AIR
GND J4-2
UIP2 J4-1
2S2
411A
2P4-7
2J4-7
J17-4
412A
2P4-14
2J4-14
J17-3
FREEZESTAT
BACNET
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET COMM OUT
SPLICE AND INSULATE SHIELDS
BACNET COMM IN
2P5-2
2J5-2
2P4-2
2J4-2
J17-2
ORG
2P5-1
2J5-1
2P4-1
2J4-1
J17-1
EWT
OCCUPANCY
J3-2
J3-1
OCC/UNOCC
OR FIELD RECONFIGURED AS GENERIC
431A
430A
429A
428A
J12-4 -IMC
J12-3 +IMC
J12-2 GND
J12-1 24VDC
24VAC J16-1
BO1 J16-2
24VAC J16-3
BO2 J16-4
24VAC J16-5
BO3 J16-6
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER
J1-4 -
J1-3 +
J1-2 GND
J1-1 24VDC
IMC
Set
ECM
Engine
Module (Blue)
(See Config Label On Panel Inside Lid)
J2-10 (CI1 RPM)
J2-9 (CI2 RPM)
J2-5 (AO1 PWM)
J2-4 (AO COM)
J2-3 (AO2 PWM)
2B1 P10 LINE 20,43,71
2B1 P4 LINE 21,44,72
2B1 P3 LINE 22,45,73
1U4 (BLUE)

NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

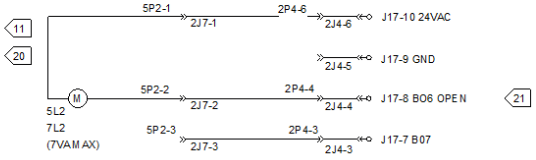
4. ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.
5. WIRING SHOWN IS FOR TWO STAGE ELECTRIC HEAT. SEE INSET "A" FOR SINGLE STAGE EH AND SCR ELECTRIC HEAT.
7. SEE SHEET 2311-4130 FOR DAMPER CONNECTIONS.
8. WIRING SHOWN IS FOR FACTORY INSTALLED DISCHARGE AIR SENSOR. FOR FIELD INSTALLED DISCHARGE AIR SENSOR SEE INSET "E".
9. WIRING SHOWN IS FOR CO2 SENSOR FOR RELATIVE HUMIDITY SENSOR SEE INSET "F".
10. SEE SHEET "UC400 - ZONE SENSORS and DAMPERS" FOR ZONE SENSOR CONNECTIONS.
11. USE CLASS TWO WIRING.
12. COMMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN. CAUTION DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.
14. CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.
16. WIRING SHOWN IS FOR SINGLE STAGE DX SELECTION. SEE INSET "B" FOR DUAL STAGE DX SELECTION.
17. WIRING SHOWN IS FOR MODULATING HEATING VALVE SELECTION. SEE INSET "C" FOR OTHER HEATING VALVE OPTIONS.
18. FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 1TB5-1 TO 1TB5-2 FOR SINGLE STAGE AND 1TB5-2 TO 1TB5-3 FOR DUAL STAGE. REMOVE RESTISTOR 1R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED FOR 24VAC 6VA MAXIMUM.
19. W1 PRESENT ON BCVD UNITS ONLY. REMOVE W1 PRIOR TO CONNECTING COIL SECTION TO FAN SECTION AND INSTALLING WIRING TO 2S4.
20. FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.
21. VALVES SHOWN IN NORMALLY CLOSED POSITION, FOR NORMALLY OPEN POSITION, THE VALVE SIGNAL BECOMES CLOSE.

INSET "A" ELECTRIC HEAT



INSET "C"

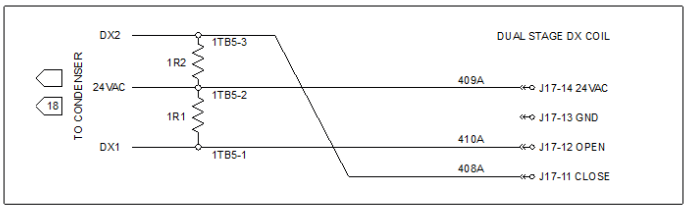
2 POSITION HEATING VALVE



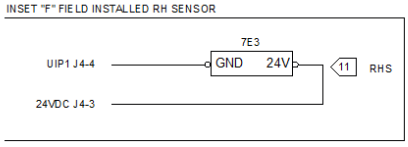
2-10V HEATING VALVE (FIELD SUPPLIED)



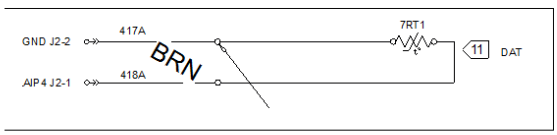
INSET B - DX COILS



INSET "F" FIELD INSTALLED RH SENSOR



INSET "E" FIELD INSTALLED DAT SENSOR



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U4	ENGINE BOARD	115
2S3	EL HT LOCKOUT SWITCH	81,117,122
6K6	CONTACTOR; EL HT STG 1	82,118
6S8	EL HT HIGH TEMP	82,118,127
6K7	CONTACTOR; EL HT STG 2	83
6K8	CONTACTOR; EL HT SCR	126
6U1	CONTACTOR; EL HT SCR	129
6U3	CONTACTOR; EL HT SCR	123
2U3	WIRELESS COM INTERFACE	86
1R1	RESISTOR; DX STG 1 TEST	89,119
1R2	RESISTOR; DX STG 2 TEST	117
5L2	HEATING COIL VALVE MOTOR	94,120
7L2	HEATING COIL VALVE MOTOR	94,120,128
2RT1	DISCHARGE AIR TEMP SNSR	89
7U3	CO2 SENSOR	92
2S1	CONDENSATE OVERFLOW SWTCH	96
7RT2	OUTSIDE AIR TEMP SENSOR	96
2S2	FREEZESTAT	98
5RT1	ENTERING WATER TEMP SENSOR	100
7RT1	FLD INSTLLED DAT SENSOR	134
7E3	ZONE HUMIDITY SENSOR	134
2S4	FROSTSTAT	85

UC400 - ZONE SENSORS and DAMPERS

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
7U1	ZONE SENSOR MODULE	74,75,83,97,105
1U3	WIRELESS RECEIVER	91
4L1	MIXING BX DMPR ACTUATOR	108
7L3	MIXING BX DMPR ACTUATOR	116
7L4	OUTSIDE AIR DMPR ACTUATOR	118

NOTES:

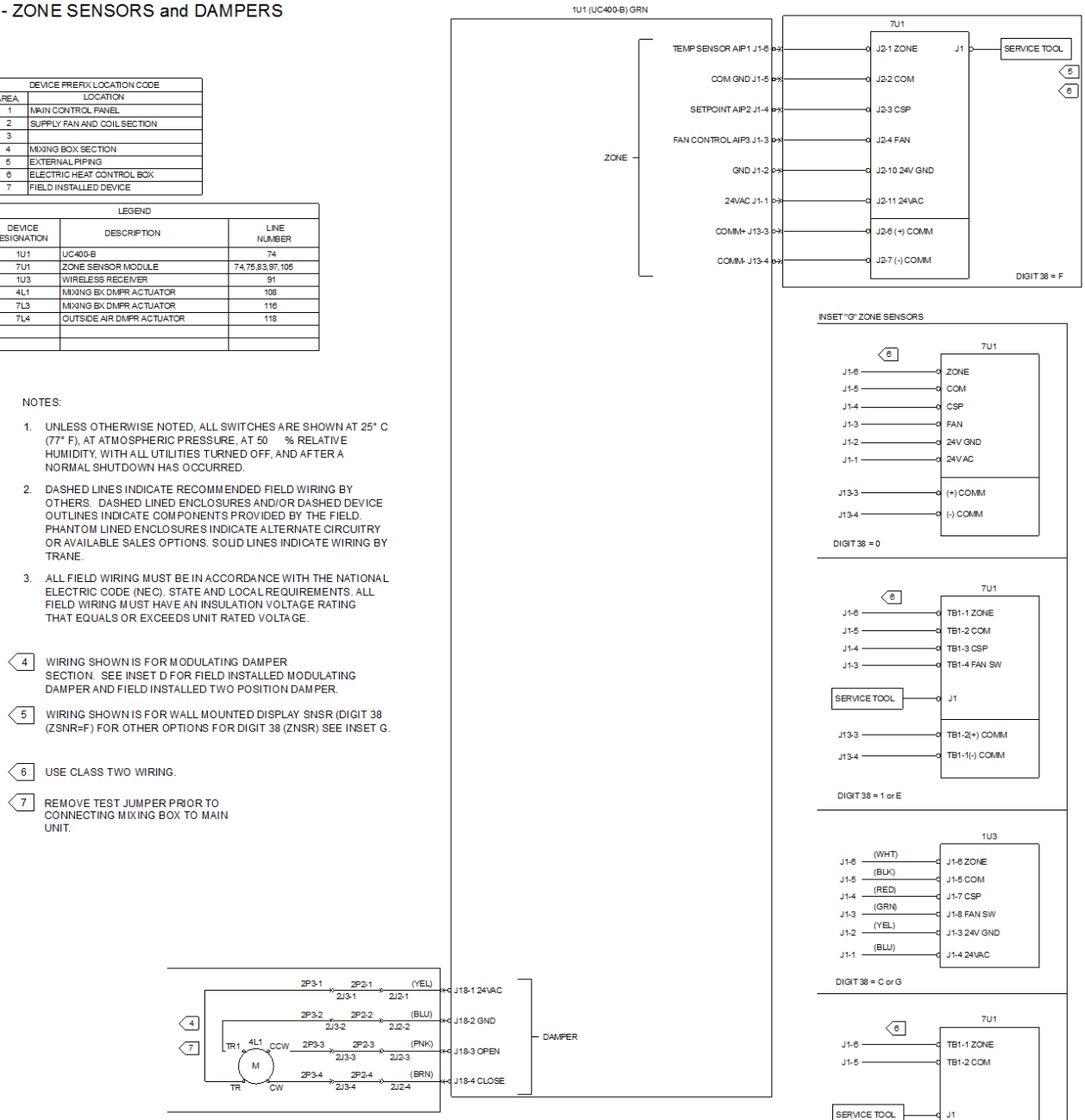
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25° C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

4 WIRING SHOWN IS FOR MODULATING DAMPER SECTION. SEE INSET D FOR FIELD INSTALLED MODULATING DAMPER AND FIELD INSTALLED TWO POSITION DAMPER.

5 WIRING SHOWN IS FOR WALL MOUNTED DISPLAY SNSR (DIGIT 38 (ZSNR=F) FOR OTHER OPTIONS FOR DIGIT 38 (ZNSR) SEE INSET G.

6 USE CLASS TWO WIRING.

7 REMOVE TEST JUMPER PRIOR TO CONNECTING MIXING BOX TO MAIN UNIT.



NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

<4> ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.

<5> WIRING SHOWN IS FOR NO ELECTRIC HEAT. FOR ELECTRIC HEAT SINGLE PHASE SEE INSET A&B. FOR ELECTRIC HEAT THREE PHASE SEE INSET A&C. FOR ELECTRIC HEAT THREE PHASE WITH DRIVER SEE SEE INSET A&D.

<6> CW JUMPER IS PRESENT FROM PIN P5 TO P11 ON UNITS WITH CW MOTOR ROTATION AS VIEWED FROM SHAFT END. JUMPER IS NOT PRESENT ON UNITS WITH CCW ROTATION.

<16> MOTOR VOLTAGE CONFIGURATION P2-P8 JUMPERED FOR 115V OPERATION ONLY.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI- DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

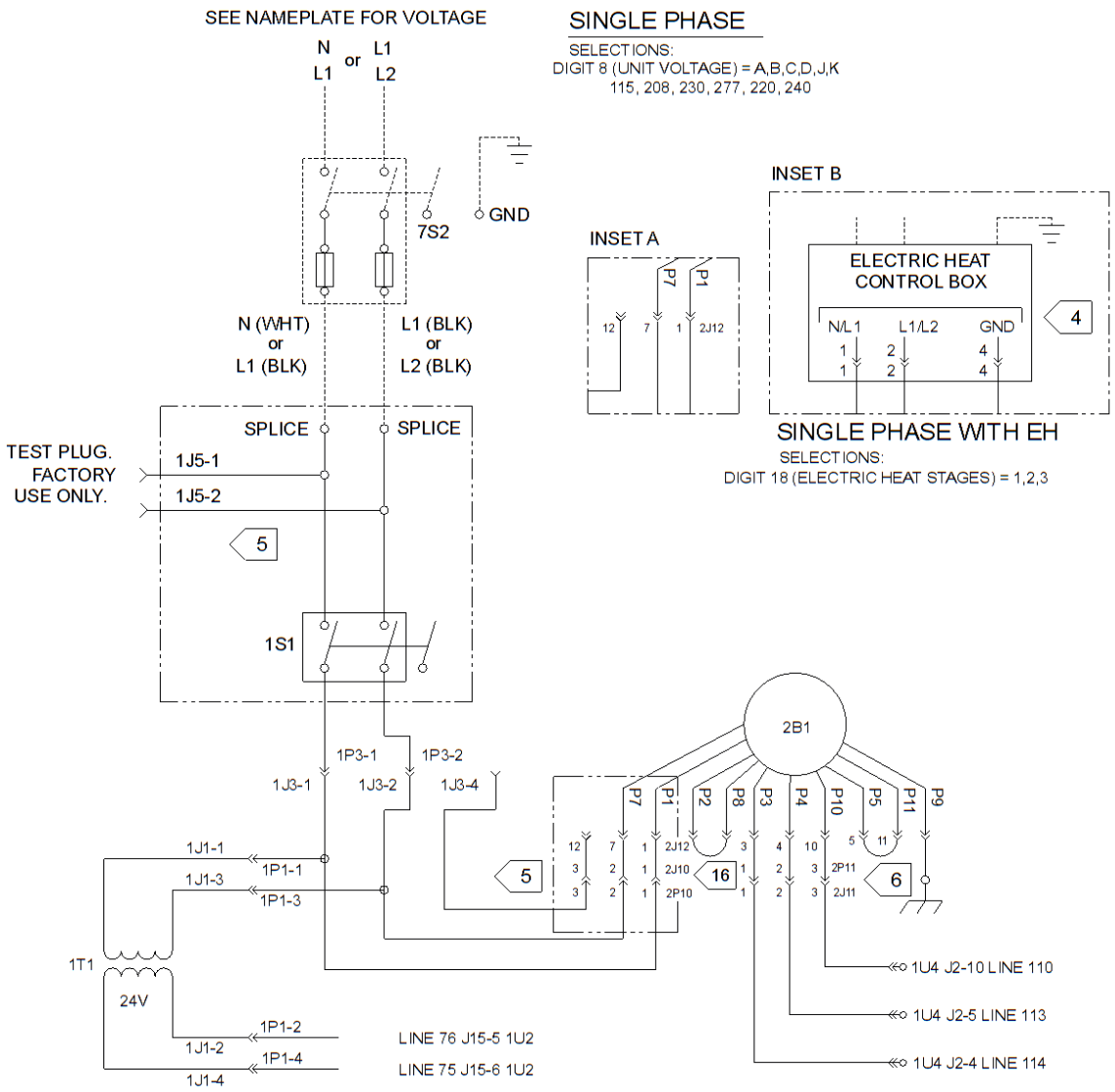
NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCIÓN DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.

EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.



SINGLE PHASE

SELECTIONS:
DIGIT 8 (UNIT VOLTAGE) = A,B,C,D,J,K
115, 208, 230, 277, 220, 240

INSET A

INSET B

SINGLE PHASE WITH EH

SELECTIONS:
DIGIT 18 (ELECTRIC HEAT STAGES) = 1,2,3

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SINGLE PHASE		
7S2	FUSED DISCONNECT SWITCH	3
1S1	MANUAL DISCONNECT SWITCH	13
1T1	TRANSFORMER	19
2B1	FAN MOTOR	14
THREE PHASE (0.5,1 HP)		
7S2	FUSED DISCONNECT SWITCH	25
1S1	MANUAL DISCONNECT SWITCH	36
1T1	TRANSFORMER	43
2B1	FAN MOTOR	37
THREE PHASE WITH DRIVER (1.5, 3.0 HP)		
7S2	FUSED DISCONNECT SWITCH	51
1S1	MANUAL DISCONNECT SWITCH	62
1T1	TRANSFORMER	70
2B1	FAN MOTOR	57
2U1	MOTOR DRIVER	65

HORIZONTAL NON–ELECTRIC HEAT BLOWER COIL

NOTES:

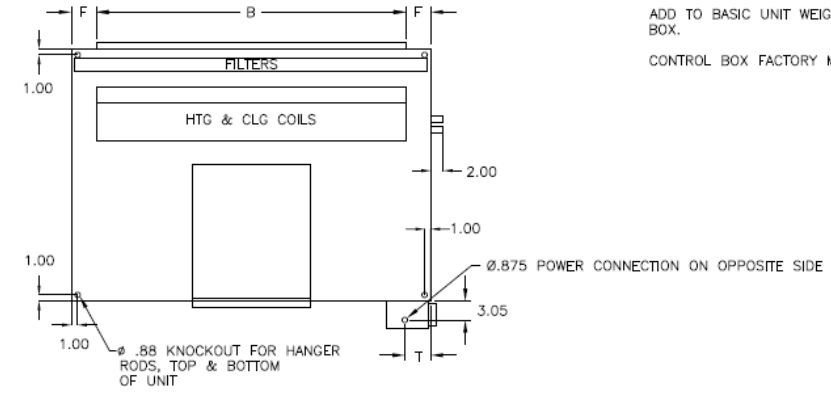
ALL DIMENSIONS ARE IN INCHES

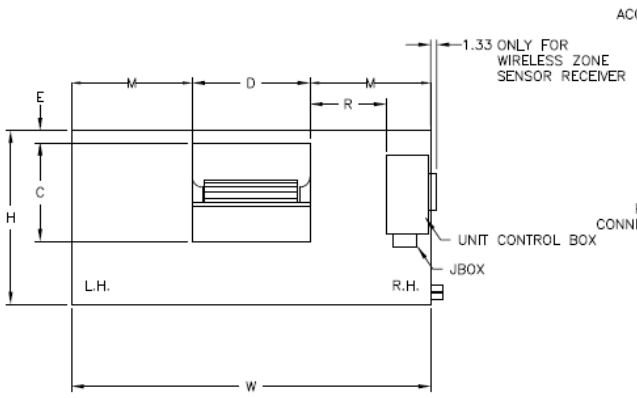
ALL COIL CONNECTIONS ARE SWEAT STYLE.

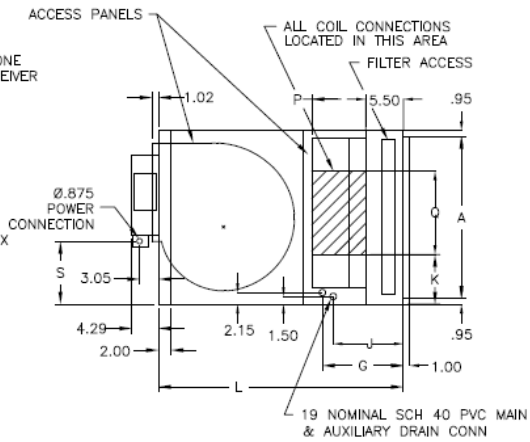
WEIGHT OF BASIC UNIT INCLUDES CABINET, FAN, WIRING AND AVERAGE FILTER. IT DOES NOT INCLUDE COIL, MOTOR OR SHIPPING PACKAGE. PLEASE REFER TO CATALOG FOR MOTOR WEIGHTS.

ADD TO BASIC UNIT WEIGHT, 7 LBS FOR WEIGHT OF CONTROL BOX.

CONTROL BOX FACTORY MOUNTED ON MOTOR SIDE.

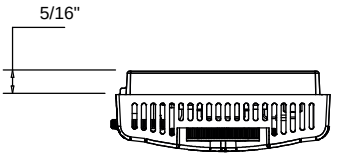




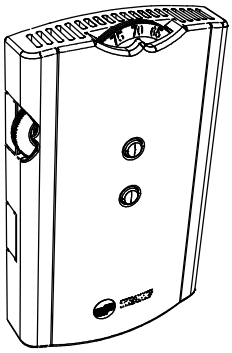


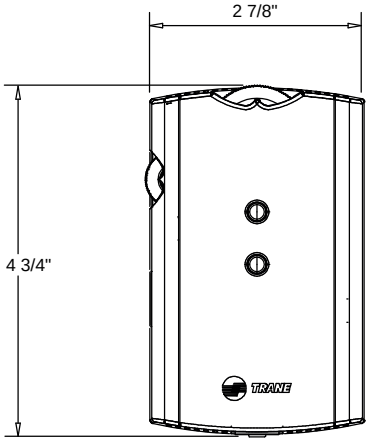
UNIT SIZE	H	W	L	A	B	C	D	E	F	G R.H.	G L.H.	J R.H.	J L.H.	K	M	P	Q	R	S	T	BASIC UNIT WEIGHT
12	14.00	24.00	31.15	12.09	18.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	8.24	9.00	5.75	1.35	.99	4.26	64.0
18	14.00	28.00	31.15	12.09	22.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	10.24	9.00	5.75	3.42	.99	4.19	69.0
24	18.00	28.00	33.72	16.09	22.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	9.68	9.00	5.75	2.73	1.17	4.09	89.6
36	18.00	40.00	33.72	16.09	34.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	15.68	9.00	5.75	8.64	1.01	4.19	104.5
54	22.00	40.00	41.57	20.09	34.00	13.58	12.57	0.72	3.00	11.42	13.42	9.42	11.42	7.43	13.72	11.00	7.27	6.87	5.01	4.19	129.9
72	22.00	48.00	41.57	20.09	40.00	13.58	12.57	0.72	4.00	11.42	13.42	9.42	11.42	7.43	17.72	11.00	7.27	10.87	5.01	4.19	142.0
90	28.00	48.00	43.94	26.09	40.00	13.58	12.57	1.66	4.00	12.79	14.79	10.79	12.79	8.24	17.72	11.25	11.64	10.92	11.14	4.14	162.8

X1379084501-Zone Sen Set TOV Fan

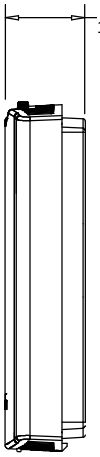


TOP VIEW

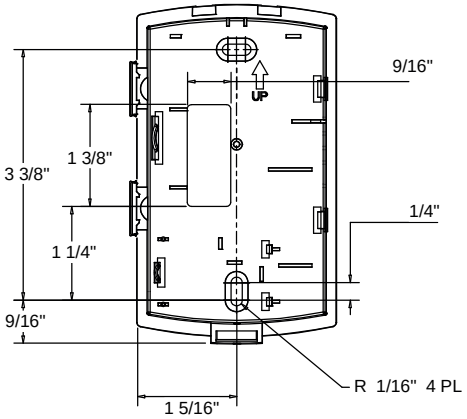




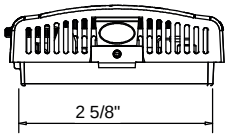
FRONT VIEW



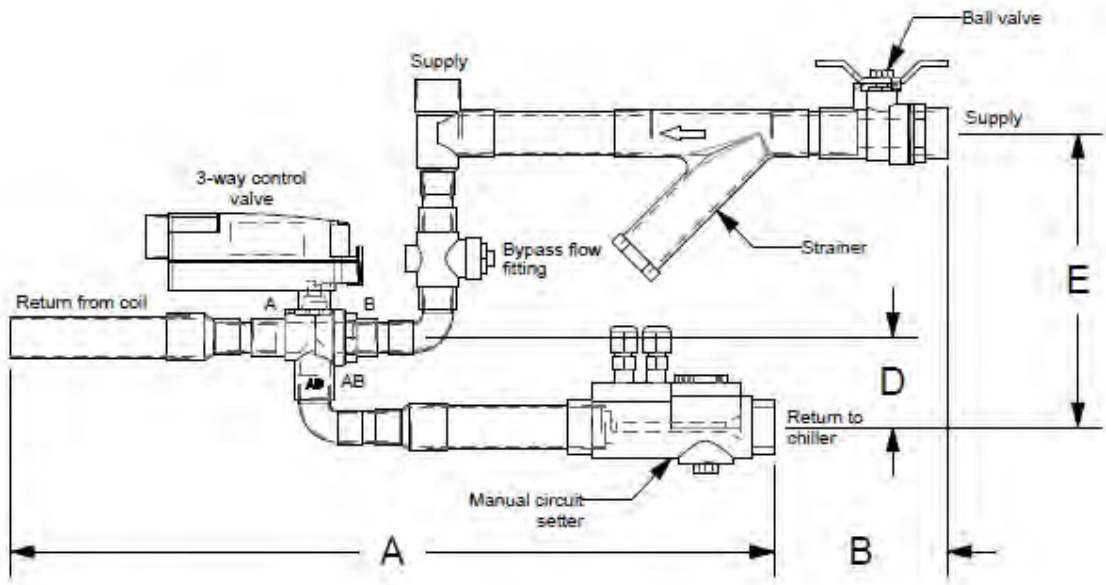
SIDE VIEW



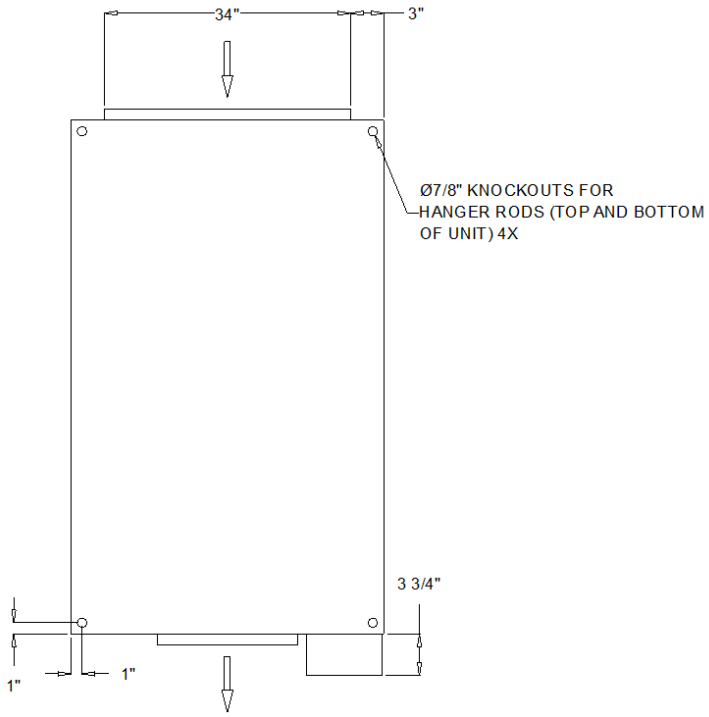
FRONT VIEW
MOUNTING BASE



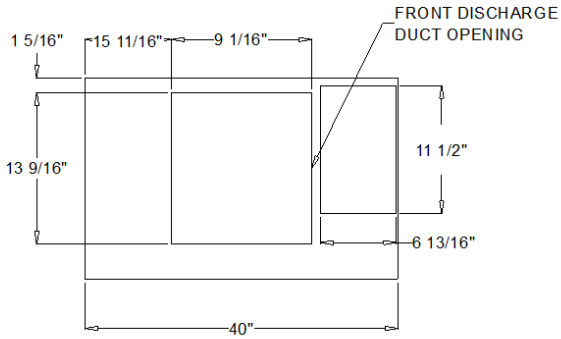
BOTTOM VIEW



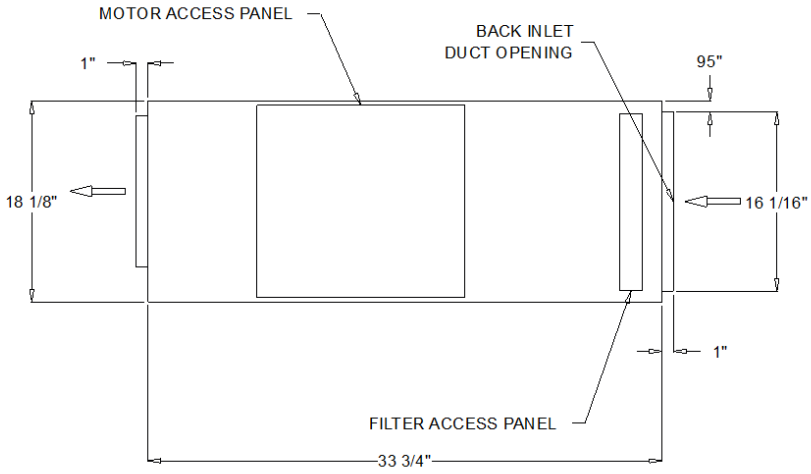
PIPING PACKAGE	NOMINAL TUBE SIZE	ACTUAL SIZE	VALVE SIZE	A	B	C	D	E	F
2-WAY, BASIC	.750	.875	.750	11.31	2.62	-	-	-	-
2-WAY, BASIC	1.000	1.125	1.000	16.06	4.40	-	-	-	-
2-WAY, BASIC	1.250	1.375	1.000	16.04	3.70	-	-	-	-
2-WAY, DELUXE	.750	.875	.750	11.31	-	6.87	-	-	-
2-WAY, DELUXE	1.000	1.125	1.000	16.06	-	9.76	-	-	-
2-WAY, DELUXE	1.250	1.375	1.000	16.04	-	9.95	-	-	-
3-WAY, BASIC	.750	.875	.500	14.17	0.96	-	1.86	6.07	-
3-WAY, BASIC	.750	.875	.750	11.11	3.28	-	2.39	7.45	-
3-WAY, BASIC	1.000	1.125	1.000	14.71	1.35	-	-	6.68	5.51
3-WAY, BASIC	1.250	1.375	1.000	17.32	1.22	-	-	7.57	7.02
3-WAY, DELUXE	.750	.875	.500	14.17	5.21	-	1.86	6.07	-
3-WAY, DELUXE	.750	.875	.750	11.11	7.53	-	2.39	7.45	-
3-WAY, DELUXE	1.000	1.125	1.000	16.06	4.02	-	5.51	6.68	-
3-WAY, DELUXE	1.250	1.375	1.000	18.54	5.03	-	7.02	7.57	-



TOP VIEW



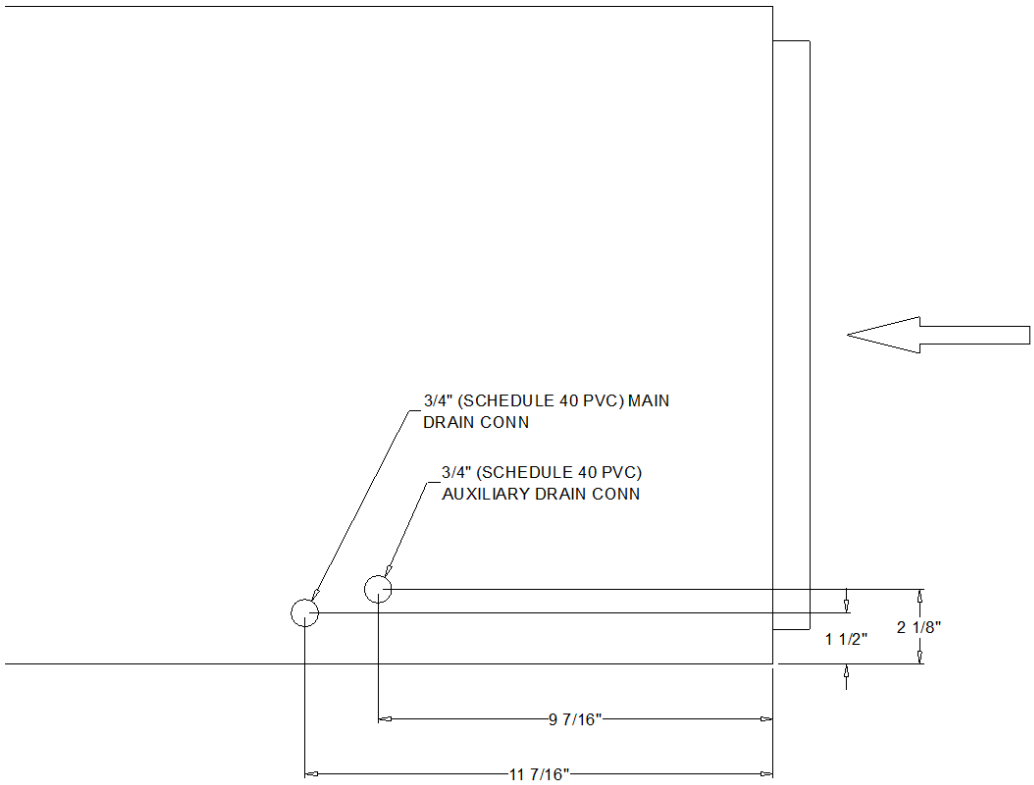
FRONT VIEW



RIGHT VIEW

NOTES:
1. ACCESS PANELS ARE LOCATED ON BOTH SIDES OF THE UNIT TO PROVIDE ACCESS TO THE UNIT'S INTERNAL COMPONENTS.

2. CONTROL BOX IS FACTORY MOUNTED ON DRIVE SIDE AND PROVIDED WITH 7/8" DIAMETER KNOCKOUTS FOR FIELD WIRING.
3. ARROWS INDICATE THE DIRECTION OF AIRFLOW.



RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE SHOWN FROM THE BOTTOM REAR CORNER OF UNIT.
2. STUBOUTS PROTRUDE 2 1/8" FROM EXTERIOR CASING OF UNIT.
3. ARROW INDICATES THE DIRECTION OF AIRFLOW.
4. DRAIN CONNECTIONS ARE UNTHREADED.

NOTES:

1. WEIGHT OF BASIC UNIT INCLUDES ONLY CABINET, FAN, AVERAGE DRIVE, WIRING AND AVERAGE FILTER.

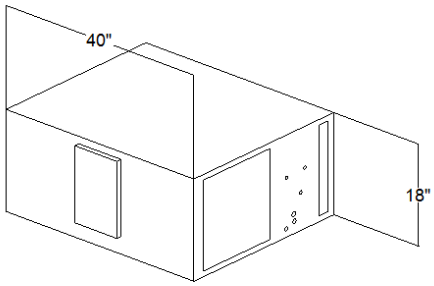
2. WEIGHT OF STEAM COIL MODULE INCLUDES ONLY CABINET WITH AVERAGE FILTER.

3. BEFORE PREPARING ANY UNIT OR ACCESSORY MODULE FOR LIFTING, ESTIMATE THE APPROXIMATE CENTER OF GRAVITY AND TEST LIFT THE UNIT OR ACCESSORY MODULE TO DETERMINE BALANCE AND STABILITY. USE A PROPER RIGGING METHOD SUCH AS STRAPS, SLINGS OR SPREADER BARS FOR PROTECTION AND SAFETY BEFORE HOISTING THE UNIT OR ACCESSORY MODULE.

4. DO NOT LIFT UNITS OR ACCESSORY MODULES IN WINDY CONDITIONS OR ABOVE INSTALLATION PERSONNEL. FAILURE TO PROPERLY LIFT UNIT OR ACCESSORY MODULE COULD RESULT IN DEATH, SERIOUS INJURY, EQUIPMENT DAMAGE OR PROPERTY-ONLY DAMAGE.

5. DO NOT RIG OR LIFT UNITS OR ACCESSORY MODULES WITH FORK LIFT FORKS.

6. ASSEMBLY OF THE UNIT MUST BE PERFORMED AT THE INSTALLATION SITE. ALWAYS RIG UNITS AND ACCESSORY MODULES AS SHIPPED FROM THE FACTORY.



ISO1 VIEW

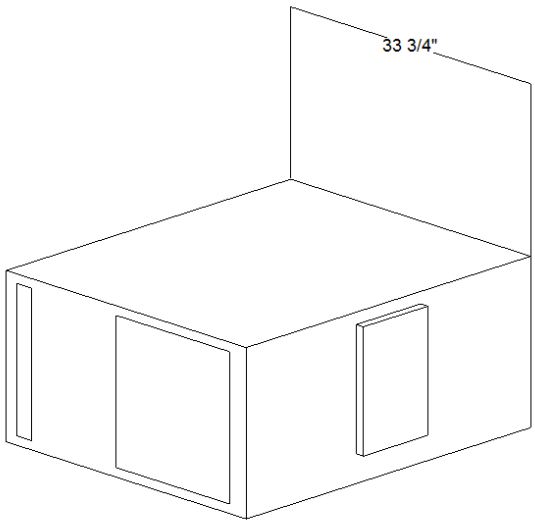
UNIT, COIL & ACCESSORY MODULE WEIGHTS

BASIC UNIT	COIL 1 DRY	COIL 1 WET	COIL 2 DRY	COIL 2 WET	MOTOR	ELECTRIC HEATER	MIXING BOX	ANGLED FILTER BOX	ANGLED FILTER MIXING BOX
104.5 lb	9.3 lb	11.0 lb	22.2 lb		14.0 lb				

FILTER ACCESS MODULE	STEAM COIL MODULE

STEAM COIL DRY	STEAM COIL WET

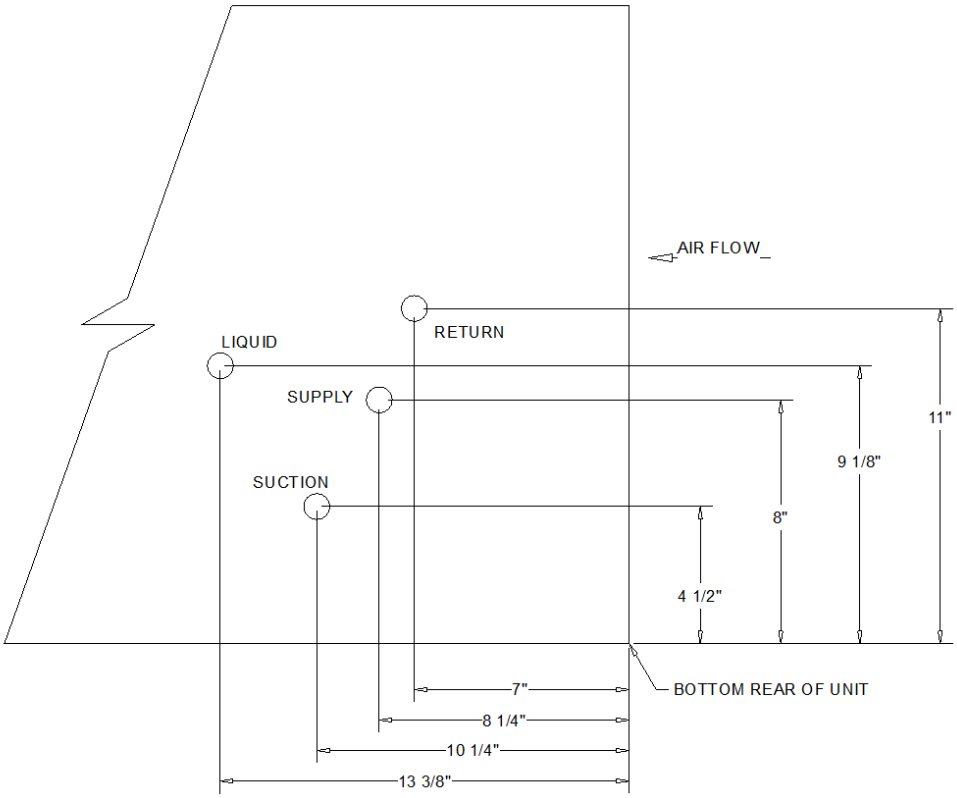
UNIT SIZE	SERVICE CLEARANCE
36	37"



ISO2 VIEW

MAIN UNIT COIL CONNECTIONS

RETURN	5/8"
SUPPLY	5/8"
SUCTION	7/8"
LIQUID	5/8"



NOTES:

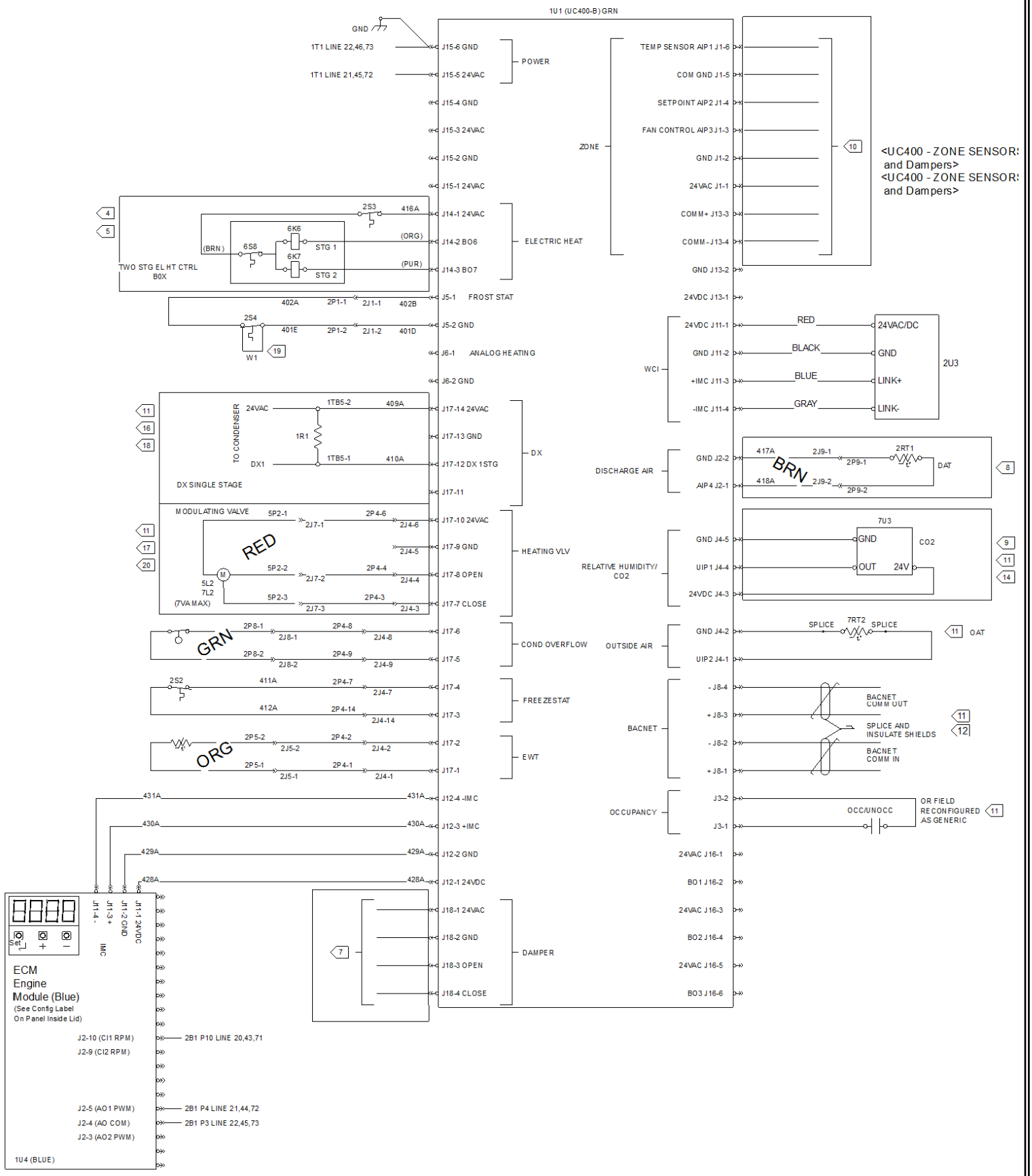
1. PICTORIAL HEADER STUBOUT LOCATIONS RELATIVE TO EACH OTHER MAY NOT BE ACCURATE.

2. LOCATING DIMENSIONS HAVE A PLUS / MINUS 2" TOLERANCE.

3. FOR UNITS WITH A FILTER ACCESS MODULE, ADD 7 3/16" TO HORIZONTAL DIMENSIONS SHOWN.

4. PIPING CONNECTIONS ARE SPECIFIED AS OUTSIDE DIAMETER (O.D.).

5. THERMAL EXPANSION VALVE IS TO BE FIELD SUPPLIED FOR DX COOLING.

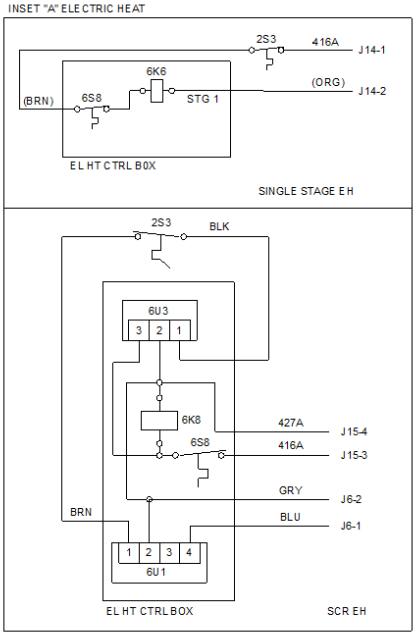

1U1 (UC400-B) GRN
GND
1T1 LINE 22,46,73
1T1 LINE 21,45,72
J15-6 GND
J15-5 24VAC
POWER
J15-4 GND
J15-3 24VAC
J15-2 GND
J15-1 24VAC
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
ZONE
GND J1-2
24VAC J1-1
COMM+ J13-3
COMM- J13-4
GND J13-2
<UC400 - ZONE SENSORS and Dampers>
<UC400 - ZONE SENSORS and Dampers>
2S3
416A
J14-1 24VAC
(ORG)
J14-2 BO6
ELECTRIC HEAT
(PUR)
J14-3 BO7
TWO STG EL HT CTRL BOX
(BRN)
6S8
6K6
6K7
STG 1
STG 2
J5-1 FROST STAT
402A
2P1-1
2J1-1
402B
2S4
401E
2P1-2
2J1-2
401D
J5-2 GND
W1
J6-1 ANALOG HEATING
J6-2 GND
24VDC J13-1
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
WCI
RED
BLACK
BLUE
GRAY
24VAC/DC
GND
LINK+
LINK-
2U3
TO CONDENSER
24VAC
1TB5-2
409A
1R1
DX1
1TB5-1
410A
J17-14 24VAC
J17-13 GND
J17-12 DX 1STG
J17-11
DX
DX SINGLE STAGE
MODULATING VALVE
5P2-1
2J7-1
2P4-6
2J4-6
J17-10 24VAC
RED
2J4-5
J17-9 GND
5P2-2
2J7-2
2P4-4
2J4-4
J17-8 OPEN
5L2
7L2
(7VA MAX)
5P2-3
2J7-3
2P4-3
2J4-3
J17-7 CLOSE
HEATING VLV
DISCHARGE AIR
GND J2-2
AIP4 J2-1
417A
418A
2J9-1
2J9-2
2P9-1
2P9-2
2RT1
BRN
DAT
RELATIVE HUMIDITY/ CO2
GND J4-5
UIP1 J4-4
24VDC J4-3
7U3
GND
OUT
24V
CO2
2P8-1
2J8-1
2P4-8
2J4-8
J17-6
GRN
2P8-2
2J8-2
2P4-9
2J4-9
J17-5
COND OVERFLOW
OUTSIDE AIR
GND J4-2
UIP2 J4-1
SPLICE
7RT2
OAT
2S2
411A
2P4-7
2J4-7
J17-4
412A
2P4-14
2J4-14
J17-3
FREEZESTAT
BACNET
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET COMM OUT
SPLICE AND INSULATE SHIELDS
BACNET COMM IN
2P5-2
2J5-2
2P4-2
2J4-2
J17-2
ORG
2P5-1
2J5-1
2P4-1
2J4-1
J17-1
EWT
OCCUPANCY
J3-2
J3-1
OCC/UNOCC
OR FIELD RECONFIGURED AS GENERIC
431A
430A
429A
428A
J12-4 -IMC
J12-3 +IMC
J12-2 GND
J12-1 24VDC
24VAC J16-1
BO1 J16-2
24VAC J16-3
BO2 J16-4
24VAC J16-5
BO3 J16-6
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER
J1-4 -
J1-3 +
J1-2 GND
J1-1 24VDC
IMC
Set
ECM
Engine
Module (Blue)
(See Config Label On Panel Inside Lid)
J2-10 (CI1 RPM)
J2-9 (CI2 RPM)
J2-5 (AO1 PWM)
J2-4 (AO COM)
J2-3 (AO2 PWM)
2B1 P10 LINE 20,43,71
2B1 P4 LINE 21,44,72
2B1 P3 LINE 22,45,73
1U4 (BLUE)

NOTES:

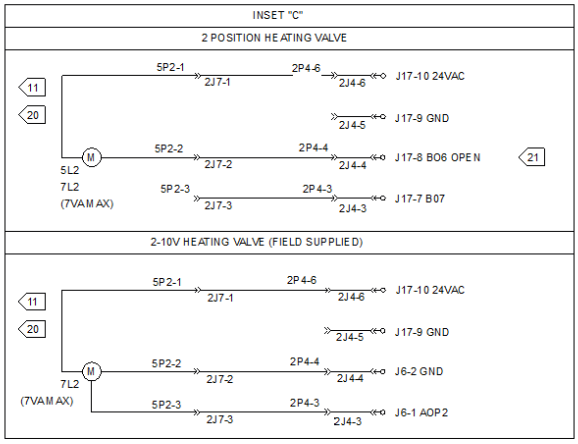
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

4. ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.
5. WIRING SHOWN IS FOR TWO STAGE ELECTRIC HEAT. SEE INSET "A" FOR SINGLE STAGE EH AND SCR ELECTRIC HEAT.
7. SEE SHEET 2311-4130 FOR DAMPER CONNECTIONS.
8. WIRING SHOWN IS FOR FACTORY INSTALLED DISCHARGE AIR SENSOR. FOR FIELD INSTALLED DISCHARGE AIR SENSOR SEE INSET "E".
9. WIRING SHOWN IS FOR CO2 SENSOR FOR RELATIVE HUMIDITY SENSOR SEE INSET "F".
10. SEE SHEET "UC400 - ZONE SENSORS and DAMPERS" FOR ZONE SENSOR CONNECTIONS.
11. USE CLASS TWO WIRING.
12. COMMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN. CAUTION DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.
14. CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.
16. WIRING SHOWN IS FOR SINGLE STAGE DX SELECTION. SEE INSET "B" FOR DUAL STAGE DX SELECTION.
17. WIRING SHOWN IS FOR MODULATING HEATING VALVE SELECTION. SEE INSET "C" FOR OTHER HEATING VALVE OPTIONS.
18. FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 1TB5-1 TO 1TB5-2 FOR SINGLE STAGE AND 1TB5-2 TO 1TB5-3 FOR DUAL STAGE. REMOVE RESTISTOR 1R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED FOR 24VAC 6VA MAXIMUM.
19. W1 PRESENT ON BCVD UNITS ONLY. REMOVE W1 PRIOR TO CONNECTING COIL SECTION TO FAN SECTION AND INSTALLING WIRING TO 2S4.
20. FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.
21. VALVES SHOWN IN NORMALLY CLOSED POSITION, FOR NORMALLY OPEN POSITION, THE VALVE SIGNAL BECOMES CLOSE.

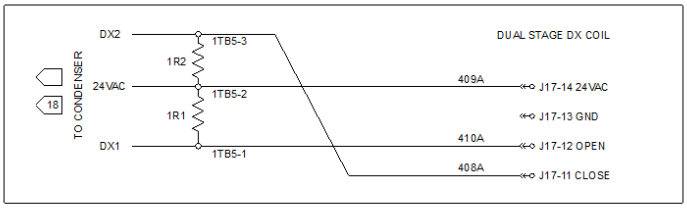
INSET "A" ELECTRIC HEAT



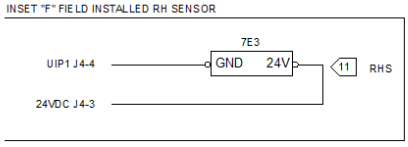
INSET "C"



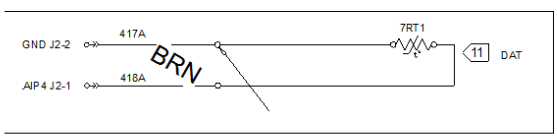
INSET B - DX COILS



INSET "F" FIELD INSTALLED RH SENSOR



INSET "E" FIELD INSTALLED DAT SENSOR



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U4	ENGINE BOARD	115
2S3	EL HT LOCKOUT SWITCH	81,117,122
6K6	CONTACTOR; EL HT STG 1	82,118
6S8	EL HT HIGH TEMP	82,118,127
6K7	CONTACTOR; EL HT STG 2	83
6K8	CONTACTOR; EL HT SCR	126
6U1	CONTACTOR; EL HT SCR	129
6U3	CONTACTOR; EL HT SCR	123
2U3	WIRELESS COM INTERFACE	86
1R1	RESISTOR; DX STG 1 TEST	89,119
1R2	RESISTOR; DX STG 2 TEST	117
5L2	HEATING COIL VALVE MOTOR	94,120
7L2	HEATING COIL VALVE MOTOR	94,120,128
2RT1	DISCHARGE AIR TEMP SNSR	89
7U3	CO2 SENSOR	92
2S1	CONDENSATE OVERFLOW SWTCH	96
7RT2	OUTSIDE AIR TEMP SENSOR	96
2S2	FREEZESTAT	98
5RT1	ENTERING WATER TEMP SENSOR	100
7RT1	FLD INSTLLED DAT SENSOR	134
7E3	ZONE HUMIDITY SENSOR	134
2S4	FROSTSTAT	85

UC400 - ZONE SENSORS and DAMPERS

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
7U1	ZONE SENSOR MODULE	74,75,83,97,105
1U3	WIRELESS RECEIVER	91
4L1	MIXING BX DMPR ACTUATOR	108
7L3	MIXING BX DMPR ACTUATOR	116
7L4	OUTSIDE AIR DMPR ACTUATOR	118

NOTES:

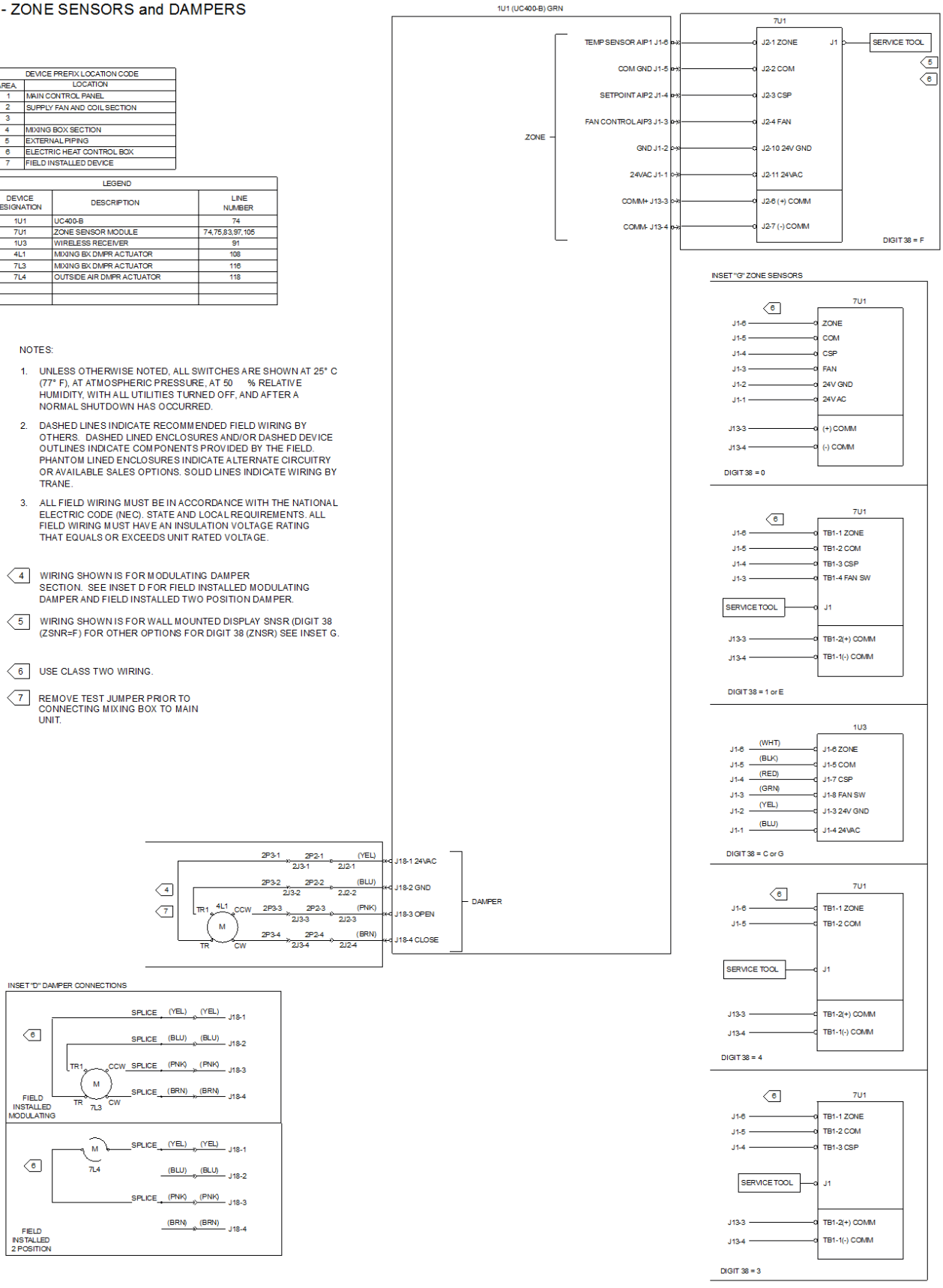
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25° C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

4 WIRING SHOWN IS FOR MODULATING DAMPER SECTION. SEE INSET D FOR FIELD INSTALLED MODULATING DAMPER AND FIELD INSTALLED TWO POSITION DAMPER.

5 WIRING SHOWN IS FOR WALL MOUNTED DISPLAY SNSR (DIGIT 38 (ZSNR=F) FOR OTHER OPTIONS FOR DIGIT 38 (ZNSR) SEE INSET G.

6 USE CLASS TWO WIRING.

7 REMOVE TEST JUMPER PRIOR TO CONNECTING MIXING BOX TO MAIN UNIT.



NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

<4> ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.

<5> WIRING SHOWN IS FOR NO ELECTRIC HEAT. FOR ELECTRIC HEAT SINGLE PHASE SEE INSET A&B. FOR ELECTRIC HEAT THREE PHASE SEE INSET A&C. FOR ELECTRIC HEAT THREE PHASE WITH DRIVER SEE SEE INSET A&D.

<6> CW JUMPER IS PRESENT FROM PIN P5 TO P11 ON UNITS WITH CW MOTOR ROTATION AS VIEWED FROM SHAFT END. JUMPER IS NOT PRESENT ON UNITS WITH CCW ROTATION.

<16> MOTOR VOLTAGE CONFIGURATION P2-P8 JUMPERED FOR 115V OPERATION ONLY.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI- DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

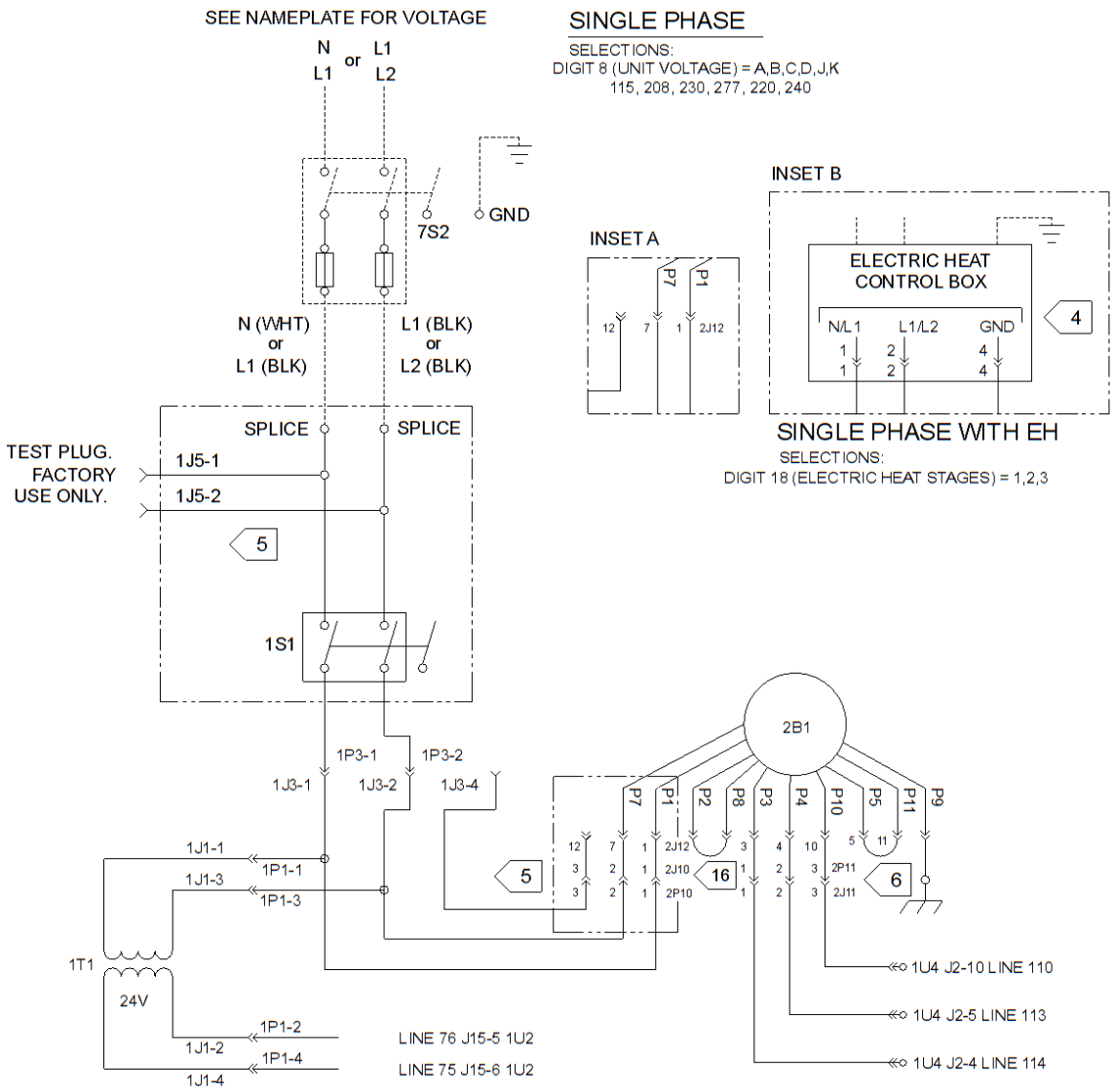
NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCIÓN DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.

EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.



LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SINGLE PHASE		
7S2	FUSED DISCONNECT SWITCH	3
1S1	MANUAL DISCONNECT SWITCH	13
1T1	TRANSFORMER	19
2B1	FAN MOTOR	14
THREE PHASE (0.5,1 HP)		
7S2	FUSED DISCONNECT SWITCH	25
1S1	MANUAL DISCONNECT SWITCH	36
1T1	TRANSFORMER	43
2B1	FAN MOTOR	37
THREE PHASE WITH DRIVER (1.5, 3.0 HP)		
7S2	FUSED DISCONNECT SWITCH	51
1S1	MANUAL DISCONNECT SWITCH	62
1T1	TRANSFORMER	70
2B1	FAN MOTOR	57
2U1	MOTOR DRIVER	65

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

TRANE

Tag: 3 Ton, , , ,
Quantity: 6
Customer:
Project:
Name: Montclair - Honeywell

HORIZONTAL NON–ELECTRIC HEAT BLOWER COIL

NOTES:

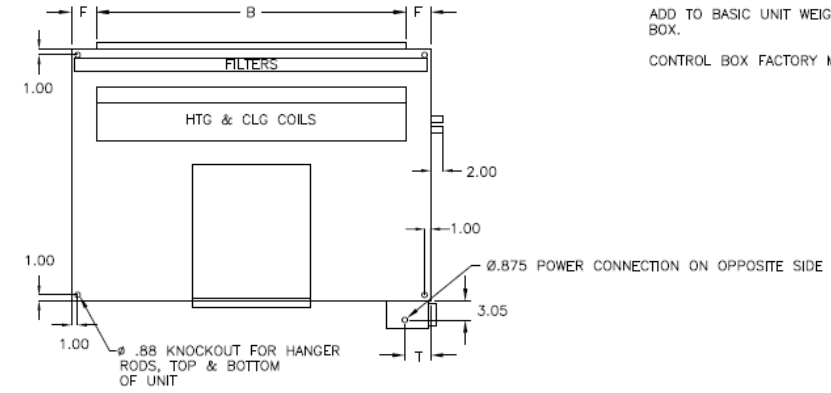
ALL DIMENSIONS ARE IN INCHES

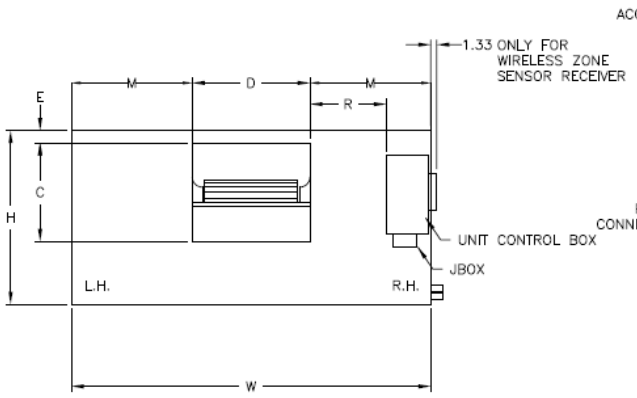
ALL COIL CONNECTIONS ARE SWEAT STYLE.

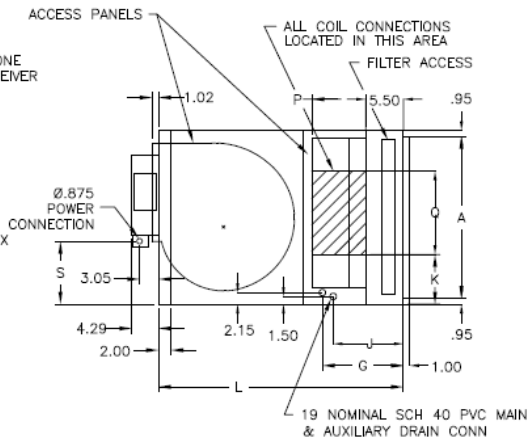
WEIGHT OF BASIC UNIT INCLUDES CABINET, FAN, WIRING AND AVERAGE FILTER. IT DOES NOT INCLUDE COIL, MOTOR OR SHIPPING PACKAGE. PLEASE REFER TO CATALOG FOR MOTOR WEIGHTS.

ADD TO BASIC UNIT WEIGHT, 7 LBS FOR WEIGHT OF CONTROL BOX.

CONTROL BOX FACTORY MOUNTED ON MOTOR SIDE.

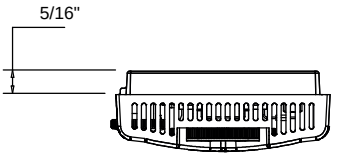




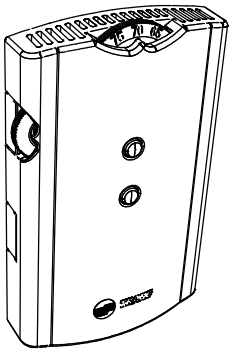


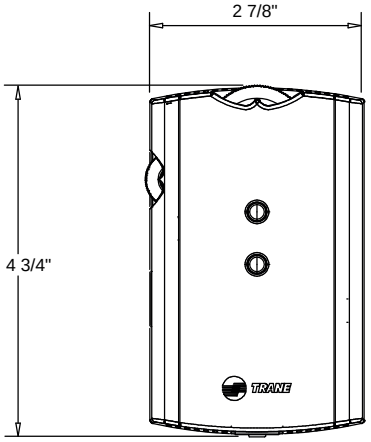
UNIT SIZE	H	W	L	A	B	C	D	E	F	G R.H.	G L.H.	J R.H.	J L.H.	K	M	P	Q	R	S	T	BASIC UNIT WEIGHT
12	14.00	24.00	31.15	12.09	18.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	8.24	9.00	5.75	1.35	.99	4.26	64.0
18	14.00	28.00	31.15	12.09	22.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	10.24	9.00	5.75	3.42	.99	4.19	69.0
24	18.00	28.00	33.72	16.09	22.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	9.68	9.00	5.75	2.73	1.17	4.09	89.6
36	18.00	40.00	33.72	16.09	34.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	15.68	9.00	5.75	8.64	1.01	4.19	104.5
54	22.00	40.00	41.57	20.09	34.00	13.58	12.57	0.72	3.00	11.42	13.42	9.42	11.42	7.43	13.72	11.00	7.27	6.87	5.01	4.19	129.9
72	22.00	48.00	41.57	20.09	40.00	13.58	12.57	0.72	4.00	11.42	13.42	9.42	11.42	7.43	17.72	11.00	7.27	10.87	5.01	4.19	142.0
90	28.00	48.00	43.94	26.09	40.00	13.58	12.57	1.66	4.00	12.79	14.79	10.79	12.79	8.24	17.72	11.25	11.64	10.92	11.14	4.14	162.8

X1379084501-Zone Sen Set TOV Fan

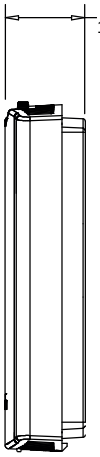


TOP VIEW

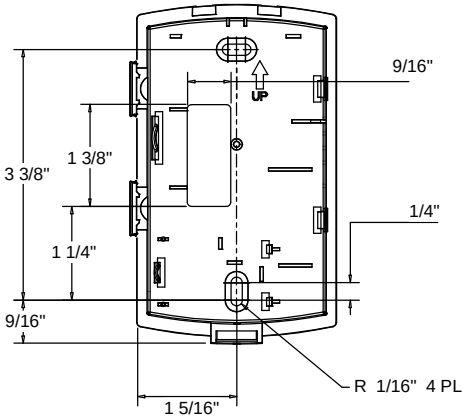




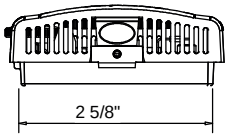
FRONT VIEW



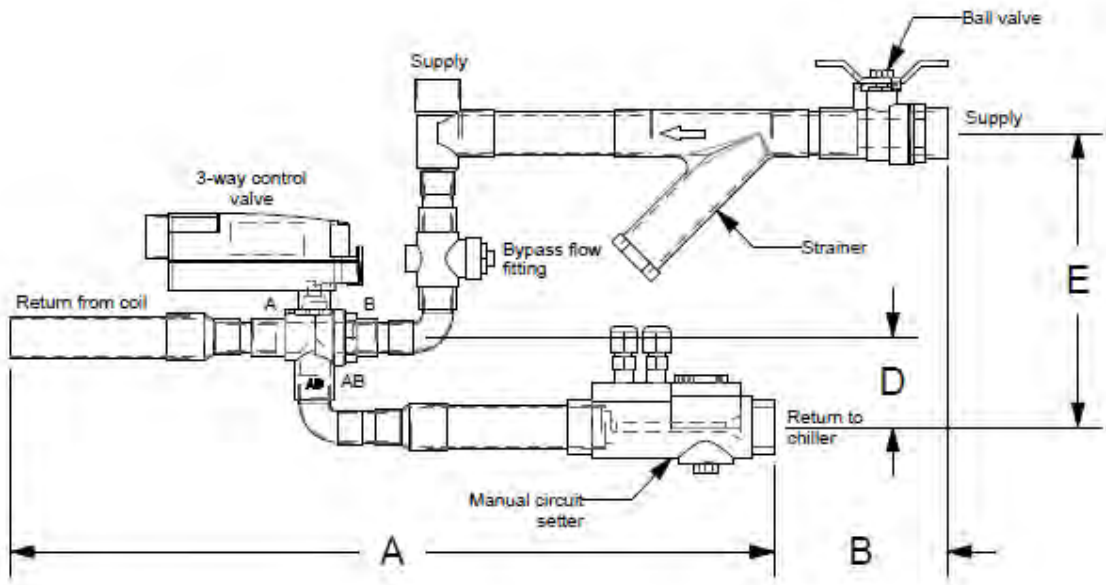
SIDE VIEW



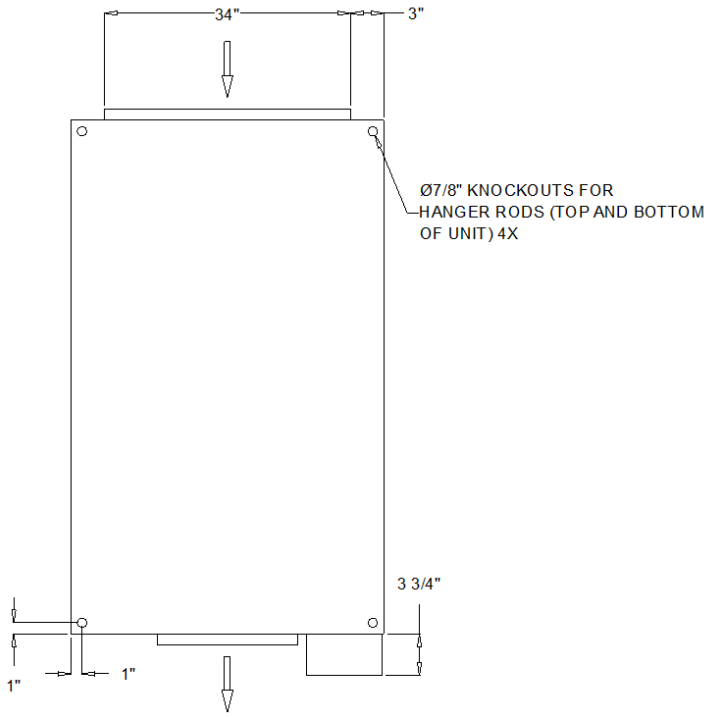
FRONT VIEW
MOUNTING BASE



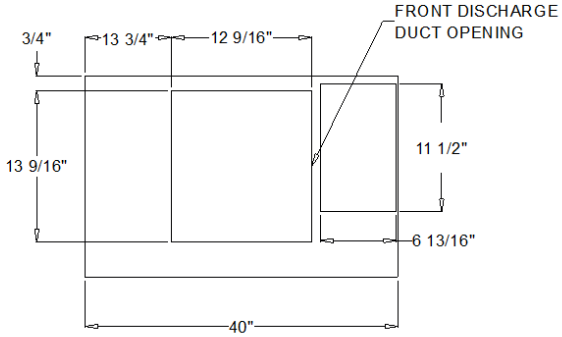
BOTTOM VIEW



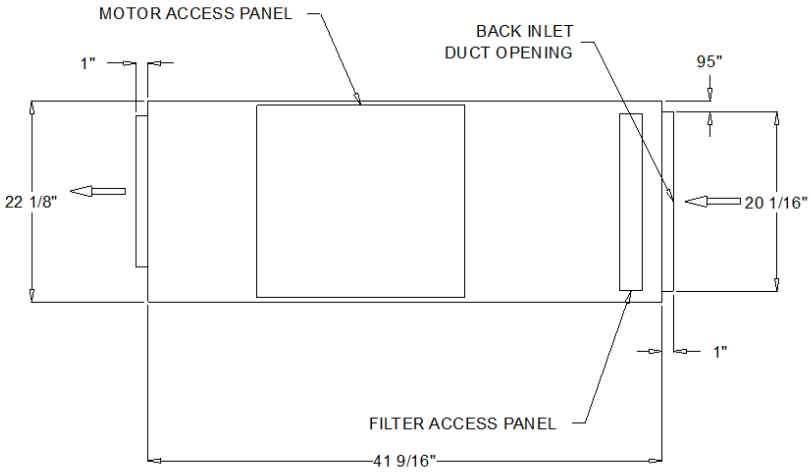
PIPING PACKAGE	NOMINAL TUBE SIZE	ACTUAL SIZE	VALVE SIZE	A	B	C	D	E	F
2-WAY, BASIC	.750	.875	.750	11.31	2.62	-	-	-	-
2-WAY, BASIC	1.000	1.125	1.000	16.06	4.40	-	-	-	-
2-WAY, BASIC	1.250	1.375	1.000	16.04	3.70	-	-	-	-
2-WAY, DELUXE	.750	.875	.750	11.31	-	6.87	-	-	-
2-WAY, DELUXE	1.000	1.125	1.000	16.06	-	9.76	-	-	-
2-WAY, DELUXE	1.250	1.375	1.000	16.04	-	9.95	-	-	-
3-WAY, BASIC	.750	.875	.500	14.17	0.96	-	1.86	6.07	-
3-WAY, BASIC	.750	.875	.750	11.11	3.28	-	2.39	7.45	-
3-WAY, BASIC	1.000	1.125	1.000	14.71	1.35	-	-	6.68	5.51
3-WAY, BASIC	1.250	1.375	1.000	17.32	1.22	-	-	7.57	7.02
3-WAY, DELUXE	.750	.875	.500	14.17	5.21	-	1.86	6.07	-
3-WAY, DELUXE	.750	.875	.750	11.11	7.53	-	2.39	7.45	-
3-WAY, DELUXE	1.000	1.125	1.000	16.06	4.02	-	5.51	6.68	-
3-WAY, DELUXE	1.250	1.375	1.000	18.54	5.03	-	7.02	7.57	-



TOP VIEW



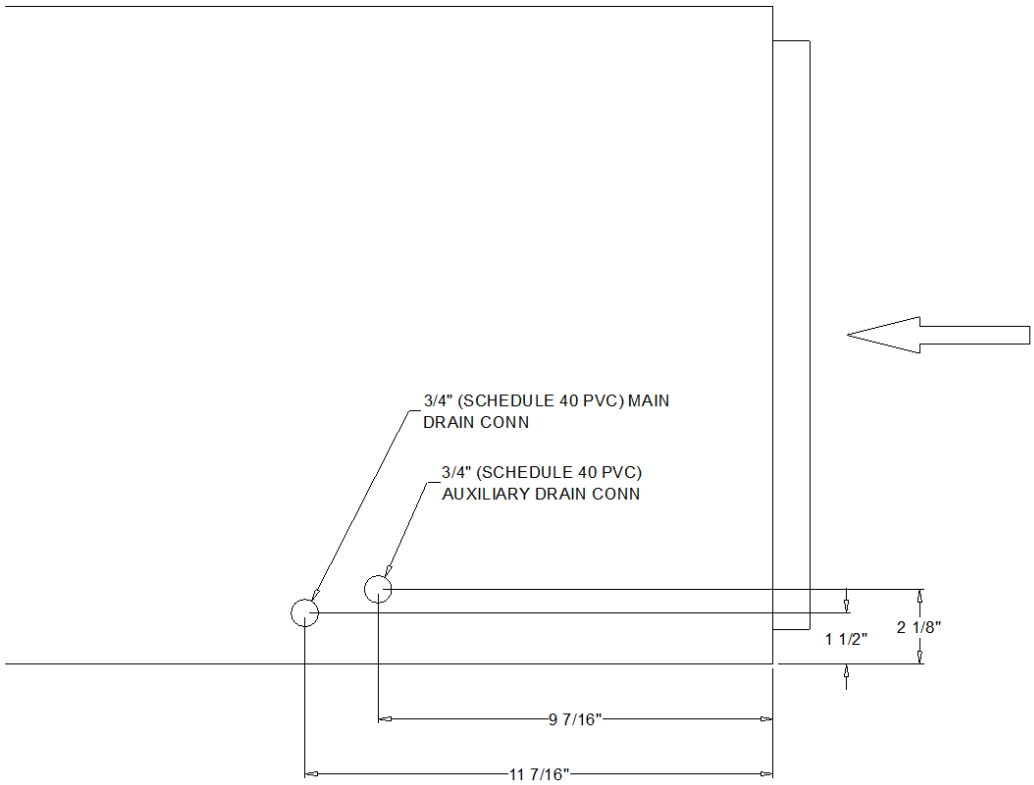
FRONT VIEW



RIGHT VIEW

NOTES:
1. ACCESS PANELS ARE LOCATED ON BOTH SIDES OF THE UNIT TO PROVIDE ACCESS TO THE UNIT'S INTERNAL COMPONENTS.

2. CONTROL BOX IS FACTORY MOUNTED ON DRIVE SIDE AND PROVIDED WITH 7/8" DIAMETER KNOCKOUTS FOR FIELD WIRING.
3. ARROWS INDICATE THE DIRECTION OF AIRFLOW.



RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE SHOWN FROM THE BOTTOM REAR CORNER OF UNIT.
2. STUBOUTS PROTRUDE 2 1/8" FROM EXTERIOR CASING OF UNIT.
3. ARROW INDICATES THE DIRECTION OF AIRFLOW.
4. DRAIN CONNECTIONS ARE UNTHREADED.

NOTES:

1. WEIGHT OF BASIC UNIT INCLUDES ONLY CABINET, FAN, AVERAGE DRIVE, WIRING AND AVERAGE FILTER.

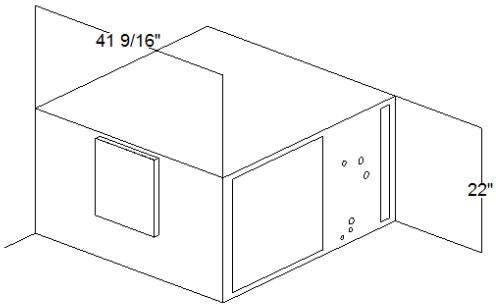
2. WEIGHT OF STEAM COIL MODULE INCLUDES ONLY CABINET WITH AVERAGE FILTER.

3. BEFORE PREPARING ANY UNIT OR ACCESSORY MODULE FOR LIFTING, ESTIMATE THE APPROXIMATE CENTER OF GRAVITY AND TEST LIFT THE UNIT OR ACCESSORY MODULE TO DETERMINE BALANCE AND STABILITY. USE A PROPER RIGGING METHOD SUCH AS STRAPS, SLINGS OR SPREADER BARS FOR PROTECTION AND SAFETY BEFORE HOISTING THE UNIT OR ACCESSORY MODULE.

4. DO NOT LIFT UNITS OR ACCESSORY MODULES IN WINDY CONDITIONS OR ABOVE INSTALLATION PERSONNEL. FAILURE TO PROPERLY LIFT UNIT OR ACCESSORY MODULE COULD RESULT IN DEATH, SERIOUS INJURY, EQUIPMENT DAMAGE OR PROPERTY-ONLY DAMAGE.

5. DO NOT RIG OR LIFT UNITS OR ACCESSORY MODULES WITH FORK LIFT FORKS.

6. ASSEMBLY OF THE UNIT MUST BE PERFORMED AT THE INSTALLATION SITE. ALWAYS RIG UNITS AND ACCESSORY MODULES AS SHIPPED FROM THE FACTORY.



ISO1 VIEW

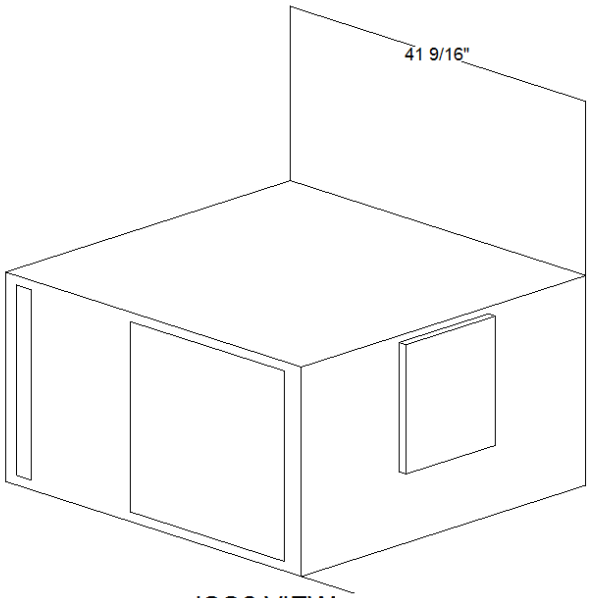
UNIT, COIL & ACCESSORY MODULE WEIGHTS

BASIC UNIT	COIL 1 DRY	COIL 1 WET	COIL 2 DRY	COIL 2 WET	MOTOR	ELECTRIC HEATER	MIXING BOX	ANGLED FILTER BOX	ANGLED FILTER MIXING BOX
129.9 lb	17.6 lb	22.4 lb	33.0 lb		19.0 lb				

FILTER ACCESS MODULE	STEAM COIL MODULE

STEAM COIL DRY	STEAM COIL WET

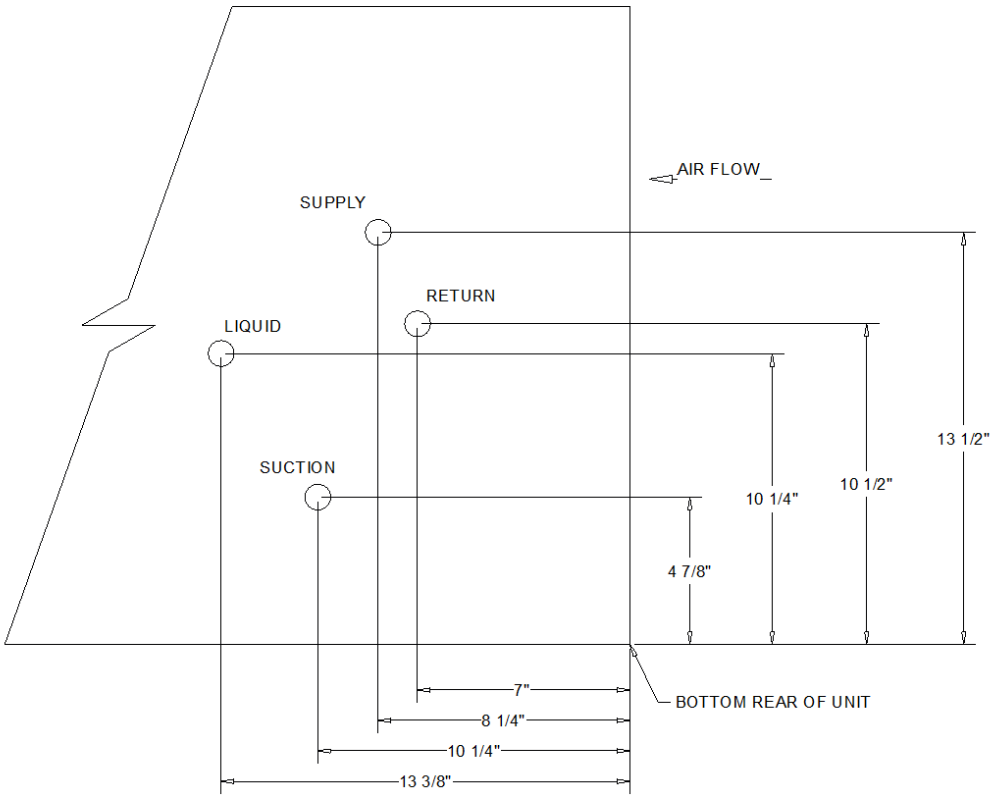
UNIT SIZE	SERVICE CLEARANCE
54	37"



ISO2 VIEW

MAIN UNIT COIL CONNECTIONS

RETURN	1 1/8"
SUPPLY	1 1/8"
SUCTION	1 1/8"
LIQUID	7/8"



NOTES:

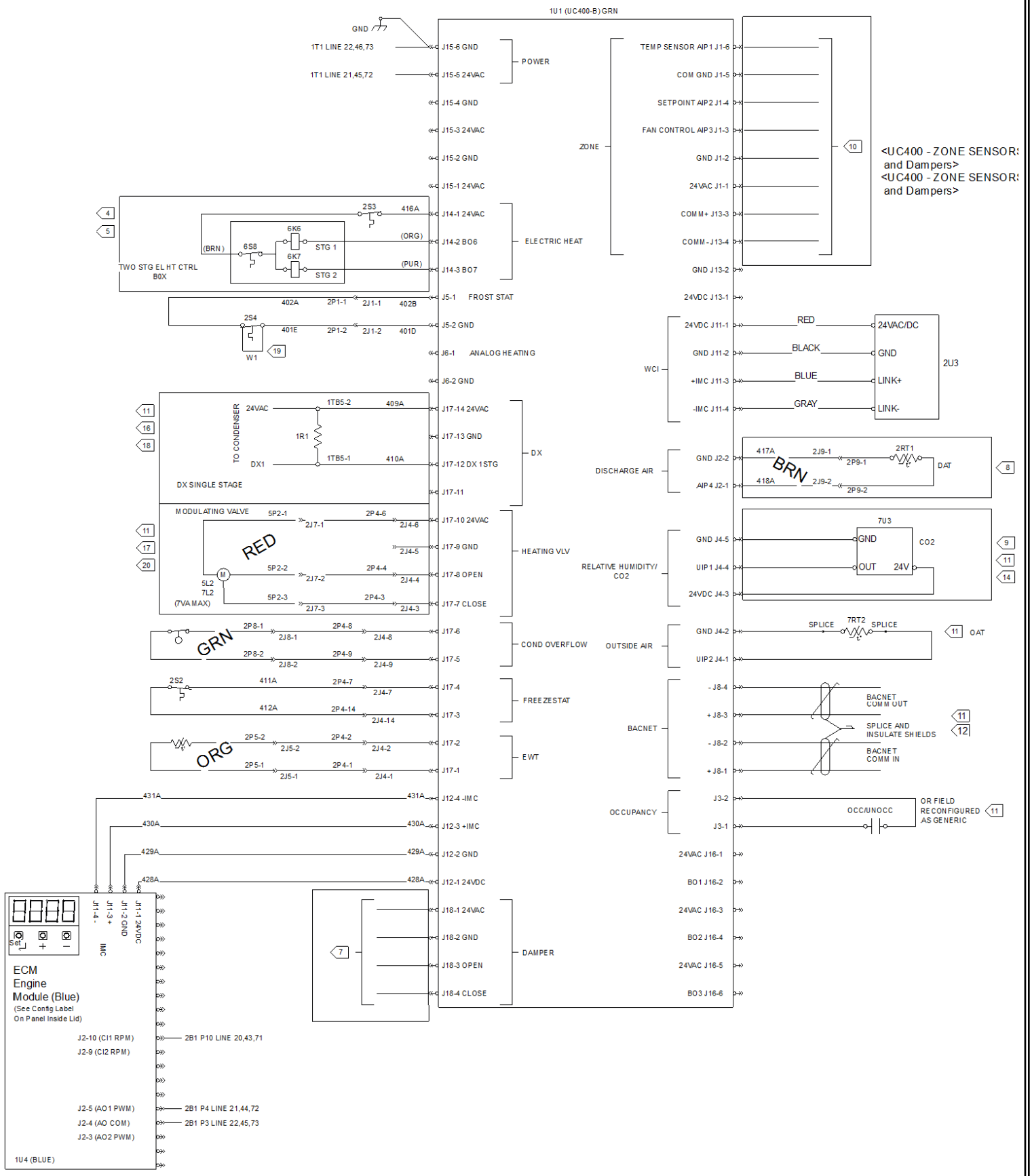
1. PICTORIAL HEADER STUBOUT LOCATIONS RELATIVE TO EACH OTHER MAY NOT BE ACCURATE.

2. LOCATING DIMENSIONS HAVE A PLUS / MINUS 2" TOLERANCE.

3. FOR UNITS WITH A FILTER ACCESS MODULE, ADD 7 3/16" TO HORIZONTAL DIMENSIONS SHOWN.

4. PIPING CONNECTIONS ARE SPECIFIED AS OUTSIDE DIAMETER (O.D.).

5. THERMAL EXPANSION VALVE IS TO BE FIELD SUPPLIED FOR DX COOLING.

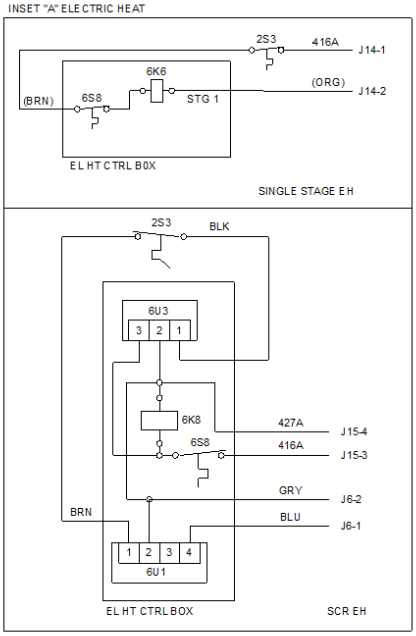

1U1 (UC400-B) GRN
GND
1T1 LINE 22,46,73
1T1 LINE 21,45,72
J15-6 GND
J15-5 24VAC
POWER
J15-4 GND
J15-3 24VAC
J15-2 GND
J15-1 24VAC
ZONE
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
GND J1-2
24VAC J1-1
COMM+ J13-3
COMM- J13-4
GND J13-2
24VDC J13-1
<UC400 - ZONE SENSORS and Dampers>
<UC400 - ZONE SENSORS and Dampers>
2S3
416A
J14-1 24VAC
(ORG)
J14-2 BO6
ELECTRIC HEAT
(PUR)
J14-3 BO7
TWO STG EL HT CTRL BOX
(BRN)
6S8
6K6
STG 1
6K7
STG 2
402A
2P1-1
2J1-1
402B
J5-1 FROST STAT
2S4
401E
2P1-2
2J1-2
401D
J5-2 GND
W1
J6-1 ANALOG HEATING
J6-2 GND
WCI
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
RED
BLACK
BLUE
GRAY
24VAC/DC
GND
LINK+
LINK-
2U3
TO CONDENSER
24VAC
1TB5-2
409A
1R1
DX1
1TB5-1
410A
J17-14 24VAC
J17-13 GND
J17-12 DX 1STG
J17-11
DX
DX SINGLE STAGE
DISCHARGE AIR
GND J2-2
AIP4 J2-1
417A
418A
2J9-1
2J9-2
2P9-1
2P9-2
2RT1
BRN
DAT
MODULATING VALVE
5P2-1
2J7-1
2P4-6
2J4-6
J17-10 24VAC
RED
2J4-5
J17-9 GND
5P2-2
2J7-2
2P4-4
2J4-4
J17-8 OPEN
5L2
7L2
(7VA MAX)
5P2-3
2J7-3
2P4-3
2J4-3
J17-7 CLOSE
HEATING VLV
7U3
GND
CO2
OUT
24V
RELATIVE HUMIDITY/ CO2
GND J4-5
UIP1 J4-4
24VDC J4-3
2P8-1
2J8-1
2P4-8
2J4-8
J17-6
GRN
2P8-2
2J8-2
2P4-9
2J4-9
J17-5
COND OVERFLOW
SPLICE
7RT2
OUTSIDE AIR
GND J4-2
UIP2 J4-1
OAT
2S2
411A
2P4-7
2J4-7
J17-4
412A
2P4-14
2J4-14
J17-3
FREEZESTAT
BACNET
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET COMM OUT
SPLICE AND INSULATE SHIELDS
BACNET COMM IN
2P5-2
2J5-2
2P4-2
2J4-2
J17-2
ORG
2P5-1
2J5-1
2P4-1
2J4-1
J17-1
EWT
431A
J12-4 -IMC
430A
J12-3 +IMC
429A
J12-2 GND
428A
J12-1 24VDC
OCCUPANCY
J3-2
J3-1
OCC/UNOCC
OR FIELD RECONFIGURED AS GENERIC
24VAC J16-1
BO1 J16-2
24VAC J16-3
BO2 J16-4
24VAC J16-5
BO3 J16-6
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER
J1-4 -
J1-3 +
J1-2 GND
J1-1 24VDC
IMC
Set
ECM
Engine
Module (Blue)
(See Config Label On Panel Inside Lid)
J2-10 (CI1 RPM)
J2-9 (CI2 RPM)
J2-5 (AO1 PWM)
J2-4 (AO COM)
J2-3 (AO2 PWM)
2B1 P10 LINE 20,43,71
2B1 P4 LINE 21,44,72
2B1 P3 LINE 22,45,73
1U4 (BLUE)

NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

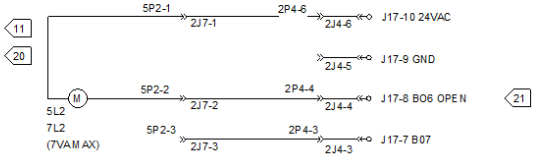
4. ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.
5. WIRING SHOWN IS FOR TWO STAGE ELECTRIC HEAT. SEE INSET "A" FOR SINGLE STAGE EH AND SCR ELECTRIC HEAT.
7. SEE SHEET 2311-4130 FOR DAMPER CONNECTIONS.
8. WIRING SHOWN IS FOR FACTORY INSTALLED DISCHARGE AIR SENSOR. FOR FIELD INSTALLED DISCHARGE AIR SENSOR SEE INSET "E".
9. WIRING SHOWN IS FOR CO2 SENSOR FOR RELATIVE HUMIDITY SENSOR SEE INSET "F".
10. SEE SHEET "UC400 - ZONE SENSORS and DAMPERS" FOR ZONE SENSOR CONNECTIONS.
11. USE CLASS TWO WIRING.
12. COMMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN. CAUTION DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.
14. CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.
16. WIRING SHOWN IS FOR SINGLE STAGE DX SELECTION. SEE INSET "B" FOR DUAL STAGE DX SELECTION.
17. WIRING SHOWN IS FOR MODULATING HEATING VALVE SELECTION. SEE INSET "C" FOR OTHER HEATING VALVE OPTIONS.
18. FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 1TB5-1 TO 1TB5-2 FOR SINGLE STAGE AND 1TB5-2 TO 1TB5-3 FOR DUAL STAGE. REMOVE RESTISTOR 1R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED FOR 24VAC 6VA MAXIMUM.
19. W1 PRESENT ON BCVD UNITS ONLY. REMOVE W1 PRIOR TO CONNECTING COIL SECTION TO FAN SECTION AND INSTALLING WIRING TO 2S4.
20. FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.
21. VALVES SHOWN IN NORMALLY CLOSED POSITION, FOR NORMALLY OPEN POSITION, THE VALVE SIGNAL BECOMES CLOSE.

INSET "A" ELECTRIC HEAT

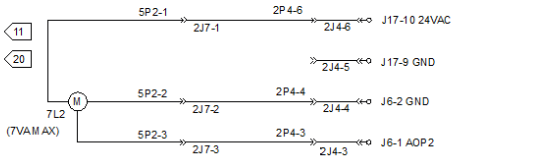


INSET "C"

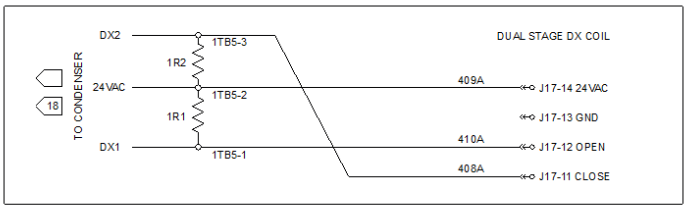
2 POSITION HEATING VALVE



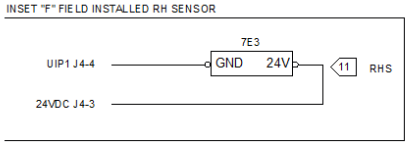
2-10V HEATING VALVE (FIELD SUPPLIED)



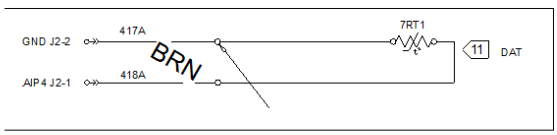
INSET B - DX COILS



INSET "F" FIELD INSTALLED RH SENSOR



INSET "E" FIELD INSTALLED DAT SENSOR



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U4	ENGINE BOARD	115
2S3	EL HT LOCKOUT SWITCH	81,117,122
6K6	CONTACTOR; EL HT STG 1	82,118
6S8	EL HT HIGH TEMP	82,118,127
6K7	CONTACTOR; EL HT STG 2	83
6K8	CONTACTOR; EL HT SCR	126
6U1	CONTACTOR; EL HT SCR	129
6U3	CONTACTOR; EL HT SCR	123
2U3	WIRELESS COM INTERFACE	86
1R1	RESISTOR; DX STG 1 TEST	89,119
1R2	RESISTOR; DX STG 2 TEST	117
5L2	HEATING COIL VALVE MOTOR	94,120
7L2	HEATING COIL VALVE MOTOR	94,120,128
2RT1	DISCHARGE AIR TEMP SNSR	89
7U3	CO2 SENSOR	92
2S1	CONDENSATE OVERFLOW SWTCH	96
7RT2	OUTSIDE AIR TEMP SENSOR	96
2S2	FREEZESTAT	98
5RT1	ENTERING WATER TEMP SENSOR	100
7RT1	FLD INSTLLED DAT SENSOR	134
7E3	ZONE HUMIDITY SENSOR	134
2S4	FROSTSTAT	85

UC400 - ZONE SENSORS and DAMPERS

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
7U1	ZONE SENSOR MODULE	74,75,83,97,105
1U3	WIRELESS RECEIVER	91
4L1	MIXING BX DMPR ACTUATOR	108
7L3	MIXING BX DMPR ACTUATOR	116
7L4	OUTSIDE AIR DMPR ACTUATOR	118

NOTES:

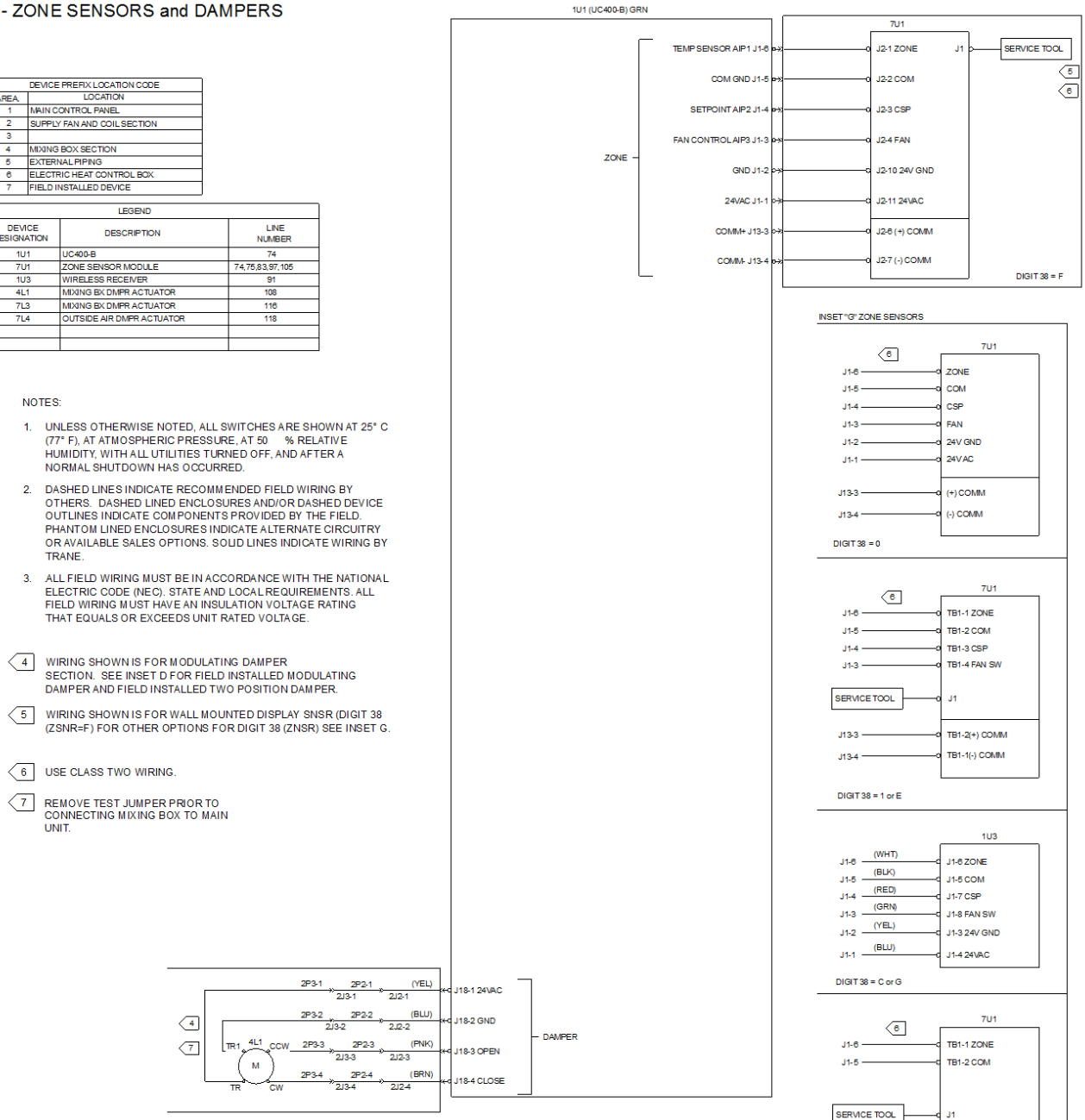
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25° C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

4 WIRING SHOWN IS FOR MODULATING DAMPER SECTION. SEE INSET D FOR FIELD INSTALLED MODULATING DAMPER AND FIELD INSTALLED TWO POSITION DAMPER.

5 WIRING SHOWN IS FOR WALL MOUNTED DISPLAY SNSR (DIGIT 38 (ZSNR=F) FOR OTHER OPTIONS FOR DIGIT 38 (ZNSR) SEE INSET G.

6 USE CLASS TWO WIRING.

7 REMOVE TEST JUMPER PRIOR TO CONNECTING MIXING BOX TO MAIN UNIT.



NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

<4> ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.

<5> WIRING SHOWN IS FOR NO ELECTRIC HEAT. FOR ELECTRIC HEAT SINGLE PHASE SEE INSET A&B. FOR ELECTRIC HEAT THREE PHASE SEE INSET A&C. FOR ELECTRIC HEAT THREE PHASE WITH DRIVER SEE SEE INSET A&D.

<6> CW JUMPER IS PRESENT FROM PIN P5 TO P11 ON UNITS WITH CW MOTOR ROTATION AS VIEWED FROM SHAFT END. JUMPER IS NOT PRESENT ON UNITS WITH CCW ROTATION.

<16> MOTOR VOLTAGE CONFIGURATION P2-P8 JUMPERED FOR 115V OPERATION ONLY.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI- DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

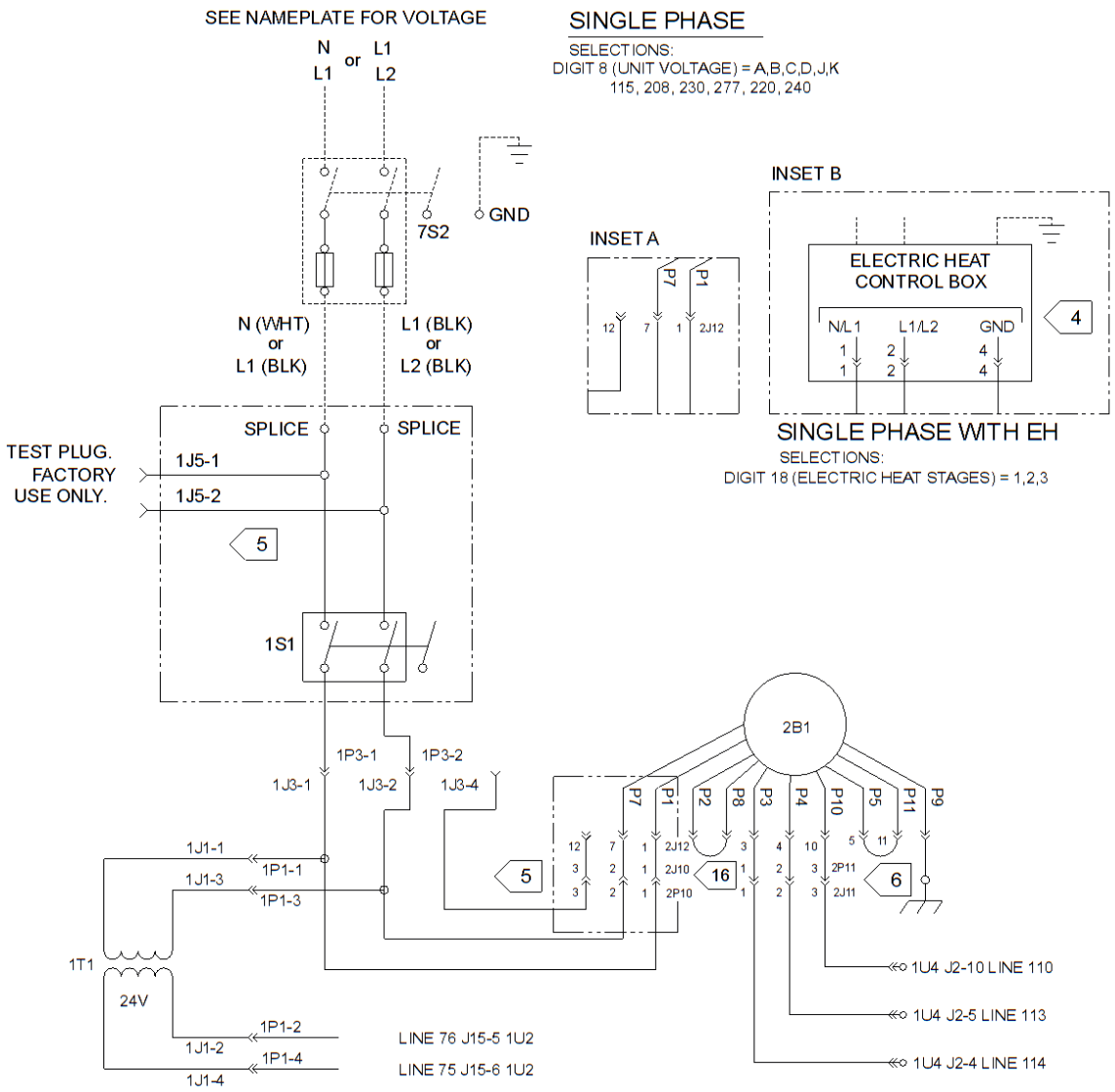
NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCIÓN DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.

EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.



SINGLE PHASE

SELECTIONS:
DIGIT 8 (UNIT VOLTAGE) = A,B,C,D,J,K
115, 208, 230, 277, 220, 240

INSET A

INSET B

SINGLE PHASE WITH EH

SELECTIONS:
DIGIT 18 (ELECTRIC HEAT STAGES) = 1,2,3

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SINGLE PHASE		
7S2	FUSED DISCONNECT SWITCH	3
1S1	MANUAL DISCONNECT SWITCH	13
1T1	TRANSFORMER	19
2B1	FAN MOTOR	14
THREE PHASE (0.5,1 HP)		
7S2	FUSED DISCONNECT SWITCH	25
1S1	MANUAL DISCONNECT SWITCH	36
1T1	TRANSFORMER	43
2B1	FAN MOTOR	37
THREE PHASE WITH DRIVER (1.5, 3.0 HP)		
7S2	FUSED DISCONNECT SWITCH	51
1S1	MANUAL DISCONNECT SWITCH	62
1T1	TRANSFORMER	70
2B1	FAN MOTOR	57
2U1	MOTOR DRIVER	65

TRANE

Tag: 4 Ton, , ,
Quantity: 4
Customer:
Project:
Name: Montclair - Honeywell

HORIZONTAL NON–ELECTRIC HEAT BLOWER COIL

NOTES:

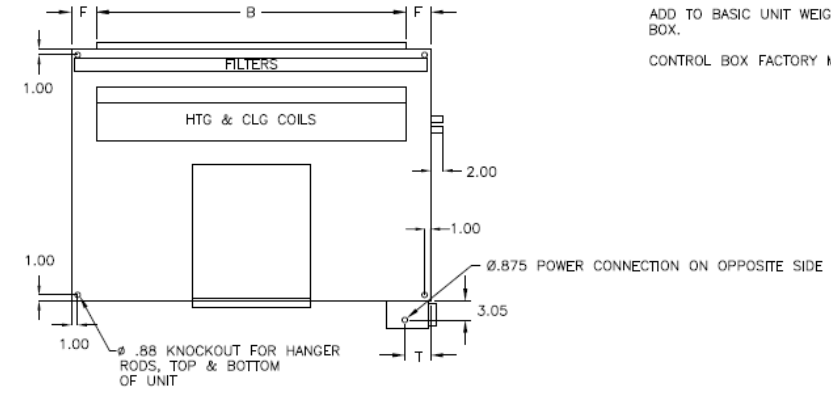
ALL DIMENSIONS ARE IN INCHES

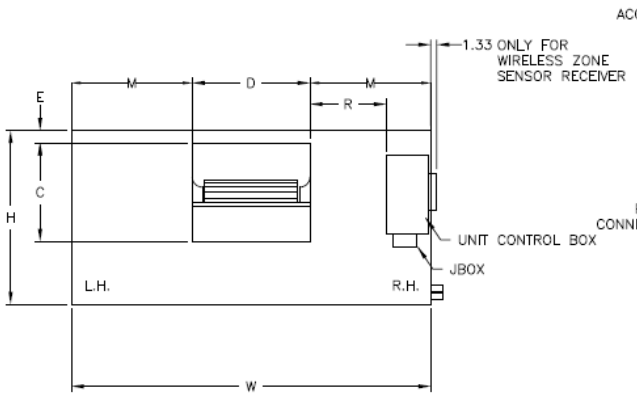
ALL COIL CONNECTIONS ARE SWEAT STYLE.

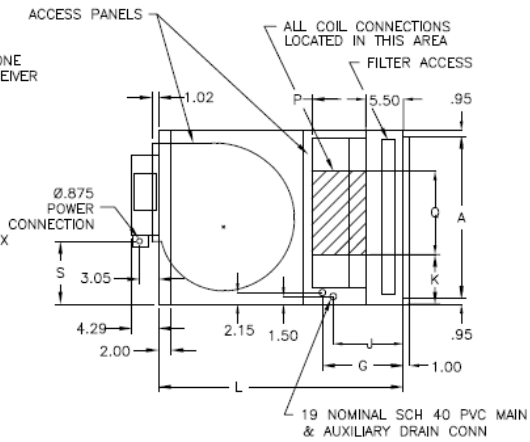
WEIGHT OF BASIC UNIT INCLUDES CABINET, FAN, WIRING AND AVERAGE FILTER. IT DOES NOT INCLUDE COIL, MOTOR OR SHIPPING PACKAGE. PLEASE REFER TO CATALOG FOR MOTOR WEIGHTS.

ADD TO BASIC UNIT WEIGHT, 7 LBS FOR WEIGHT OF CONTROL BOX.

CONTROL BOX FACTORY MOUNTED ON MOTOR SIDE.

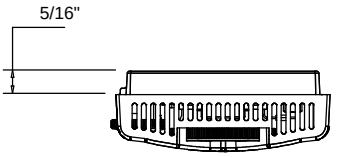




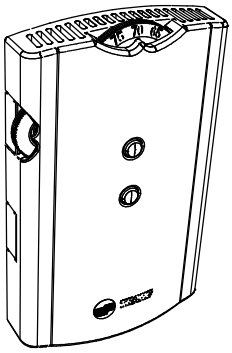


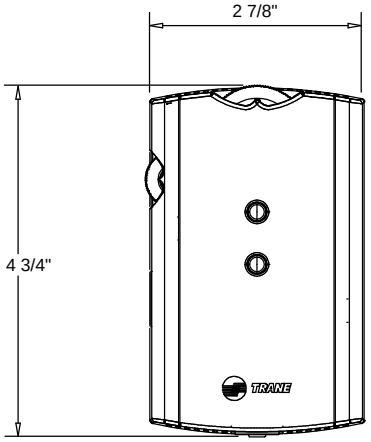
UNIT SIZE	H	W	L	A	B	C	D	E	F	G R.H.	G L.H.	J R.H.	J L.H.	K	M	P	Q	R	S	T	BASIC UNIT WEIGHT
12	14.00	24.00	31.15	12.09	18.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	8.24	9.00	5.75	1.35	.99	4.26	64.0
18	14.00	28.00	31.15	12.09	22.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	10.24	9.00	5.75	3.42	.99	4.19	69.0
24	18.00	28.00	33.72	16.09	22.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	9.68	9.00	5.75	2.73	1.17	4.09	89.6
36	18.00	40.00	33.72	16.09	34.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	15.68	9.00	5.75	8.64	1.01	4.19	104.5
54	22.00	40.00	41.57	20.09	34.00	13.58	12.57	0.72	3.00	11.42	13.42	9.42	11.42	7.43	13.72	11.00	7.27	6.87	5.01	4.19	129.9
72	22.00	48.00	41.57	20.09	40.00	13.58	12.57	0.72	4.00	11.42	13.42	9.42	11.42	7.43	17.72	11.00	7.27	10.87	5.01	4.19	142.0
90	28.00	48.00	43.94	26.09	40.00	13.58	12.57	1.66	4.00	12.79	14.79	10.79	12.79	8.24	17.72	11.25	11.64	10.92	11.14	4.14	162.8

X1379084501-Zone Sen Set TOV Fan

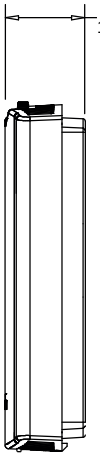


TOP VIEW

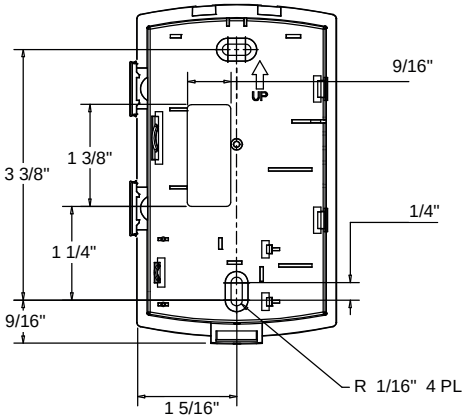




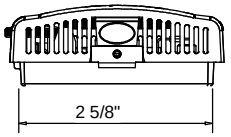
FRONT VIEW



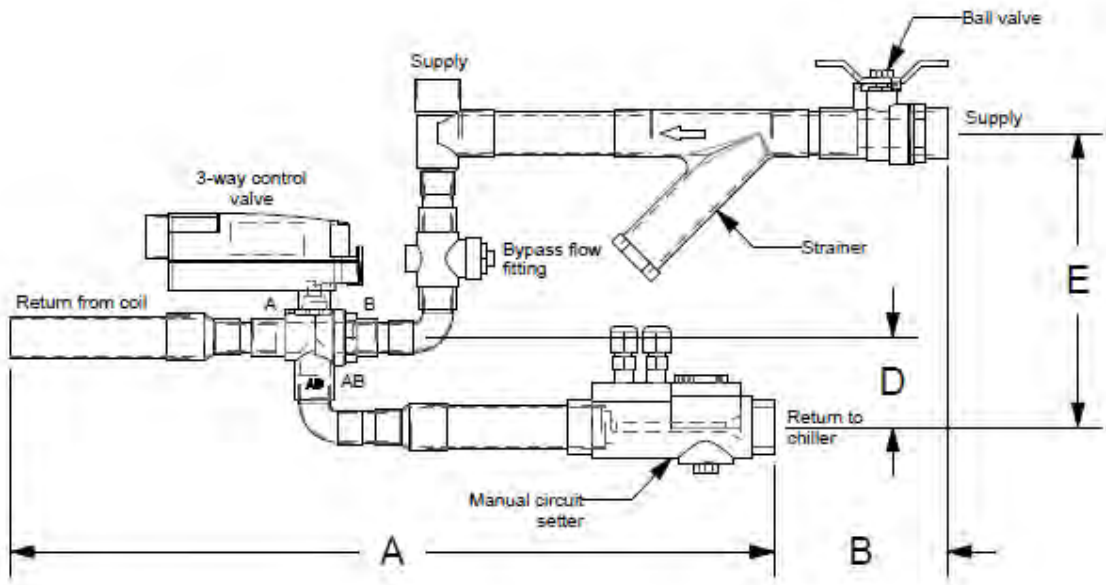
SIDE VIEW



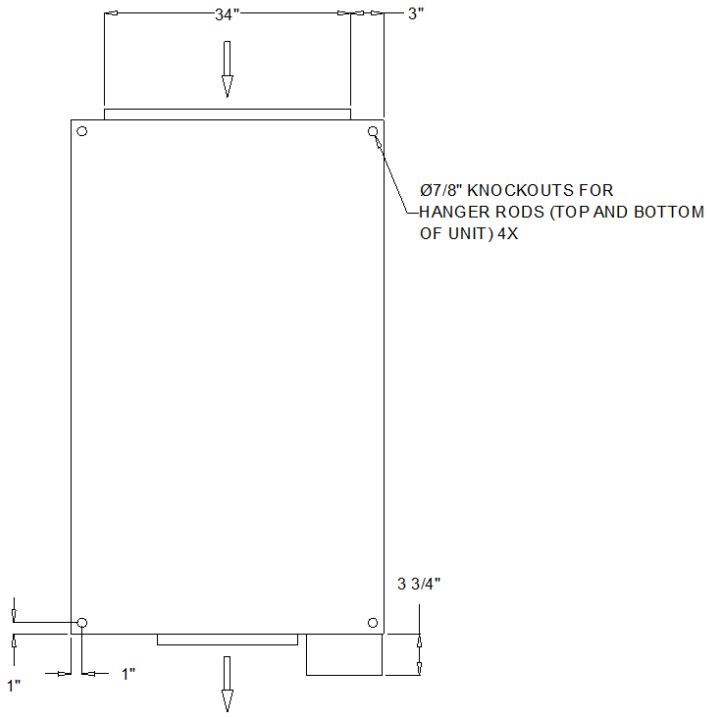
FRONT VIEW
MOUNTING BASE



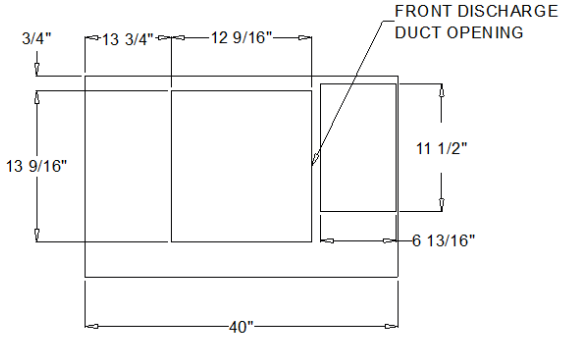
BOTTOM VIEW



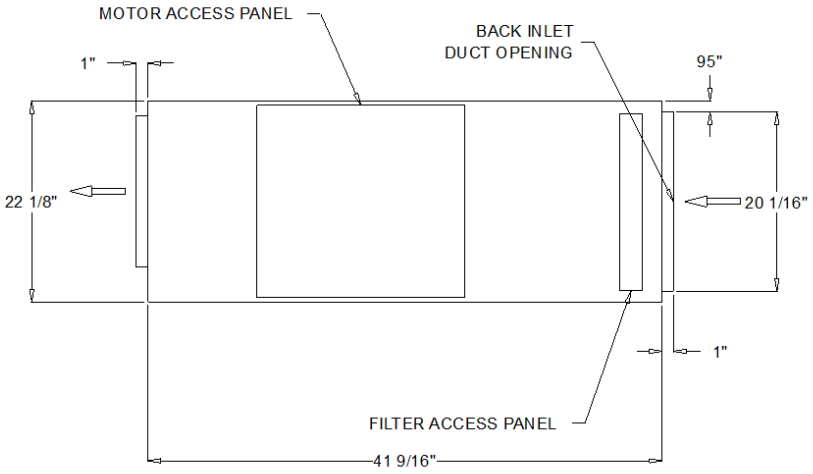
PIPING PACKAGE	NOMINAL TUBE SIZE	ACTUAL SIZE	VALVE SIZE	A	B	C	D	E	F
2-WAY, BASIC	.750	.875	.750	11.31	2.62	-	-	-	-
2-WAY, BASIC	1.000	1.125	1.000	16.06	4.40	-	-	-	-
2-WAY, BASIC	1.250	1.375	1.000	16.04	3.70	-	-	-	-
2-WAY, DELUXE	.750	.875	.750	11.31	-	6.87	-	-	-
2-WAY, DELUXE	1.000	1.125	1.000	16.06	-	9.76	-	-	-
2-WAY, DELUXE	1.250	1.375	1.000	16.04	-	9.95	-	-	-
3-WAY, BASIC	.750	.875	.500	14.17	0.96	-	1.86	6.07	-
3-WAY, BASIC	.750	.875	.750	11.11	3.28	-	2.39	7.45	-
3-WAY, BASIC	1.000	1.125	1.000	14.71	1.35	-	-	6.68	5.51
3-WAY, BASIC	1.250	1.375	1.000	17.32	1.22	-	-	7.57	7.02
3-WAY, DELUXE	.750	.875	.500	14.17	5.21	-	1.86	6.07	-
3-WAY, DELUXE	.750	.875	.750	11.11	7.53	-	2.39	7.45	-
3-WAY, DELUXE	1.000	1.125	1.000	16.06	4.02	-	5.51	6.68	-
3-WAY, DELUXE	1.250	1.375	1.000	18.54	5.03	-	7.02	7.57	-



TOP VIEW



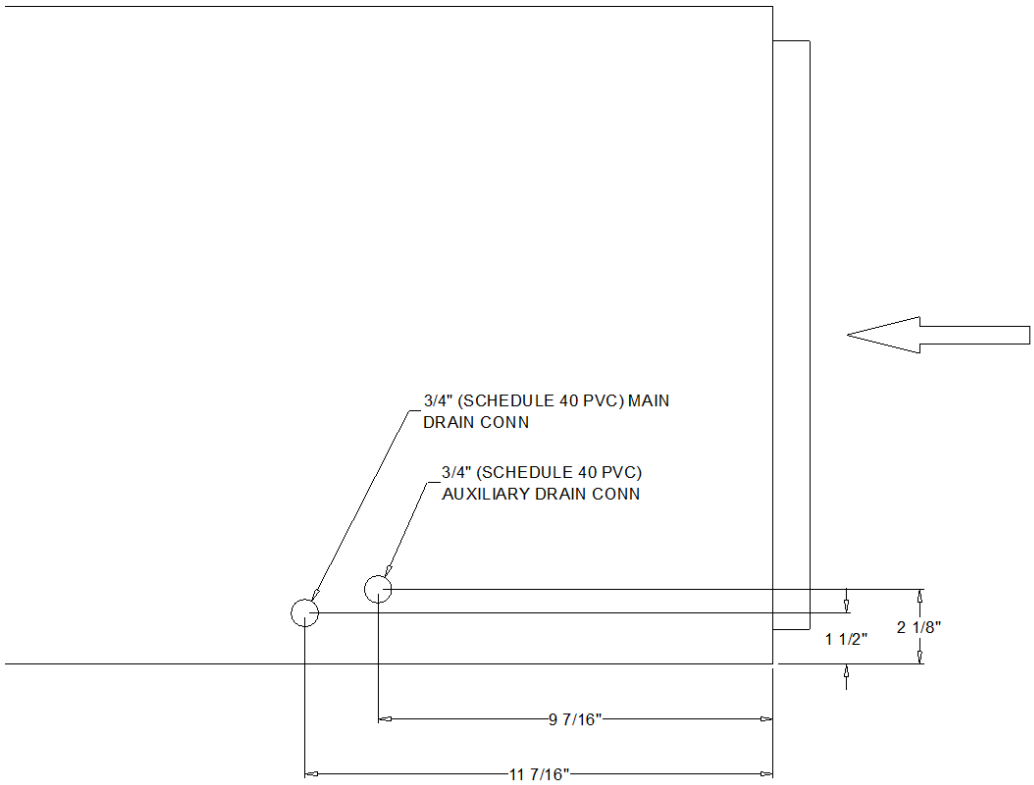
FRONT VIEW



RIGHT VIEW

NOTES:
1. ACCESS PANELS ARE LOCATED ON BOTH SIDES OF THE UNIT TO PROVIDE ACCESS TO THE UNIT'S INTERNAL COMPONENTS.

2. CONTROL BOX IS FACTORY MOUNTED ON DRIVE SIDE AND PROVIDED WITH 7/8" DIAMETER KNOCKOUTS FOR FIELD WIRING.
3. ARROWS INDICATE THE DIRECTION OF AIRFLOW.



RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE SHOWN FROM THE BOTTOM REAR CORNER OF UNIT.
2. STUBOUTS PROTRUDE 2 1/8" FROM EXTERIOR CASING OF UNIT.
3. ARROW INDICATES THE DIRECTION OF AIRFLOW.
4. DRAIN CONNECTIONS ARE UNTHREADED.

NOTES:

1. WEIGHT OF BASIC UNIT INCLUDES ONLY CABINET, FAN, AVERAGE DRIVE, WIRING AND AVERAGE FILTER.

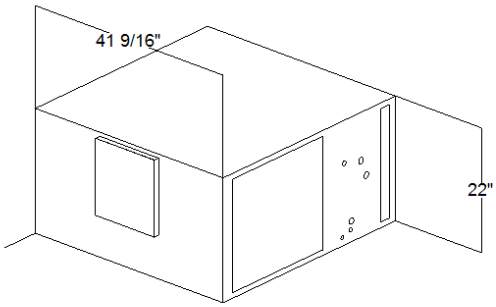
2. WEIGHT OF STEAM COIL MODULE INCLUDES ONLY CABINET WITH AVERAGE FILTER.

3. BEFORE PREPARING ANY UNIT OR ACCESSORY MODULE FOR LIFTING, ESTIMATE THE APPROXIMATE CENTER OF GRAVITY AND TEST LIFT THE UNIT OR ACCESSORY MODULE TO DETERMINE BALANCE AND STABILITY. USE A PROPER RIGGING METHOD SUCH AS STRAPS, SLINGS OR SPREADER BARS FOR PROTECTION AND SAFETY BEFORE HOISTING THE UNIT OR ACCESSORY MODULE.

4. DO NOT LIFT UNITS OR ACCESSORY MODULES IN WINDY CONDITIONS OR ABOVE INSTALLATION PERSONNEL. FAILURE TO PROPERLY LIFT UNIT OR ACCESSORY MODULE COULD RESULT IN DEATH, SERIOUS INJURY, EQUIPMENT DAMAGE OR PROPERTY-ONLY DAMAGE.

5. DO NOT RIG OR LIFT UNITS OR ACCESSORY MODULES WITH FORK LIFT FORKS.

6. ASSEMBLY OF THE UNIT MUST BE PERFORMED AT THE INSTALLATION SITE. ALWAYS RIG UNITS AND ACCESSORY MODULES AS SHIPPED FROM THE FACTORY.



ISO1 VIEW

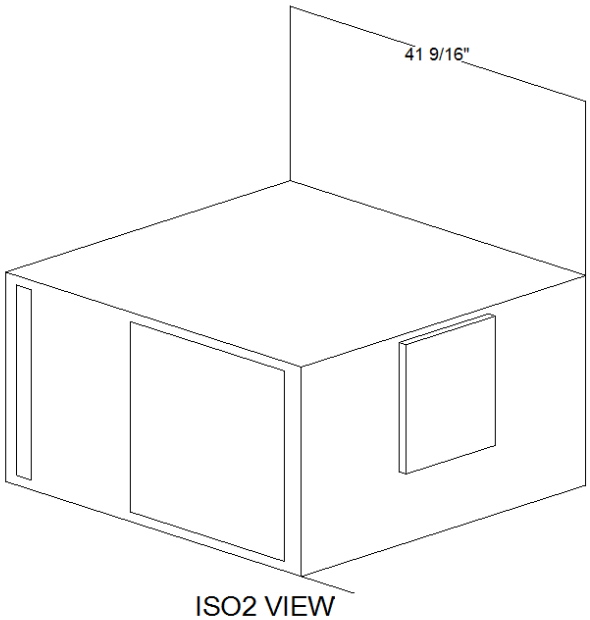
UNIT, COIL & ACCESSORY MODULE WEIGHTS

BASIC UNIT	COIL 1 DRY	COIL 1 WET	COIL 2 DRY	COIL 2 WET	MOTOR	ELECTRIC HEATER	MIXING BOX	ANGLED FILTER BOX	ANGLED FILTER MIXING BOX
129.9 lb	17.6 lb	22.4 lb	33.0 lb		19.0 lb				

FILTER ACCESS MODULE	STEAM COIL MODULE

STEAM COIL DRY	STEAM COIL WET

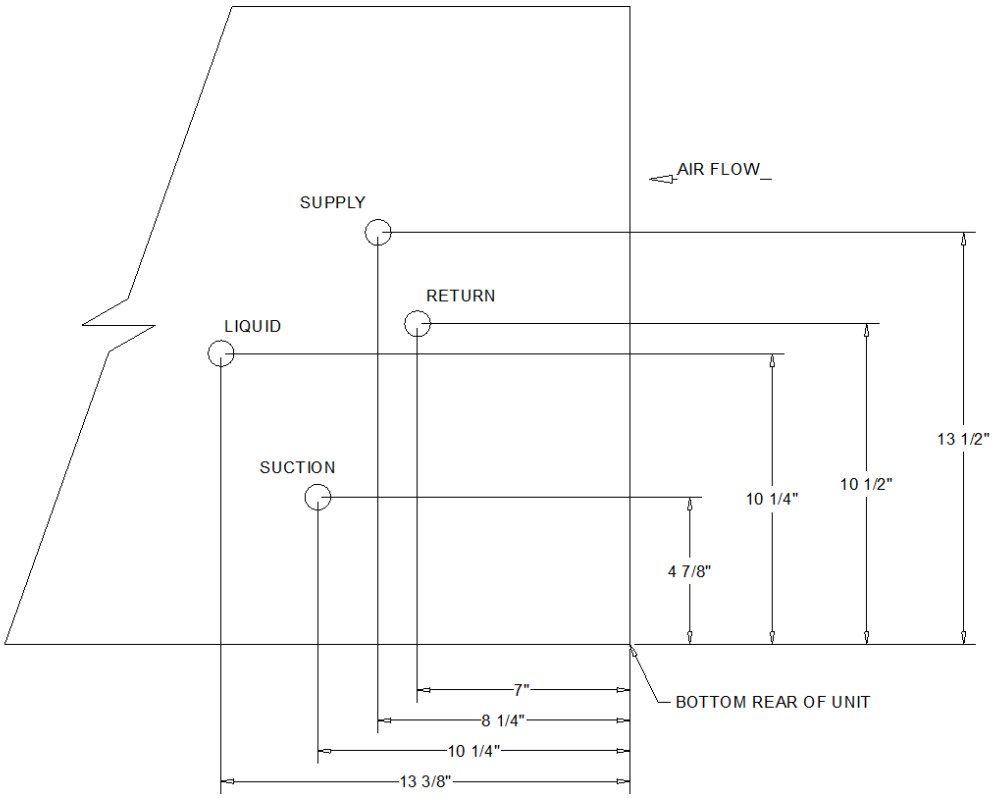
UNIT SIZE	SERVICE CLEARANCE
54	37"



ISO2 VIEW

MAIN UNIT COIL CONNECTIONS

RETURN	1 1/8"
SUPPLY	1 1/8"
SUCTION	1 1/8"
LIQUID	7/8"



NOTES:

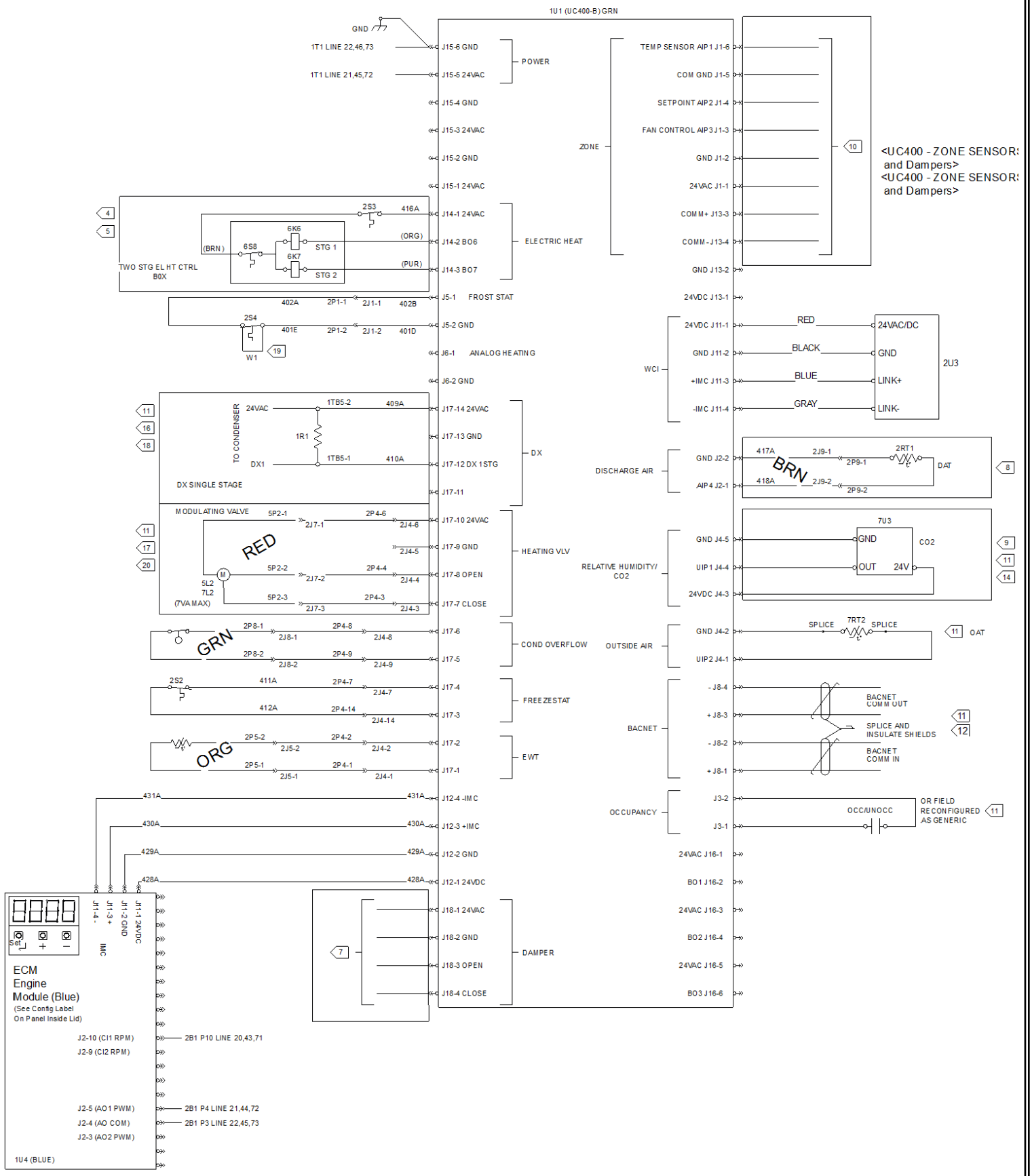
1. PICTORIAL HEADER STUBOUT LOCATIONS RELATIVE TO EACH OTHER MAY NOT BE ACCURATE.

2. LOCATING DIMENSIONS HAVE A PLUS / MINUS 2" TOLERANCE.

3. FOR UNITS WITH A FILTER ACCESS MODULE, ADD 7 3/16" TO HORIZONTAL DIMENSIONS SHOWN.

4. PIPING CONNECTIONS ARE SPECIFIED AS OUTSIDE DIAMETER (O.D.).

5. THERMAL EXPANSION VALVE IS TO BE FIELD SUPPLIED FOR DX COOLING.

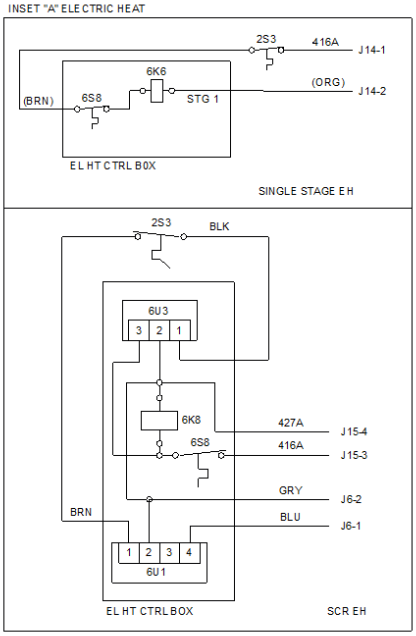

1U1 (UC400-B) GRN
GND
1T1 LINE 22,46,73
1T1 LINE 21,45,72
J15-6 GND
J15-5 24VAC
POWER
J15-4 GND
J15-3 24VAC
J15-2 GND
J15-1 24VAC
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
ZONE
GND J1-2
24VAC J1-1
COMM+ J13-3
COMM- J13-4
GND J13-2
24VDC J13-1
<UC400 - ZONE SENSORS and Dampers>
<UC400 - ZONE SENSORS and Dampers>
2S3
416A
J14-1 24VAC
(ORG)
J14-2 BO6
ELECTRIC HEAT
(PUR)
J14-3 BO7
6K6
6K7
6S8
(BRN)
STG 1
STG 2
TWO STG EL HT CTRL BOX
402A
2P1-1
2J1-1
402B
J5-1 FROST STAT
2S4
401E
2P1-2
2J1-2
401D
J5-2 GND
W1
J6-1 ANALOG HEATING
J6-2 GND
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
WCI
RED
BLACK
BLUE
GRAY
24VAC/DC
GND
LINK+
LINK-
2U3
TO CONDENSER
24VAC
1TB5-2
409A
1R1
DX1
1TB5-1
410A
J17-14 24VAC
J17-13 GND
J17-12 DX 1STG
J17-11
DX
DX SINGLE STAGE
DISCHARGE AIR
GND J2-2
AIP4 J2-1
417A
418A
2J9-1
2J9-2
2P9-1
2P9-2
2RT1
BRN
DAT
MODULATING VALVE
5P2-1
2J7-1
2P4-6
2J4-6
J17-10 24VAC
RED
2J4-5
J17-9 GND
5P2-2
2J7-2
2P4-4
2J4-4
J17-8 OPEN
5L2
7L2
(7VA MAX)
5P2-3
2J7-3
2P4-3
2J4-3
J17-7 CLOSE
HEATING VLV
7U3
GND
OUT
24V
CO2
RELATIVE HUMIDITY/ CO2
GND J4-5
UIP1 J4-4
24VDC J4-3
2P8-1
2J8-1
2P4-8
2J4-8
J17-6
GRN
2P8-2
2J8-2
2P4-9
2J4-9
J17-5
COND OVERFLOW
SPLICE
7RT2
SPLICE
OAT
OUTSIDE AIR
GND J4-2
UIP2 J4-1
2S2
411A
2P4-7
2J4-7
J17-4
412A
2P4-14
2J4-14
J17-3
FREEZESTAT
BACNET
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET COMM OUT
SPLICE AND INSULATE SHIELDS
BACNET COMM IN
2P5-2
2J5-2
2P4-2
2J4-2
J17-2
ORG
2P5-1
2J5-1
2P4-1
2J4-1
J17-1
EWT
OCCUPANCY
J3-2
J3-1
OCC/UNOCC
OR FIELD RECONFIGURED AS GENERIC
431A
430A
429A
428A
J12-4 -IMC
J12-3 +IMC
J12-2 GND
J12-1 24VDC
24VAC J16-1
BO1 J16-2
24VAC J16-3
BO2 J16-4
24VAC J16-5
BO3 J16-6
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER
J1-4 -
J1-3 +
J1-2 GND
J1-1 24VDC
IMC
Set
ECM
Engine
Module (Blue)
(See Config Label On Panel Inside Lid)
J2-10 (CI1 RPM)
J2-9 (CI2 RPM)
J2-5 (AO1 PWM)
J2-4 (AO COM)
J2-3 (AO2 PWM)
2B1 P10 LINE 20,43,71
2B1 P4 LINE 21,44,72
2B1 P3 LINE 22,45,73
1U4 (BLUE)

NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

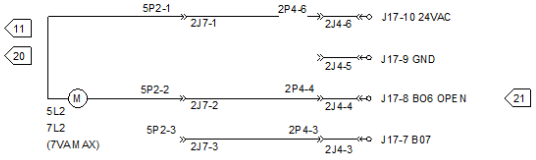
4. ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.
5. WIRING SHOWN IS FOR TWO STAGE ELECTRIC HEAT. SEE INSET "A" FOR SINGLE STAGE EH AND SCR ELECTRIC HEAT.
7. SEE SHEET 2311-4130 FOR DAMPER CONNECTIONS.
8. WIRING SHOWN IS FOR FACTORY INSTALLED DISCHARGE AIR SENSOR. FOR FIELD INSTALLED DISCHARGE AIR SENSOR SEE INSET "E".
9. WIRING SHOWN IS FOR CO2 SENSOR FOR RELATIVE HUMIDITY SENSOR SEE INSET "F".
10. SEE SHEET "UC400 - ZONE SENSORS and DAMPERS" FOR ZONE SENSOR CONNECTIONS.
11. USE CLASS TWO WIRING.
12. COMMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN. CAUTION DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.
14. CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.
16. WIRING SHOWN IS FOR SINGLE STAGE DX SELECTION. SEE INSET "B" FOR DUAL STAGE DX SELECTION.
17. WIRING SHOWN IS FOR MODULATING HEATING VALVE SELECTION. SEE INSET "C" FOR OTHER HEATING VALVE OPTIONS.
18. FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 1TB5-1 TO 1TB5-2 FOR SINGLE STAGE AND 1TB5-2 TO 1TB5-3 FOR DUAL STAGE. REMOVE RESTISTOR 1R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED FOR 24VAC 6VA MAXIMUM.
19. W1 PRESENT ON BCVD UNITS ONLY. REMOVE W1 PRIOR TO CONNECTING COIL SECTION TO FAN SECTION AND INSTALLING WIRING TO 2S4.
20. FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.
21. VALVES SHOWN IN NORMALLY CLOSED POSITION, FOR NORMALLY OPEN POSITION, THE VALVE SIGNAL BECOMES CLOSE.

INSET "A" ELECTRIC HEAT



INSET "C"

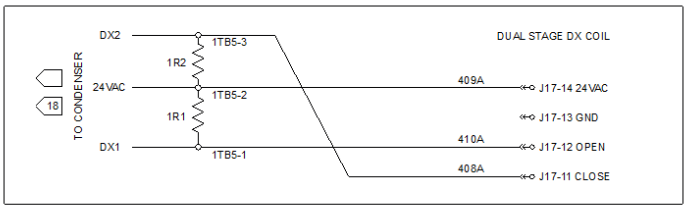
2 POSITION HEATING VALVE



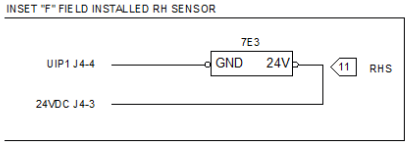
2-10V HEATING VALVE (FIELD SUPPLIED)



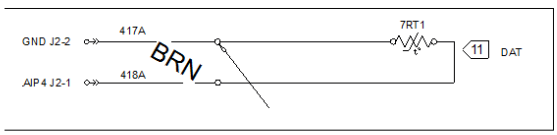
INSET B - DX COILS



INSET "F" FIELD INSTALLED RH SENSOR



INSET "E" FIELD INSTALLED DAT SENSOR



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U4	ENGINE BOARD	115
2S3	EL HT LOCKOUT SWITCH	81,117,122
6K6	CONTACTOR; EL HT STG 1	82,118
6S8	EL HT HIGH TEMP	82,118,127
6K7	CONTACTOR; EL HT STG 2	83
6K8	CONTACTOR; EL HT SCR	126
6U1	CONTACTOR; EL HT SCR	129
6U3	CONTACTOR; EL HT SCR	123
2U3	WIRELESS COM INTERFACE	86
1R1	RESISTOR; DX STG 1 TEST	89,119
1R2	RESISTOR; DX STG 2 TEST	117
5L2	HEATING COIL VALVE MOTOR	94,120
7L2	HEATING COIL VALVE MOTOR	94,120,128
2RT1	DISCHARGE AIR TEMP SNSR	89
7U3	CO2 SENSOR	92
2S1	CONDENSATE OVERFLOW SWTCH	96
7RT2	OUTSIDE AIR TEMP SENSOR	96
2S2	FREEZESTAT	98
5RT1	ENTERING WATER TEMP SENSOR	100
7RT1	FLD INSTLLED DAT SENSOR	134
7E3	ZONE HUMIDITY SENSOR	134
2S4	FROSTSTAT	85

UC400 - ZONE SENSORS and DAMPERS

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
7U1	ZONE SENSOR MODULE	74,75,83,97,105
1U3	WIRELESS RECEIVER	91
4L1	MIXING BX DMPR ACTUATOR	108
7L3	MIXING BX DMPR ACTUATOR	116
7L4	OUTSIDE AIR DMPR ACTUATOR	118

NOTES:

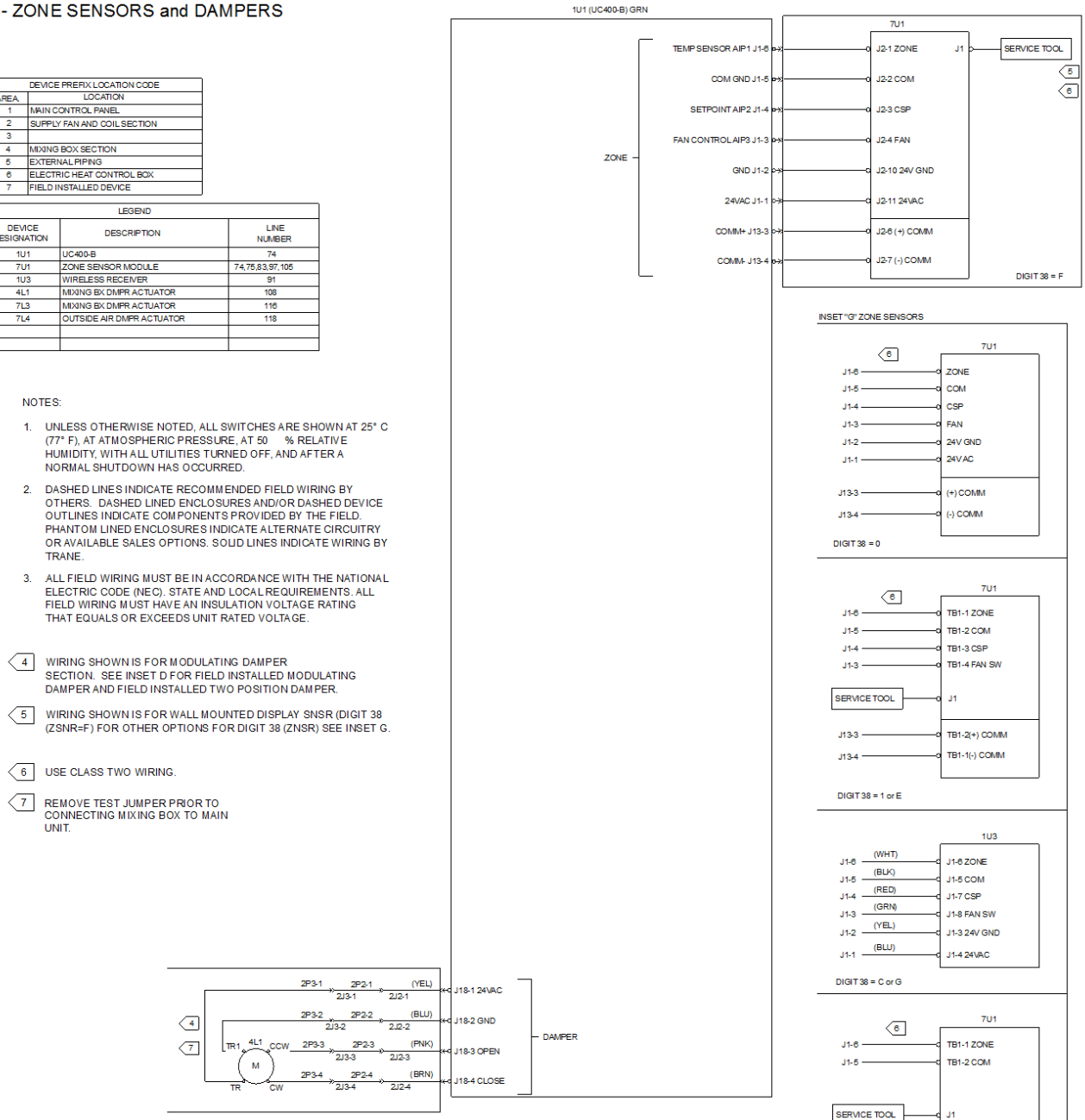
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25° C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINED ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE.

4 WIRING SHOWN IS FOR MODULATING DAMPER SECTION. SEE INSET D FOR FIELD INSTALLED MODULATING DAMPER AND FIELD INSTALLED TWO POSITION DAMPER.

5 WIRING SHOWN IS FOR WALL MOUNTED DISPLAY SNSR (DIGIT 38 (ZSNR=F) FOR OTHER OPTIONS FOR DIGIT 38 (ZNSR) SEE INSET G.

6 USE CLASS TWO WIRING.

7 REMOVE TEST JUMPER PRIOR TO CONNECTING MIXING BOX TO MAIN UNIT.



NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

<4> ELECTRIC HEAT SCHEMATIC IS LOCATED IN THE ELECTRIC HEAT CONTROL BOX PANEL.

<5> WIRING SHOWN IS FOR NO ELECTRIC HEAT. FOR ELECTRIC HEAT SINGLE PHASE SEE INSET A&B. FOR ELECTRIC HEAT THREE PHASE SEE INSET A&C. FOR ELECTRIC HEAT THREE PHASE WITH DRIVER SEE SEE INSET A&D.

<6> CW JUMPER IS PRESENT FROM PIN P5 TO P11 ON UNITS WITH CW MOTOR ROTATION AS VIEWED FROM SHAFT END. JUMPER IS NOT PRESENT ON UNITS WITH CCW ROTATION.

<16> MOTOR VOLTAGE CONFIGURATION P2-P8 JUMPERED FOR 115V OPERATION ONLY.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI- DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCIÓN DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.

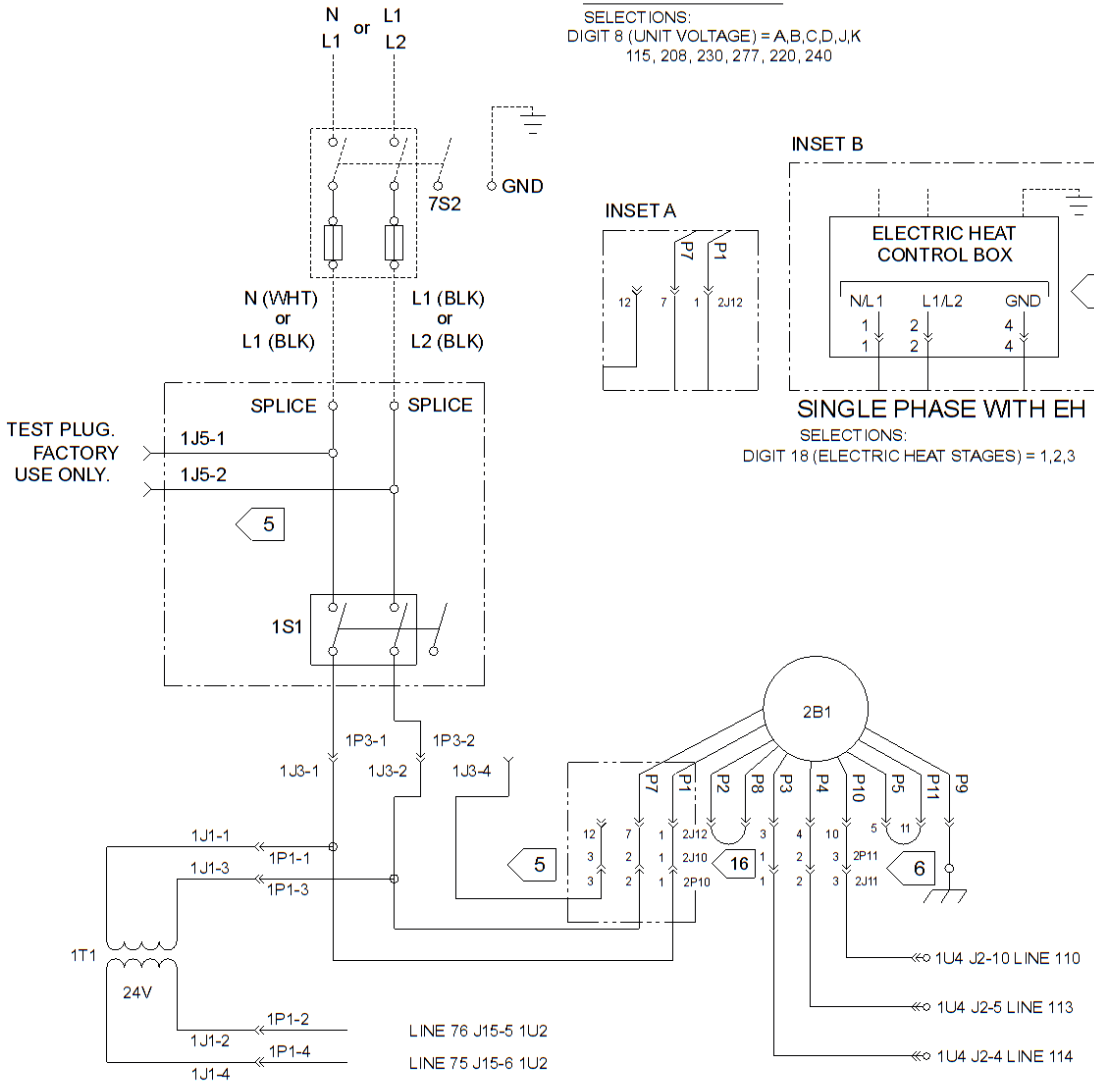
EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.

SEE NAMEPLATE FOR VOLTAGE

N or L1
L1 L2

SINGLE PHASE

SELECTIONS:
DIGIT 8 (UNIT VOLTAGE) = A,B,C,D,J,K
115, 208, 230, 277, 220, 240



SINGLE PHASE WITH EH

SELECTIONS:
DIGIT 18 (ELECTRIC HEAT STAGES) = 1,2,3

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SINGLE PHASE		
7S2	FUSED DISCONNECT SWITCH	3
1S1	MANUAL DISCONNECT SWITCH	13
1T1	TRANSFORMER	19
2B1	FAN MOTOR	14
THREE PHASE (0.5,1 HP)		
7S2	FUSED DISCONNECT SWITCH	25
1S1	MANUAL DISCONNECT SWITCH	36
1T1	TRANSFORMER	43
2B1	FAN MOTOR	37
THREE PHASE WITH DRIVER (1.5, 3.0 HP)		
7S2	FUSED DISCONNECT SWITCH	51
1S1	MANUAL DISCONNECT SWITCH	62
1T1	TRANSFORMER	70
2B1	FAN MOTOR	57
2U1	MOTOR DRIVER	65

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	MAIN CONTROL PANEL
2	SUPPLY FAN AND COIL SECTION
3	
4	MIXING BOX SECTION
5	EXTERNAL PIPING
6	ELECTRIC HEAT CONTROL BOX
7	FIELD INSTALLED DEVICE

Tag: 5 Ton
Quantity: 1
Customer:
Project:
Name: Montclair - Honeywell

HORIZONTAL NON–ELECTRIC HEAT BLOWER COIL

NOTES:

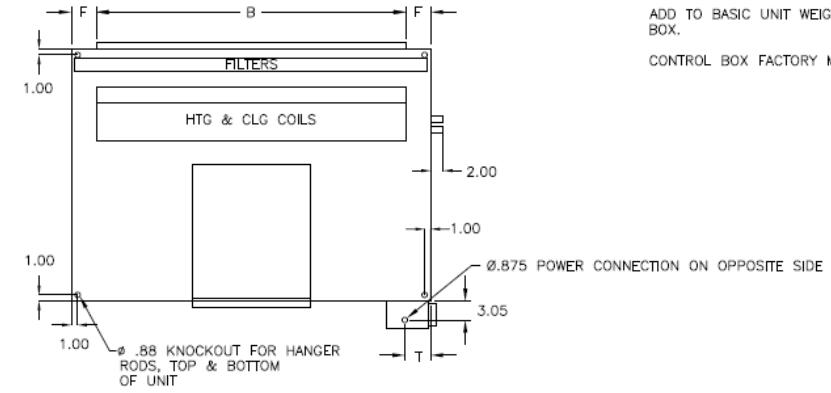
ALL DIMENSIONS ARE IN INCHES

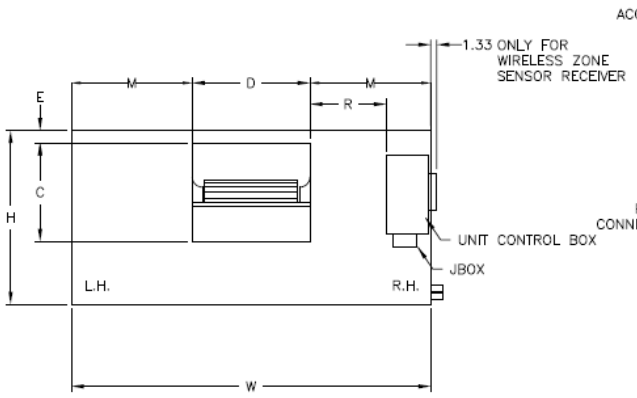
ALL COIL CONNECTIONS ARE SWEAT STYLE.

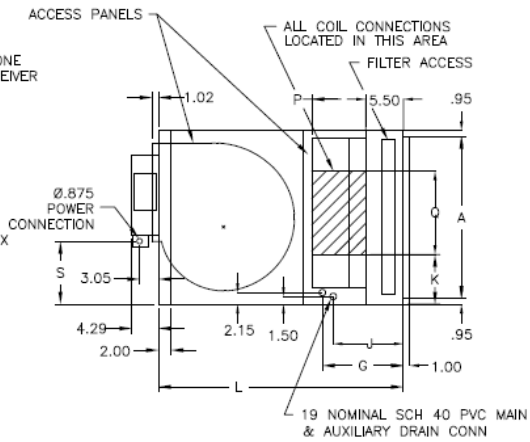
WEIGHT OF BASIC UNIT INCLUDES CABINET, FAN, WIRING AND AVERAGE FILTER. IT DOES NOT INCLUDE COIL, MOTOR OR SHIPPING PACKAGE. PLEASE REFER TO CATALOG FOR MOTOR WEIGHTS.

ADD TO BASIC UNIT WEIGHT, 7 LBS FOR WEIGHT OF CONTROL BOX.

CONTROL BOX FACTORY MOUNTED ON MOTOR SIDE.

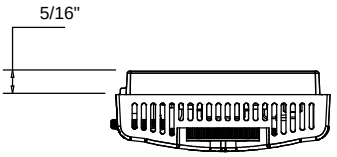




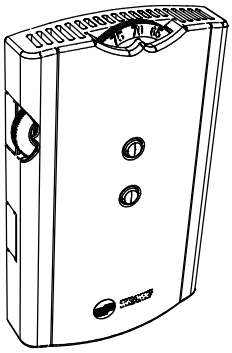


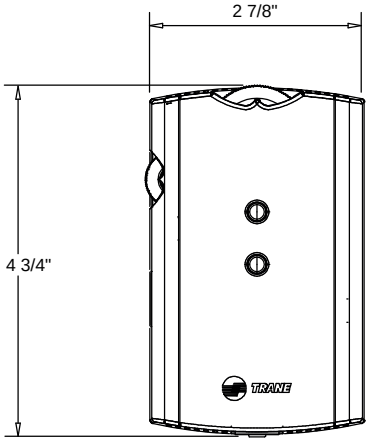
UNIT SIZE	H	W	L	A	B	C	D	E	F	G R.H.	G L.H.	J R.H.	J L.H.	K	M	P	Q	R	S	T	BASIC UNIT WEIGHT
12	14.00	24.00	31.15	12.09	18.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	8.24	9.00	5.75	1.35	.99	4.26	64.0
18	14.00	28.00	31.15	12.09	22.00	10.56	7.47	0.55	3.00	11.42	13.42	9.42	11.42	4.20	10.24	9.00	5.75	3.42	.99	4.19	69.0
24	18.00	28.00	33.72	16.09	22.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	9.68	9.00	5.75	2.73	1.17	4.09	89.6
36	18.00	40.00	33.72	16.09	34.00	13.57	9.04	1.30	3.00	11.42	13.42	9.42	11.42	6.20	15.68	9.00	5.75	8.64	1.01	4.19	104.5
54	22.00	40.00	41.57	20.09	34.00	13.58	12.57	0.72	3.00	11.42	13.42	9.42	11.42	7.43	13.72	11.00	7.27	6.87	5.01	4.19	129.9
72	22.00	48.00	41.57	20.09	40.00	13.58	12.57	0.72	4.00	11.42	13.42	9.42	11.42	7.43	17.72	11.00	7.27	10.87	5.01	4.19	142.0
90	28.00	48.00	43.94	26.09	40.00	13.58	12.57	1.66	4.00	12.79	14.79	10.79	12.79	8.24	17.72	11.25	11.64	10.92	11.14	4.14	162.8

X1379084501-Zone Sen Set TOV Fan

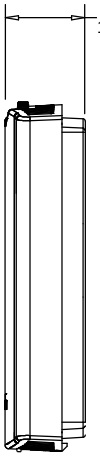


TOP VIEW

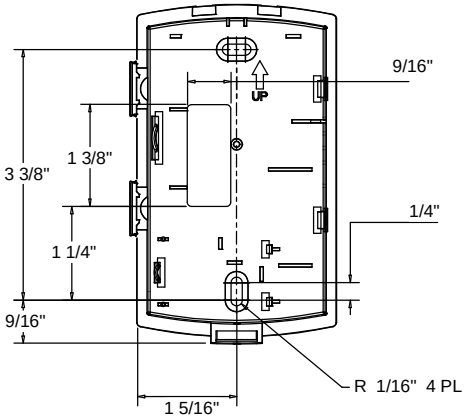




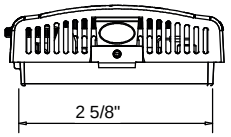
FRONT VIEW



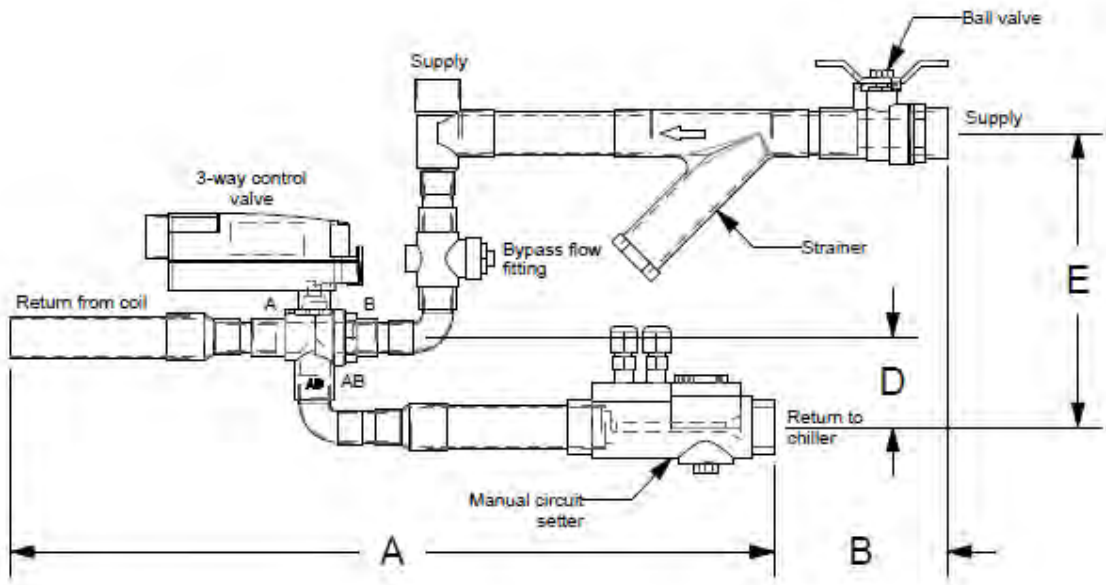
SIDE VIEW



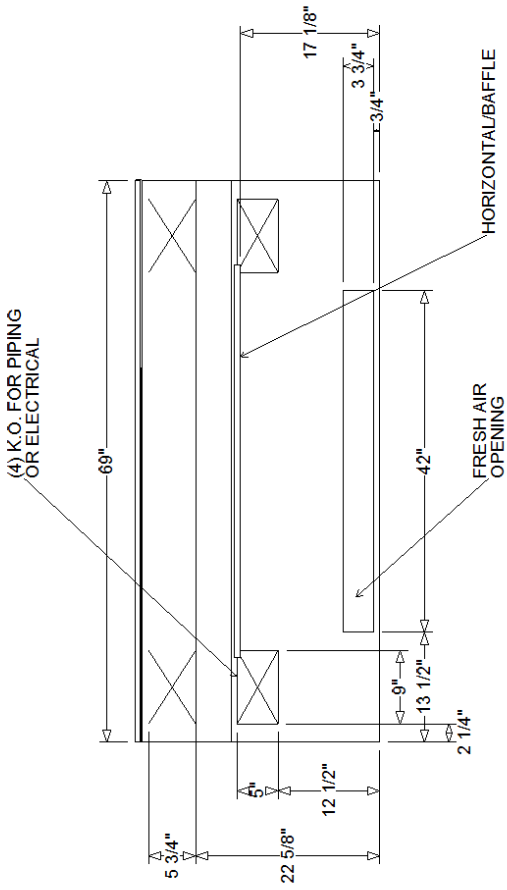
FRONT VIEW
MOUNTING BASE



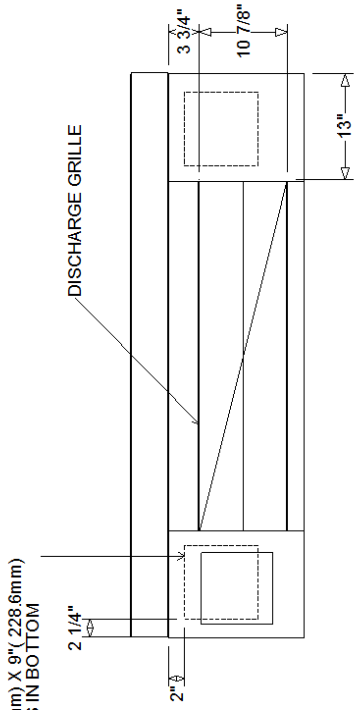
BOTTOM VIEW



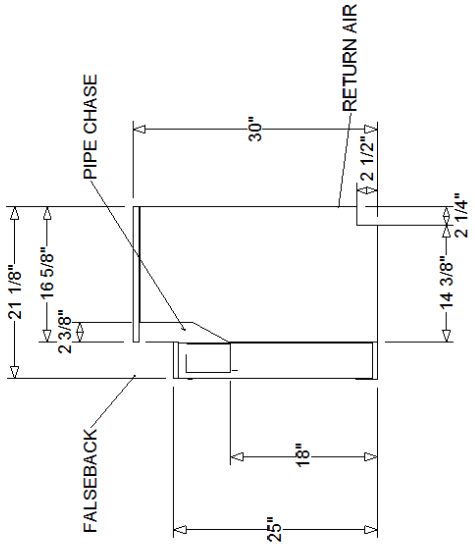
PIPING PACKAGE	NOMINAL TUBE SIZE	ACTUAL SIZE	VALVE SIZE	A	B	C	D	E	F
2-WAY, BASIC	.750	.875	.750	11.31	2.62	-	-	-	-
2-WAY, BASIC	1.000	1.125	1.000	16.06	4.40	-	-	-	-
2-WAY, BASIC	1.250	1.375	1.000	16.04	3.70	-	-	-	-
2-WAY, DELUXE	.750	.875	.750	11.31	-	6.87	-	-	-
2-WAY, DELUXE	1.000	1.125	1.000	16.06	-	9.76	-	-	-
2-WAY, DELUXE	1.250	1.375	1.000	16.04	-	9.95	-	-	-
3-WAY, BASIC	.750	.875	.500	14.17	0.96	-	1.86	6.07	-
3-WAY, BASIC	.750	.875	.750	11.11	3.28	-	2.39	7.45	-
3-WAY, BASIC	1.000	1.125	1.000	14.71	1.35	-	-	6.68	5.51
3-WAY, BASIC	1.250	1.375	1.000	17.32	1.22	-	-	7.57	7.02
3-WAY, DELUXE	.750	.875	.500	14.17	5.21	-	1.86	6.07	-
3-WAY, DELUXE	.750	.875	.750	11.11	7.53	-	2.39	7.45	-
3-WAY, DELUXE	1.000	1.125	1.000	16.06	4.02	-	5.51	6.68	-
3-WAY, DELUXE	1.250	1.375	1.000	18.54	5.03	-	7.02	7.57	-



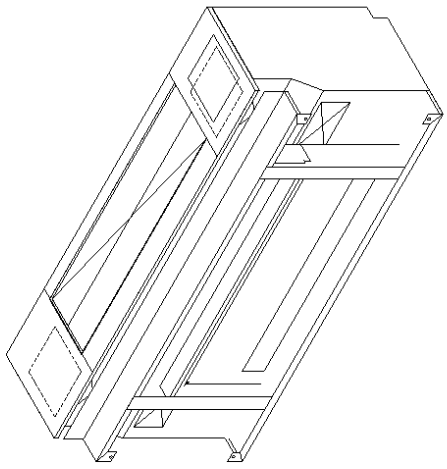
BACK VIEW



TOP VIEW



SIDE VIEW



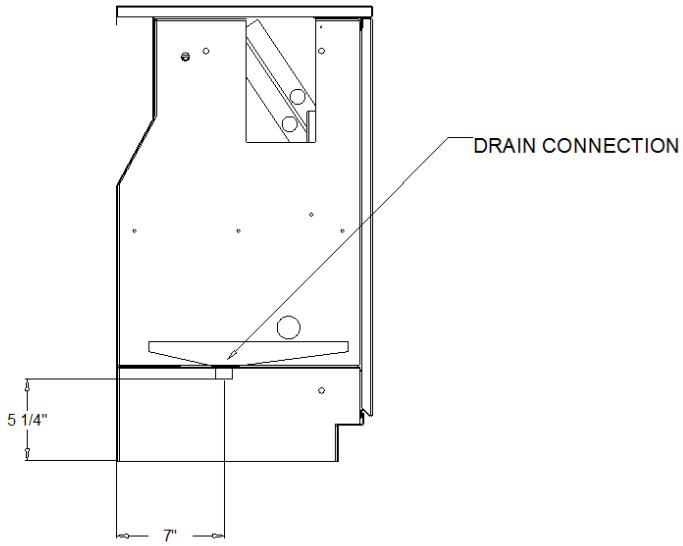
UNIT LENGTH DOES NOT INCLUDE END COVERS.
KNOCKOUTS TO BE USED FOR PIPING AND/OR ELECTRICAL CONNECTIONS.
WHEN ELECTRIC HEAT IS PRESENT, ALL POWER CONNECTIONS ARE MADE IN RIGHT HAND END POCKET. ON ALL OTHERS, CONNECTIONS ARE MADE IN LEFT HAND END POCKET.

WALL BOX MAY BE LOCATED UP TO 1" BELOW THE TOP OF THE UNIT VENTILATOR.

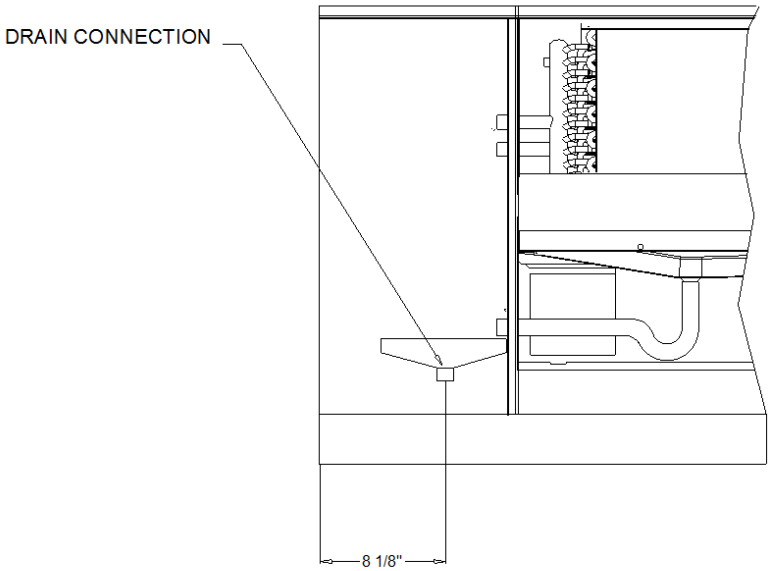
FILTER SIZE	QTY
14"x20"x1"	2

UNIT WEIGHT
320.0 lb

LH AUXILIARY DRAIN CONNECTION

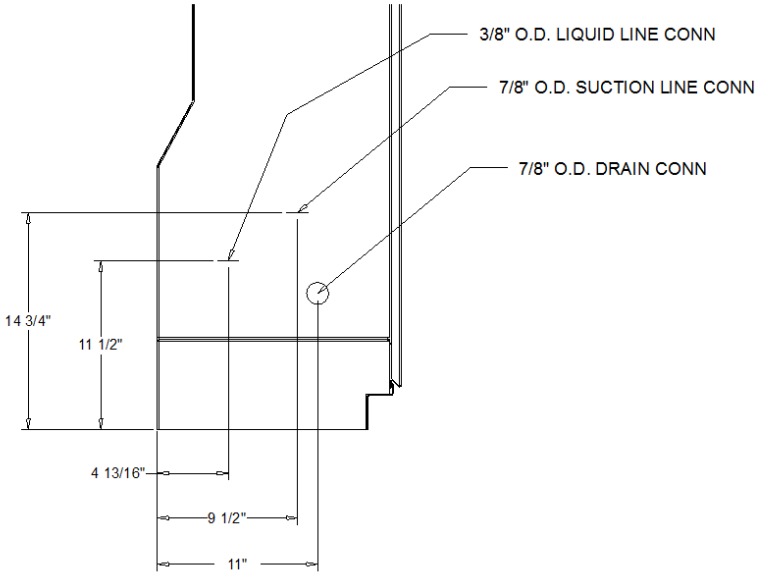


LEFT SIDE VIEW

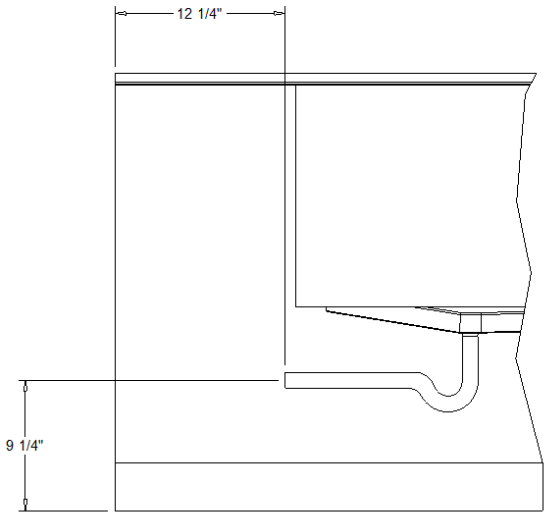


FRONT OF UNIT

DX COIL CONNECTIONS

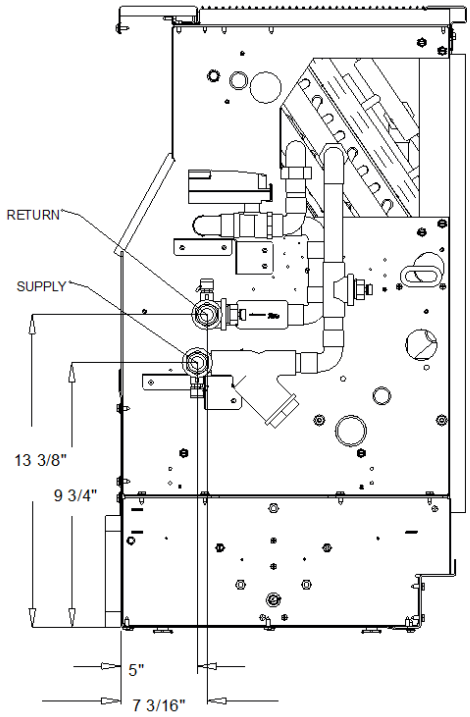


LEFT VIEW

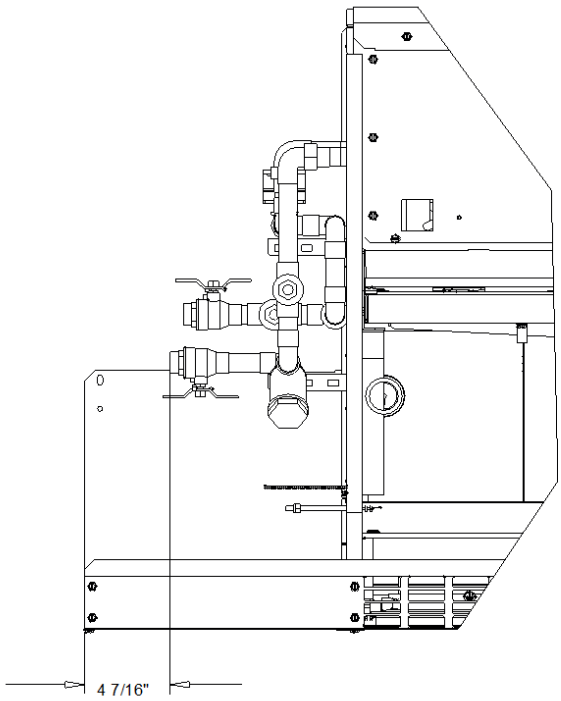


FRONT VIEW

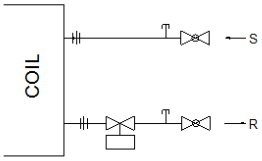
LH MAIN PIPING VALVE CONNECTION

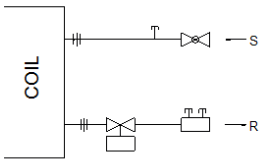


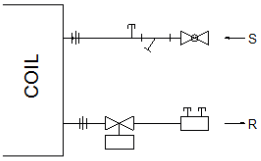
LEFT SIDE

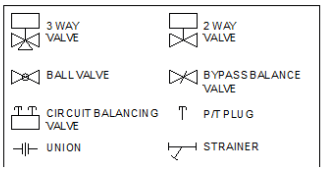


FRONT VIEW

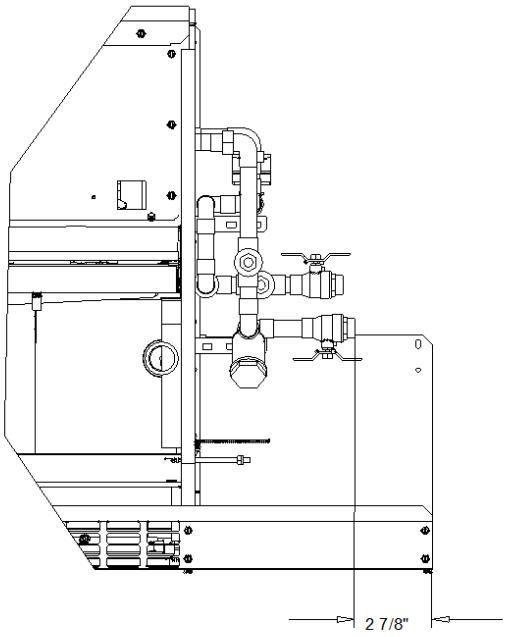




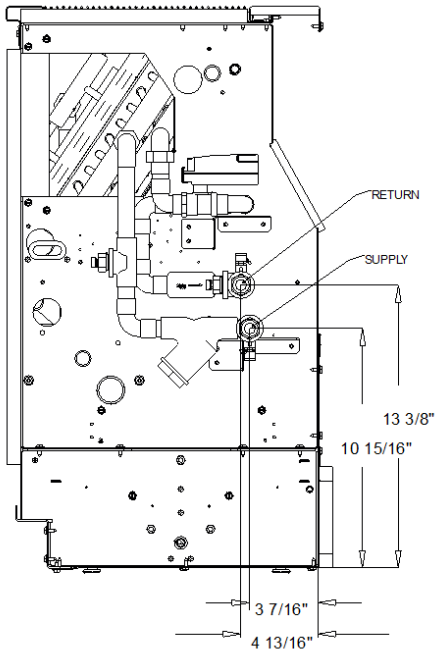




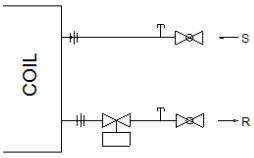
RH AUX PIPING VALVE CONNECTION

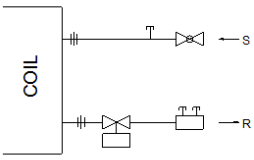


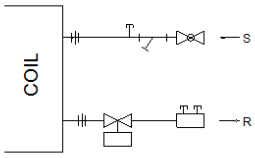
FRONT VIEW

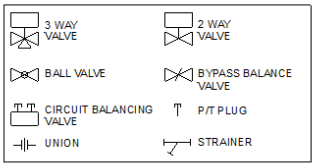


RIGHT SIDE

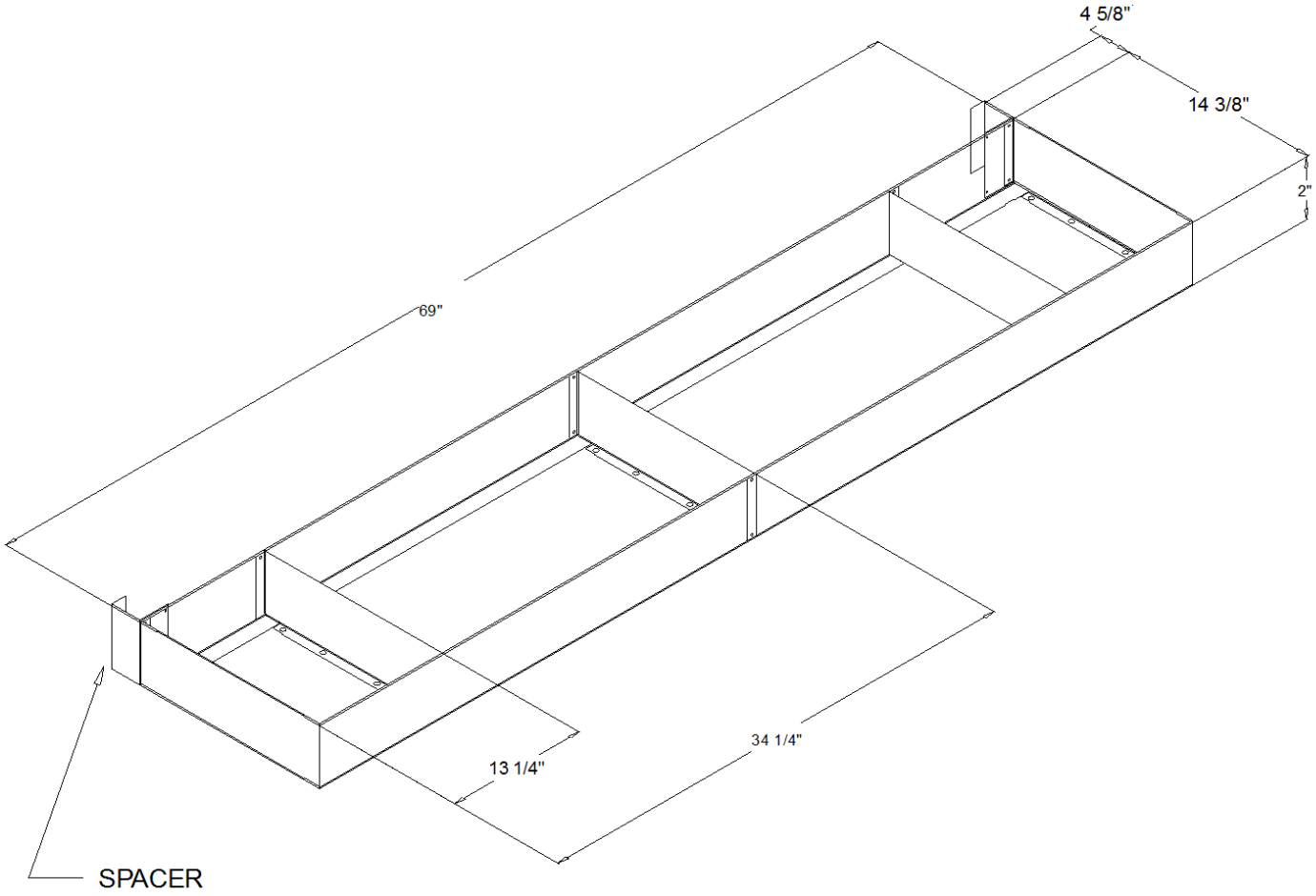




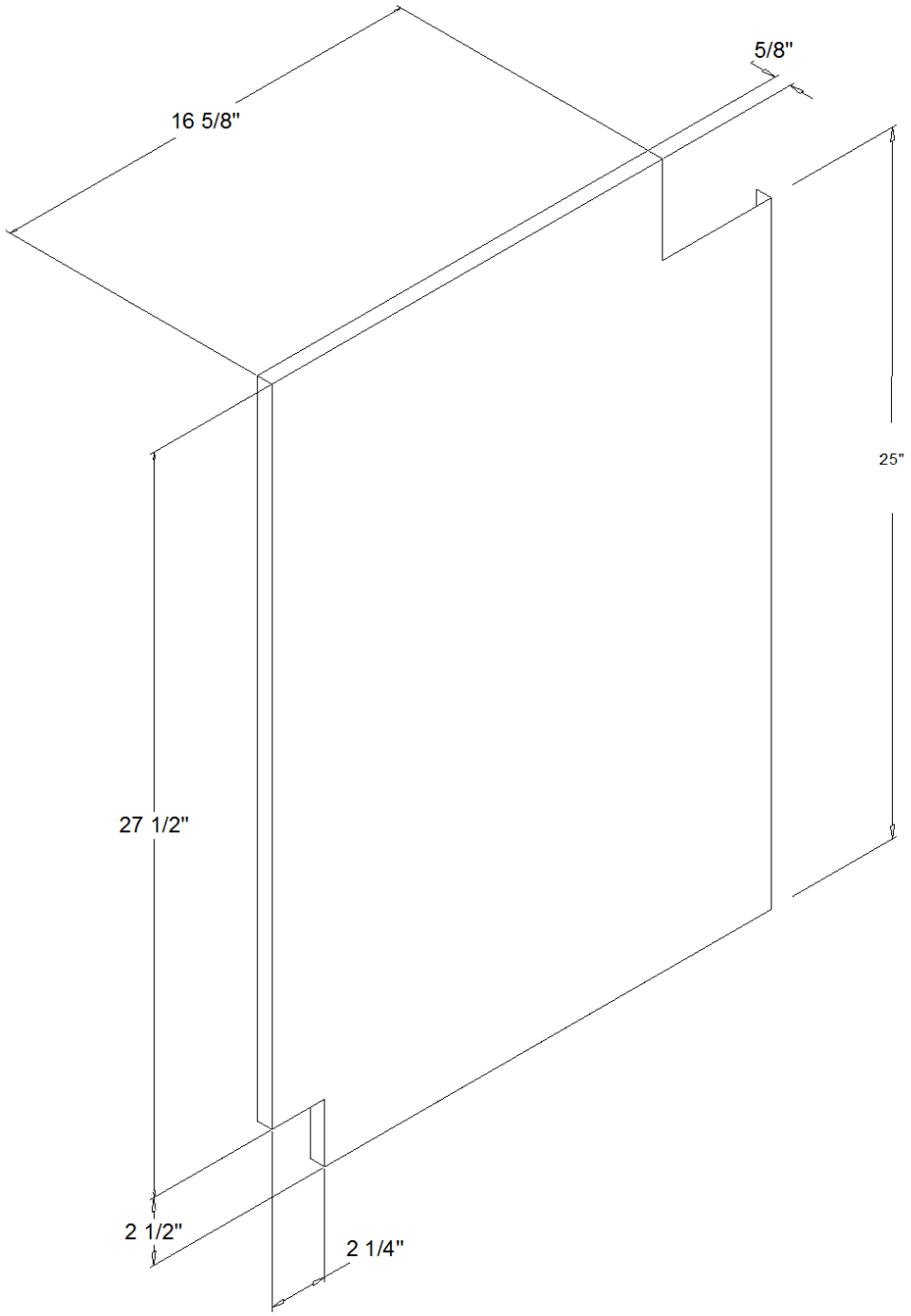




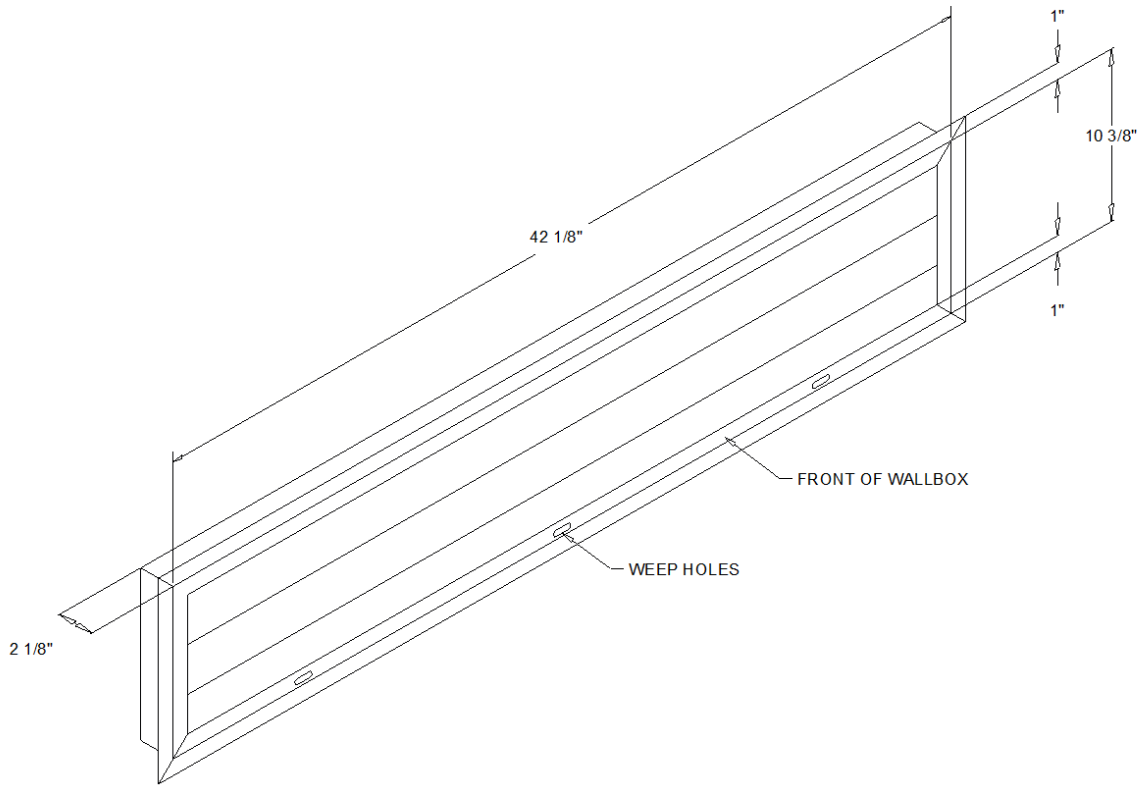
SUBBASE

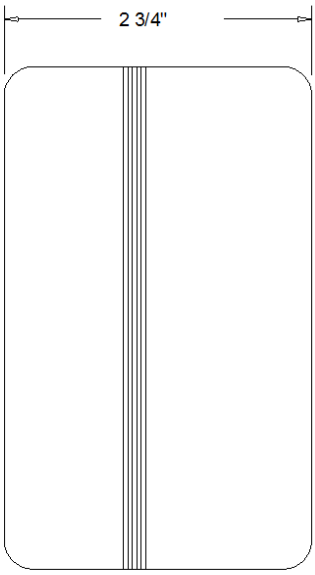


END COVER

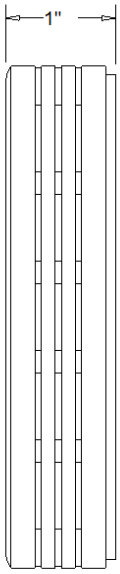


WALLBOX W/HORIZONTAL
LOUVERS & FLANGE

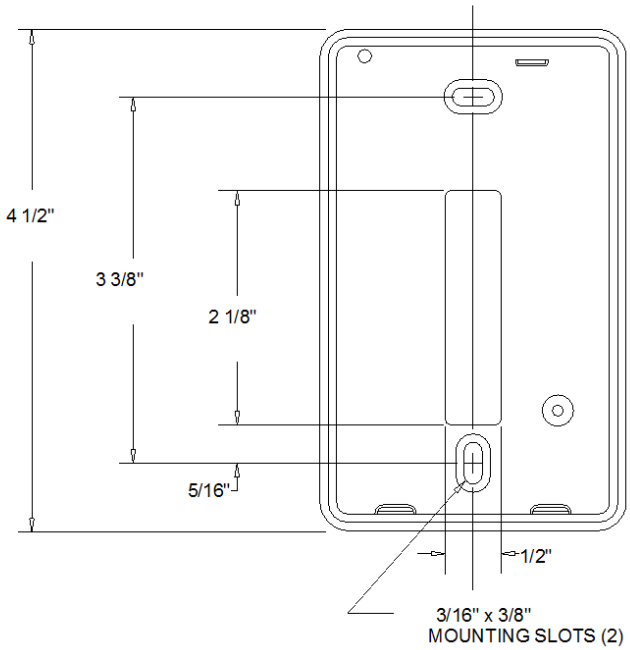




FRONT VIEW

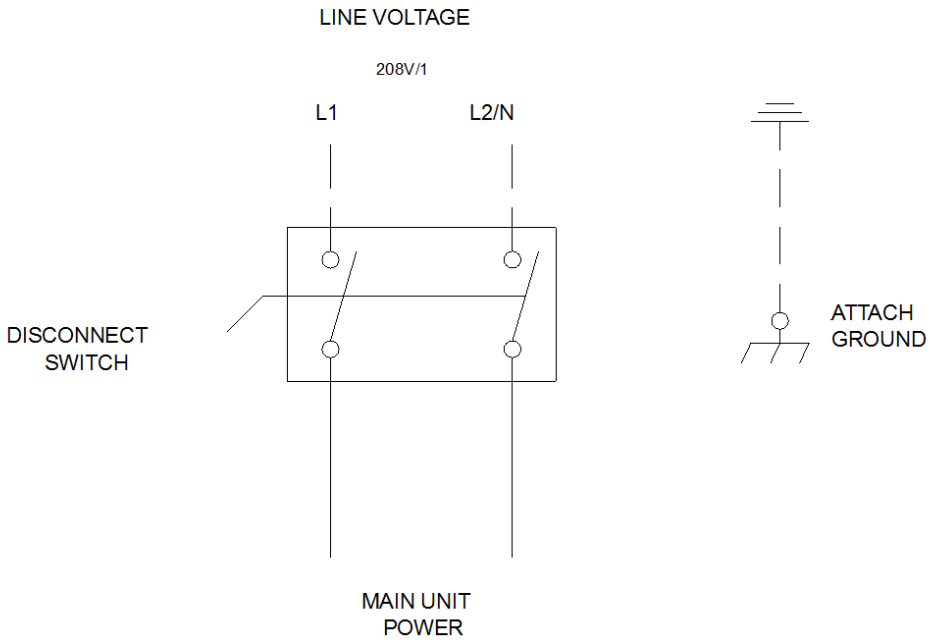


RIGHT SIDE VIEW



BACK VIEW

UNIT POWER WIRING



NOTES:

1. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY OTHERS. SOLID LINES INDICATE WIRING BY THE TRANE CO.

2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNIT'S WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

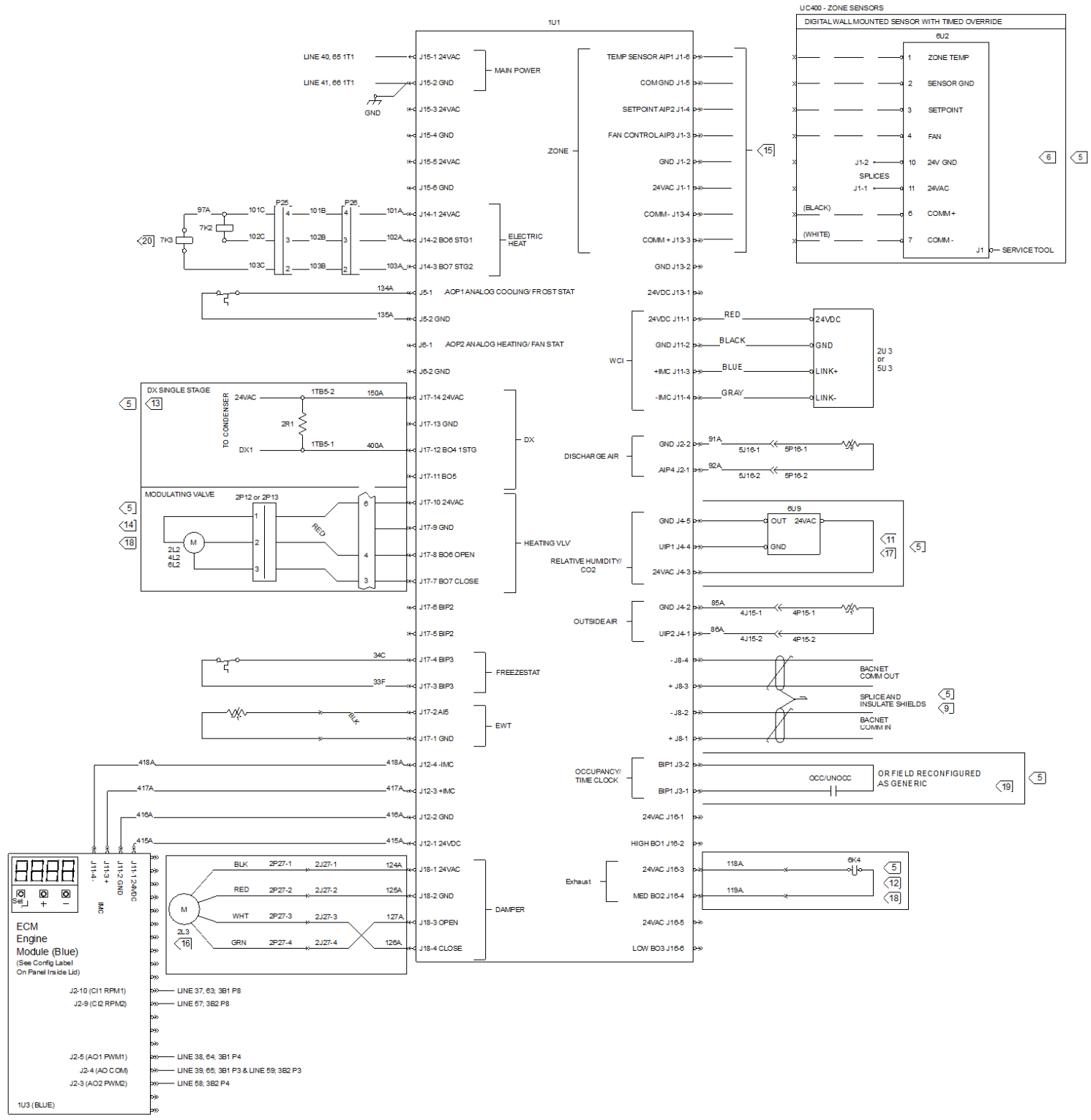
NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

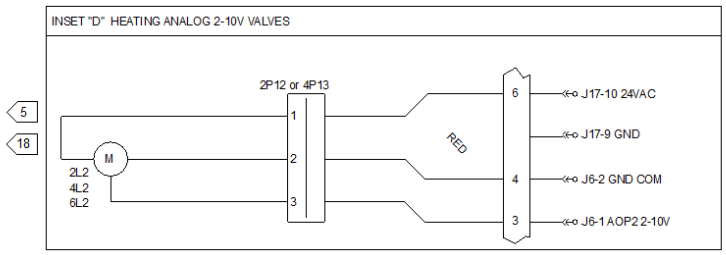
⚠ ADVERTENCIA

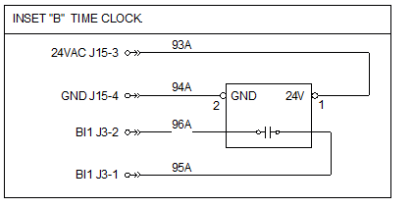
¡VOLTAJE PELIGROSO!

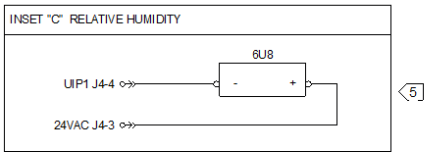
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EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.


1U1
UC400 - ZONE SENSORS
DIGITAL WALL MOUNTED SENSOR WITH TIMED OVERRIDE
6U2
LINE 40, 65 1T1
LINE 41, 66 1T1
GND
J15-1 24VAC
J15-2 GND
J15-3 24VAC
J15-4 GND
J15-5 24VAC
J15-6 GND
MAIN POWER
ZONE
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
GND J1-2
24VAC J1-1
COMM- J13-4
COMM + J13-3
GND J13-2
24VDC J13-1
1 ZONE TEMP
2 SENSOR GND
3 SETPOINT
4 FAN
10 24V GND
11 24VAC
6 COMM+
7 COMM-
J1-2
J1-1
SPLICES
(BLACK)
(WHITE)
J1 SERVICE TOOL
97A
7K2
7K3
101C
102C
103C
101B
102B
103B
101A
102A
103A
P25
P26
J14-1 24VAC
J14-2 BO6 STG1
J14-3 BO7 STG2
ELECTRIC HEAT
134A
135A
J5-1 AOP1 ANALOG COOLING/ FROST STAT
J5-2 GND
J6-1 AOP2 ANALOG HEATING/ FAN STAT
J6-2 GND
WCI
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
RED
BLACK
BLUE
GRAY
24VDC
GND
LINK+
LINK-
2U 3
or
5U 3
DX SINGLE STAGE
TO CONDENSER
24VAC
DX1
2R1
1TB5-2
1TB5-1
150A
400A
J17-14 24VAC
J17-13 GND
J17-12 BO4 1STG
J17-11 BO5
DX
DISCHARGE AIR
GND J2-2
AIP4 J2-1
91A
92A
5J16-1
5P16-1
5J16-2
5P16-2
MODULATING VALVE
2P12 or 2P13
2L2
4L2
6L2
RED
J17-10 24VAC
J17-9 GND
J17-8 BO6 OPEN
J17-7 BO7 CLOSE
HEATING VLV
RELATIVE HUMIDITY/
CO2
6U9
OUT 24VAC
GND
GND J4-5
UIP1 J4-4
24VAC J4-3
J17-6 BIP2
J17-5 BIP2
OUTSIDE AIR
GND J4-2
UIP2 J4-1
85A
86A
4J15-1
4P15-1
4J15-2
4P15-2
34C
33F
J17-4 BIP3
J17-3 BIP3
FREEZESTAT
BLK
J17-2 AI5
J17-1 GND
EWT
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET
COMM OUT
SPLICE AND
INSULATE SHIELDS
BACNET
COMM IN
418A
417A
416A
415A
J12-4 -IMC
J12-3 +IMC
J12-2 GND
J12-1 24VDC
OCCUPANCY/
TIME CLOCK
BIP1 J3-2
BIP1 J3-1
OCC/UNOCC
OR FIELD RECONFIGURED
AS GENERIC
24VAC J16-1
HIGH BO1 J16-2
24VAC J16-3
MED BO2 J16-4
24VAC J16-5
LOW BO3 J16-6
Exhaust
118A
119A
6K4
BLK
RED
WHT
GRN
2P27-1
2P27-2
2P27-3
2P27-4
2J27-1
2J27-2
2J27-3
2J27-4
124A
125A
127A
126A
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER
2L3
ECM
Engine
Module (Blue)
(See Config Label
On Panel Inside Lid)
J11-4-
J11-3+
J11-2 GND
J11-1 24VDC
IMC
J2-10 (CI1 RPM1)
J2-9 (CI2 RPM2)
J2-5 (AO1 PWM1)
J2-4 (AO COM)
J2-3 (AO2 PWM2)
LINE 37, 63; 3B1 P8
LINE 57; 3B2 P8
LINE 38, 64; 3B1 P4
LINE 39, 65; 3B1 P3 & LINE 59; 3B2 P3
LINE 58; 3B2 P4
1U3 (BLUE)







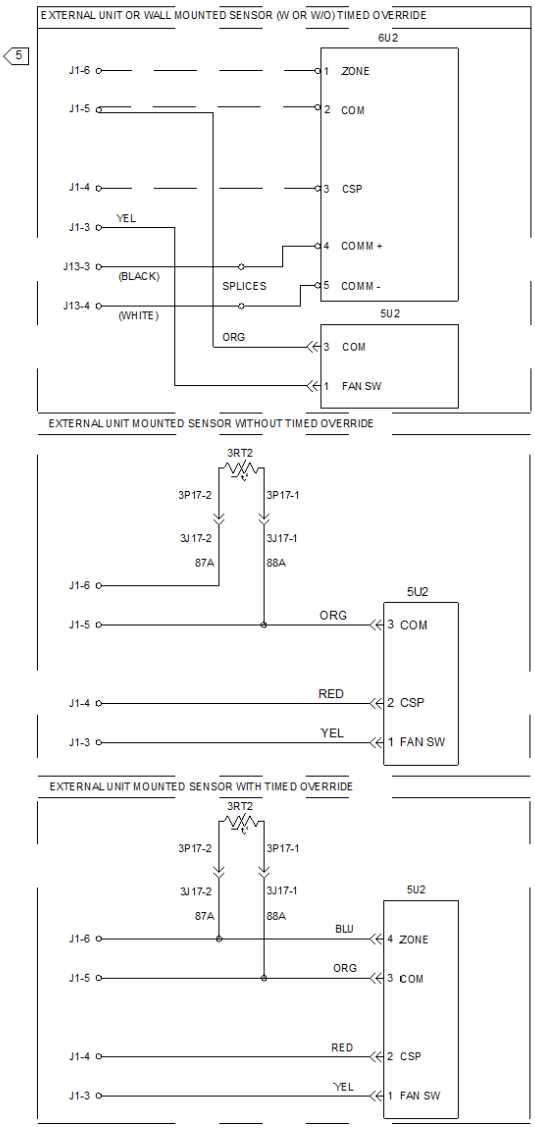
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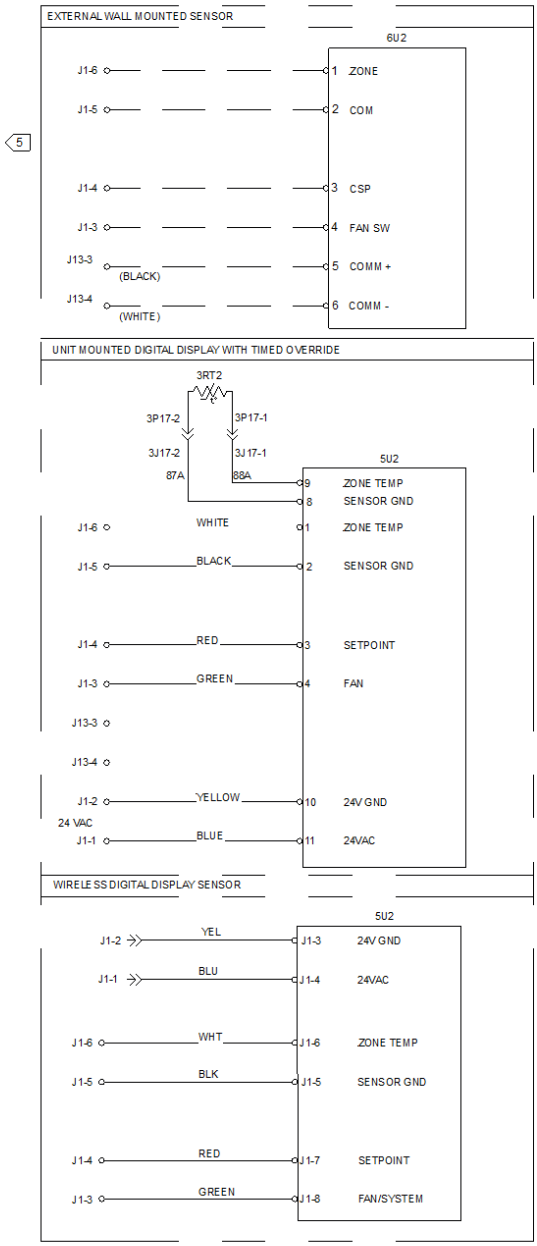
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
4. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE
5. USE CLASS 2 WIRING.
9. COMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN.
   CAUTION! DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.
11. CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.
12. FOR WIRED POWER EXHAUST, 24VAC 12VA MAXIMUM.
13. FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 2TB4-1 AND 2TB4-2 FOR SINGLE STAGE. REMOVE RESISTOR 2R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED 24VAC 6VA MAXIMUM.
14. WIRING SHOWN IS FOR MODULATING VALVE SECTION. SEE INSET "D" FOR HEATING 2-10V VALVE SELECTIONS.
15. SEE SHEET "UC400 - ZONE SENSORS" FOR ZONE SENSOR CONNECTIONS.
16. WIRING SHOWN IS FOR 3 WIRE MODULATING DAMPER SECTION. SEE INSET "A" FOR ERSA CONNECTIONS.
17. WIRING SHOWN IS FOR CO2 SENSOR. SEE INSET "C" FOR RELATIVE HUMIDITY SENSOR.
18. FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.
19. WIRING SHOWN IS FOR OCCUPIED/UNOCCUPIED. SEE INSET "B" FOR TIMECLOCK CONNECTIONS.
20. SEE ELECTRIC HEAT SCHEMATIC FOR ADDITIONAL ELECTRIC WIRING.

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U3	ENGINE BOARD	115
2L2	HEATING COIL VALVE	93, 123
4L2	HEATING COIL VALVE	93, 123
6L2	FIELD INSTALLED HTG CL VLV	93, 123
7K2	EH STG 1 CONTACT	81
7K3	EH STG 2 CONTACT	82
2S8	FROSTSTAT	84
2U3	WIRELESS COM INTERFACE	86
5U3	WIRELESS COM INTERFACE	86
3RT5	DISCHARGE AIR TEMP SNSR	90
6U9	CO2 SENSOR	92
6U8	ZONE HUMIDITY SENSOR	126
3RT4	OUTSIDE AIR TEMP SENSOR	96
2S9	FREEZE-STAT	98
3RT3	ENTERING WATER TEMP SNSR	100
2C1	TIMECLOCK	120
2L3	OA DAMPER ACTUATOR	107
2R1	RESISTOR; DX STG 1 TEST	89
6K4	EXHAUST RELAY	106

UC400 - ZONE SENSORS





NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 °C (77 °F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. SOLID LINES INDICATE WIRING BY TRANE CO.
3. UNITS WITH ELECTRIC HEAT WILL NOT OPERATE BELOW MINIMUM REQUIRED CFM.
4. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE
5. USE CLASS 2 WIRING.
6. WIRING SHOWN IS FOR WALL MOUNTED (DG27=2), DIGITAL DISPLAY (DG28=3) WITH TIMED OVERRIDE (DG29=1) FOR OTHER OPTIONS SEE INSET A AND REFER TO ZONE SENSOR SELECTION CHART.

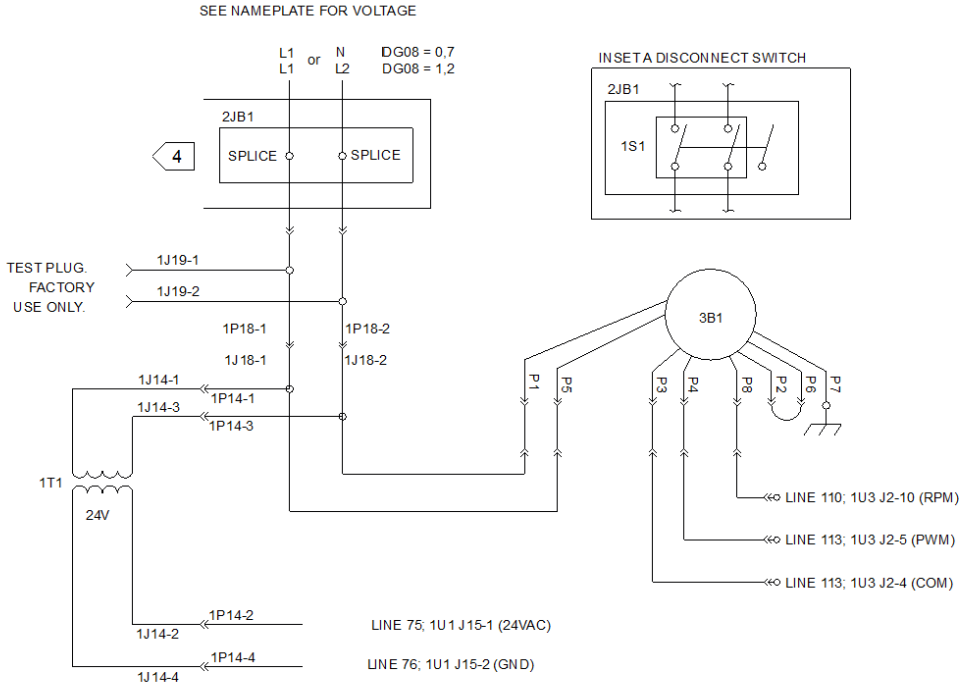
DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U3	ENGINE BOARD	115
6U2	ZONE SENSOR MODULE	74,103
5U2	ZONE SENSOR MODULE	89,96,113,125
3RT2	RETURN AIR SENSOR	85,94,111

ZONE SENSOR SELECTION		
DIGIT	DIGIT VALUE	DESCRIPTION
DG27	0	NO UNIT OR WALL MOUNTED CONTROILS
DG27	1	UNIT MOUNTED
DG27	2	WALL MOUNTED
DG27	3	COMBINED UNIT AND WALL MOUNTED
DG27	4	WIRELESS SENSOR
DG28	0	NO INTERNAL OR EXTERNAL SET POINT
DG28	2	EXTERNAL
DG28	3	DIGITAL DISPLAY
DG29	0	NO TIMED OVERRIDE
DG29	1	YES, TIMED OVERRIDE

SINGLE PHASE SIZE 750 & 1000

SELECTIONS: VUV
DIGIT 8 (VOLTAGE) = 0,1,2,7
115/60/1, 208/60/1, 230/60/1, 277/60/1
DIGIT 5,6,7 (NOMINAL AIR FLOW) = 075,100
750 CFM, 100 CFM
DIGIT 16 (HEATING COIL) = 0,A,B,C,D,E,H,K,L
NON ELECTRIC HEAT COILS



⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

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EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI-DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

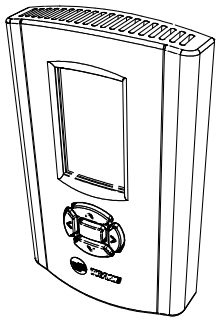
NOTES:

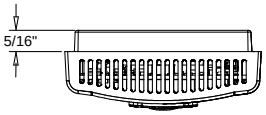
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3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.
4. WIRING SHOWN IS FOR UNITS WITHOUT DISCONNECT SWITCH. SEE INSET A FOR UNITS WITH DISCONNECT SWITCH.
5. FIELD POWER SUPPLY CONDUCTORS MUST HAVE MINIMUM 90C INSULATION.
6. USE COPPER CONDUCTORS ONLY.

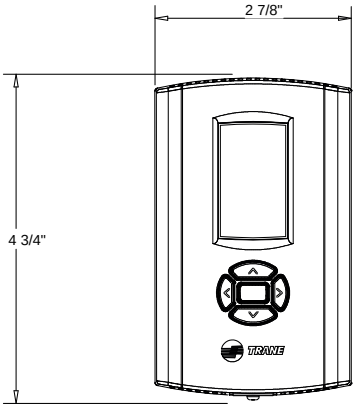
LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SIZE 750, 1000 WITHOUT ELECTRIC HEAT		
2JB1	JUNCTION BOX	28
1S1	DISCONNECT SWITCH	28
3B1	FAN MOTOR	33
1T1	TRANSFORMER	37
SIZE 1250, 1500 WITHOUT ELECTRIC HEAT		
1S1	DISCONNECT SWITCH	51
2JB1	JUNCTION BOX	51,54
3B2	FAN MOTOR	53
3B1	FAN MOTOR	58
1T1	TRANSFORMER	62

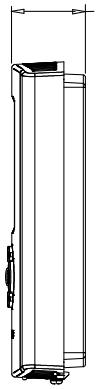
DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

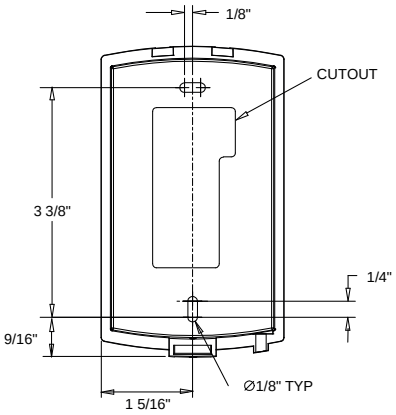
VOLTAGE SELECTION		
DIGIT	DIGIT VALUE	DESCRIPTION
DG08	0	115/60/1
DG08	1	208/60/1
DG08	2	230/60/1
DG08	3	208/60/3
DG08	4	460/60/3
DG08	7	277/60/1
DG08	8	230/60/3
DG08	S	SPECIAL VOLTAGE



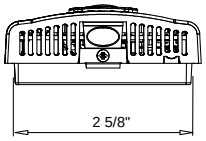








MOUNTING BASE



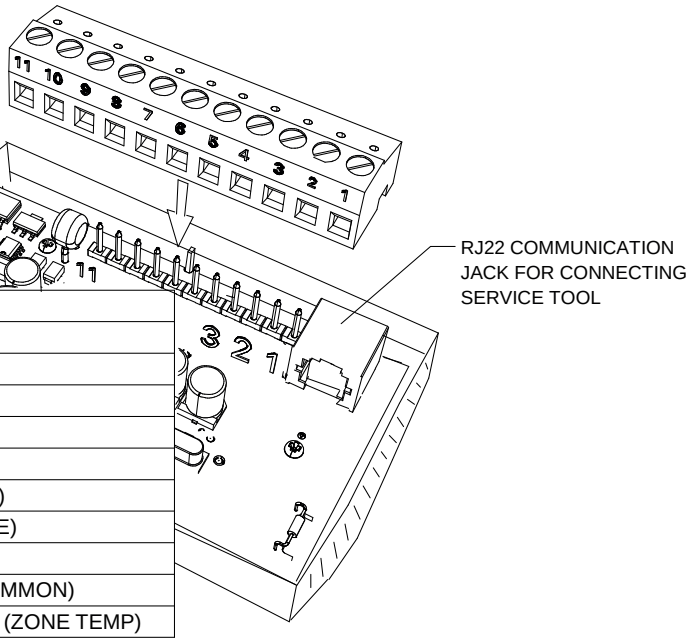
Hydronic Coil Specifications

Hydronic Main / Auxiliary Reheat Coils:
(Cooling Coil or Heating / Cooling Changeover Coil)
• Wavy plate finned.
• Hydrostatically tested at 350 psig.
• All piping packages for the main coil and auxiliary reheat coil assemblies are always supplied as a 3/4” package.

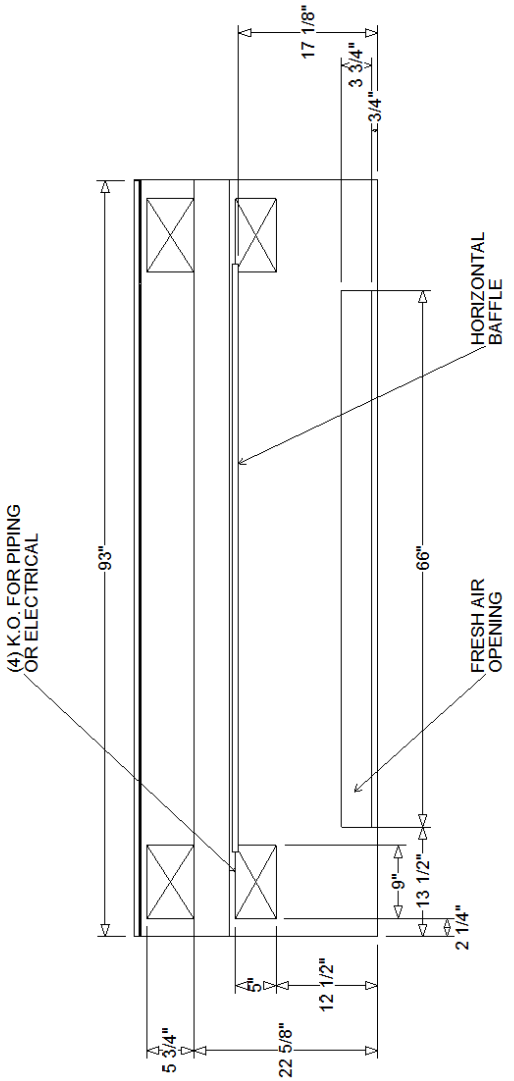
Header Sizes:
• 3/4” Nominal
• 7/8” ID

Hydronic Auxiliary Preheat Coils:
(Heating Coil)
• Wavy plate finned.
• Hydrostatically tested at 350 psig.
• All piping packages for the auxiliary preheat coil assemblies are always supplied as a 1/2” package.

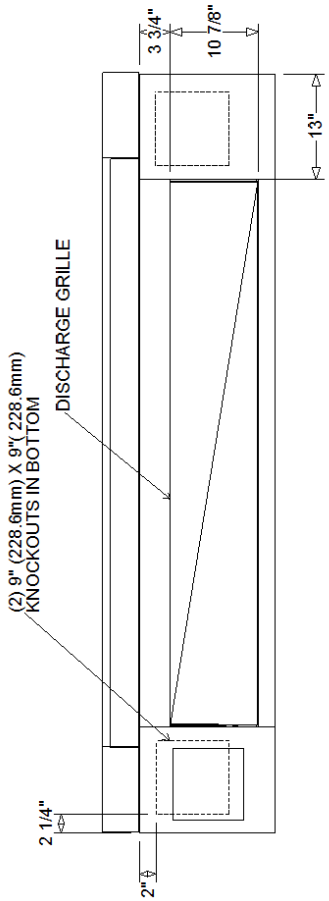
Header Sizes:
• 1/2” Nominal
• 5/8” ID



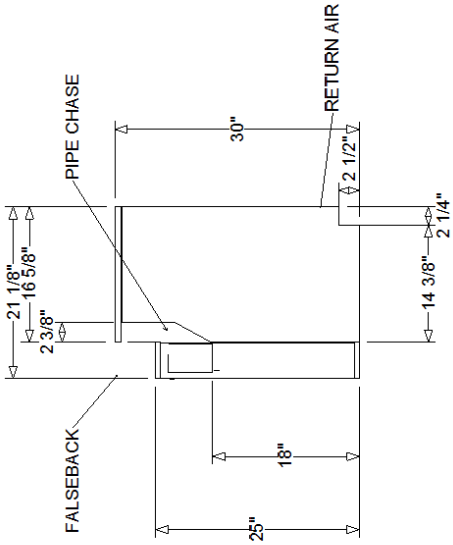
11	24 VAC/VDC
10	⏚ (GROUND)
9	
8	
7	COMM-
6	COMM+
5	HEAT SETPOINT (HSP)
4	SYS/FAN MODE (MODE)
3	SETPOINT
2	SIGNAL COMMON (COMMON)
1	ZONE TEMPERATURE (ZONE TEMP)



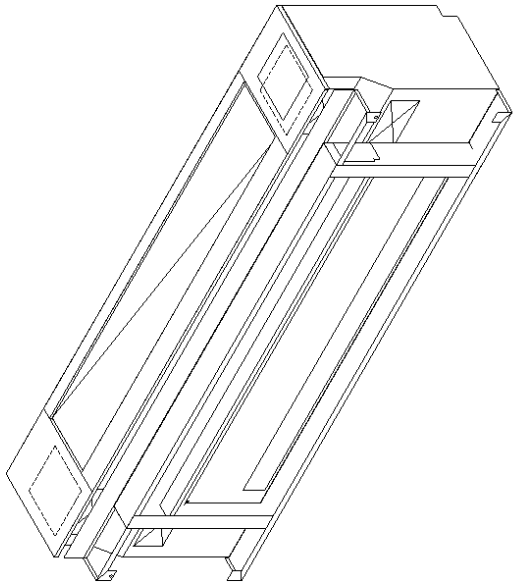
BACK VIEW



TOP VIEW



SIDE VIEW



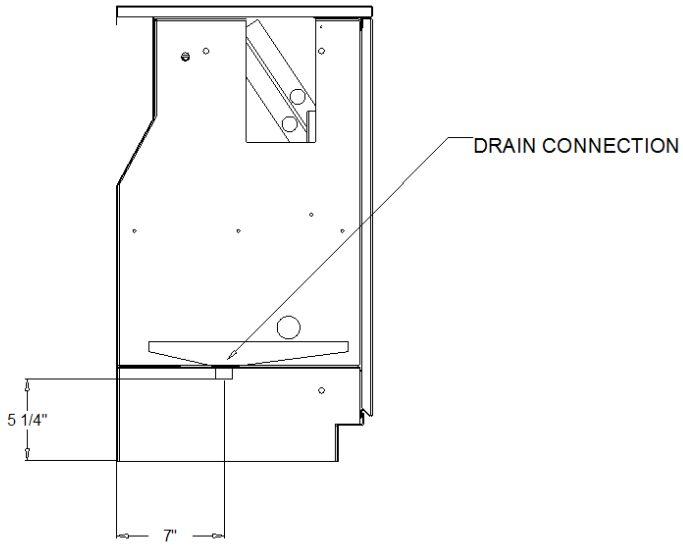
UNIT LENGTH DOES NOT INCLUDE END COVERS.
KNOCKOUTS TO BE USED FOR PIPING AND/OR ELECTRICAL CONNECTIONS.
WHEN ELECTRIC HEAT IS PRESENT, ALL POWER CONNECTIONS ARE MADE IN RIGHT HAND END POCKET. ON ALL OTHERS, CONNECTIONS ARE MADE IN LEFT HAND END POCKET.

WALL BOX MAY BE LOCATED UP TO 1" BELOW THE TOP OF THE UNIT VENTILATOR.

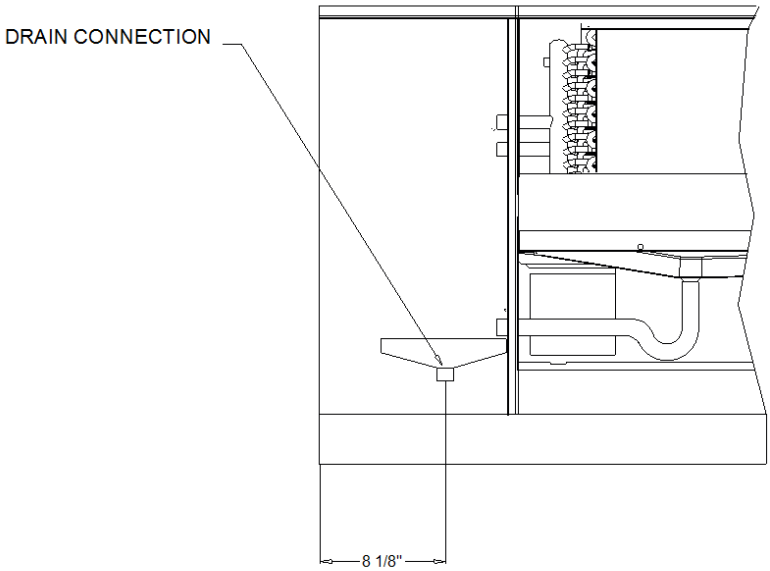
FILTER SIZE	QTY
14"x20"x1"	2
14"x24"x1"	1

UNIT WEIGHT
450.0 lb

LH AUXILIARY DRAIN CONNECTION

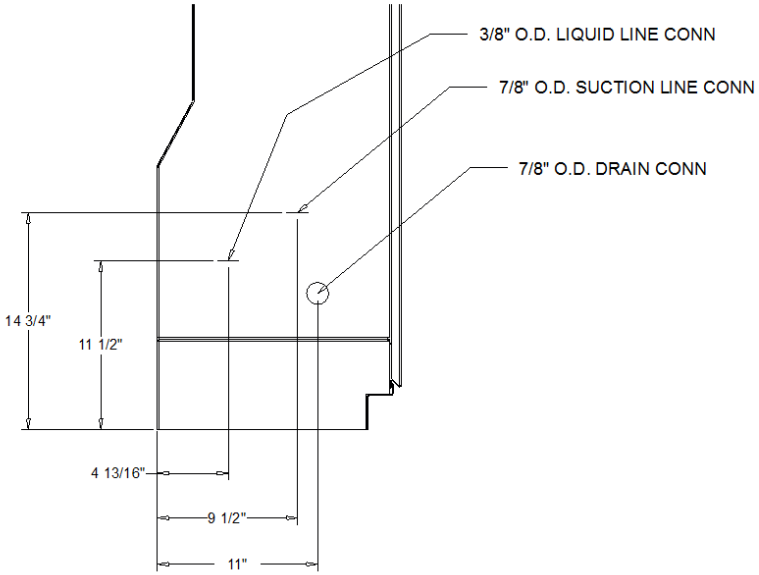


LEFT SIDE VIEW

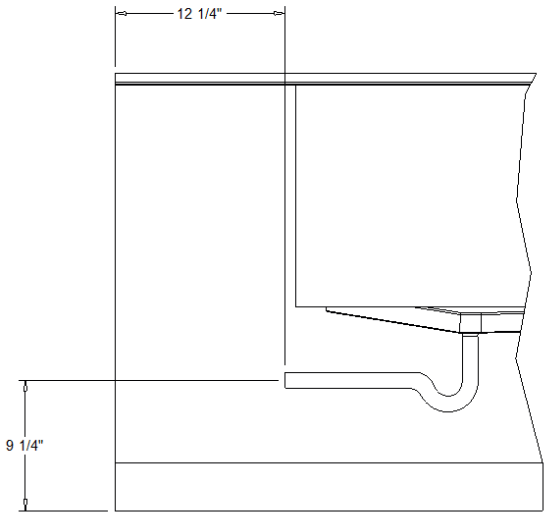


FRONT OF UNIT

DX COIL CONNECTIONS

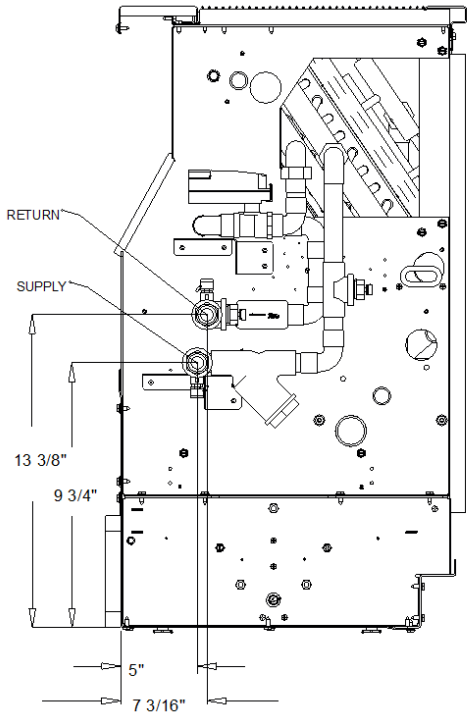


LEFT VIEW

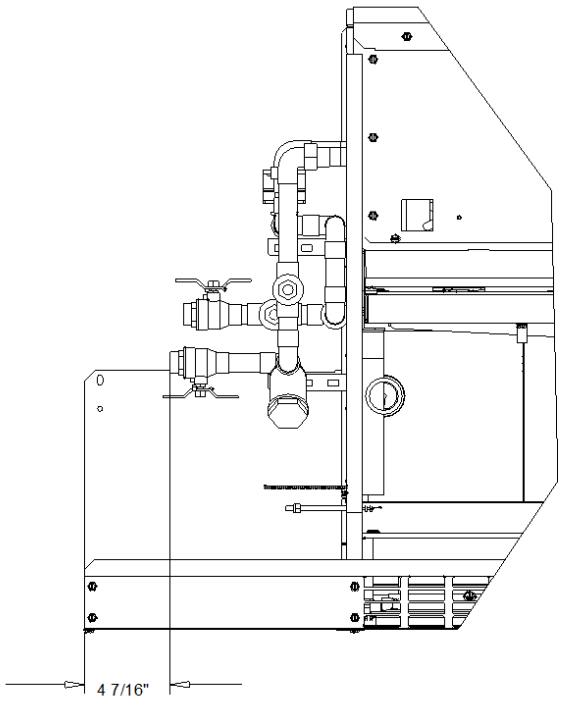


FRONT VIEW

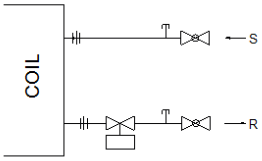
LH MAIN PIPING VALVE CONNECTION

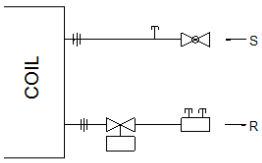


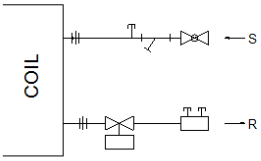
LEFT SIDE

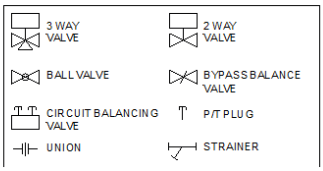


FRONT VIEW

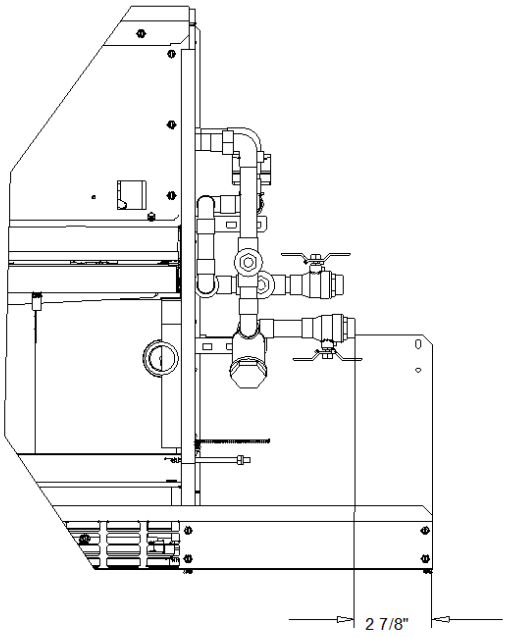




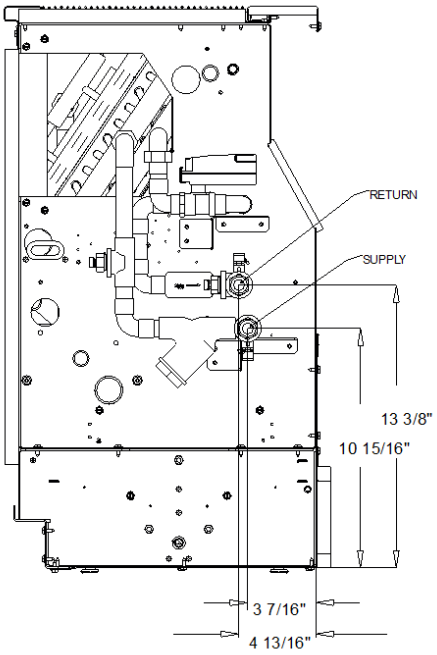




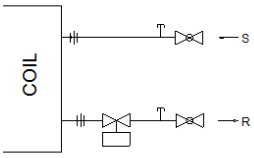
RH AUX PIPING VALVE CONNECTION

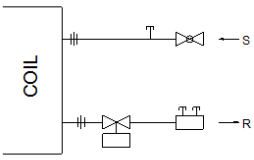


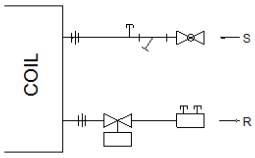
FRONT VIEW

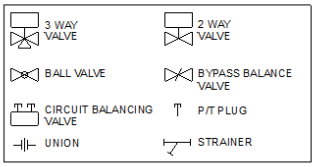


RIGHT SIDE

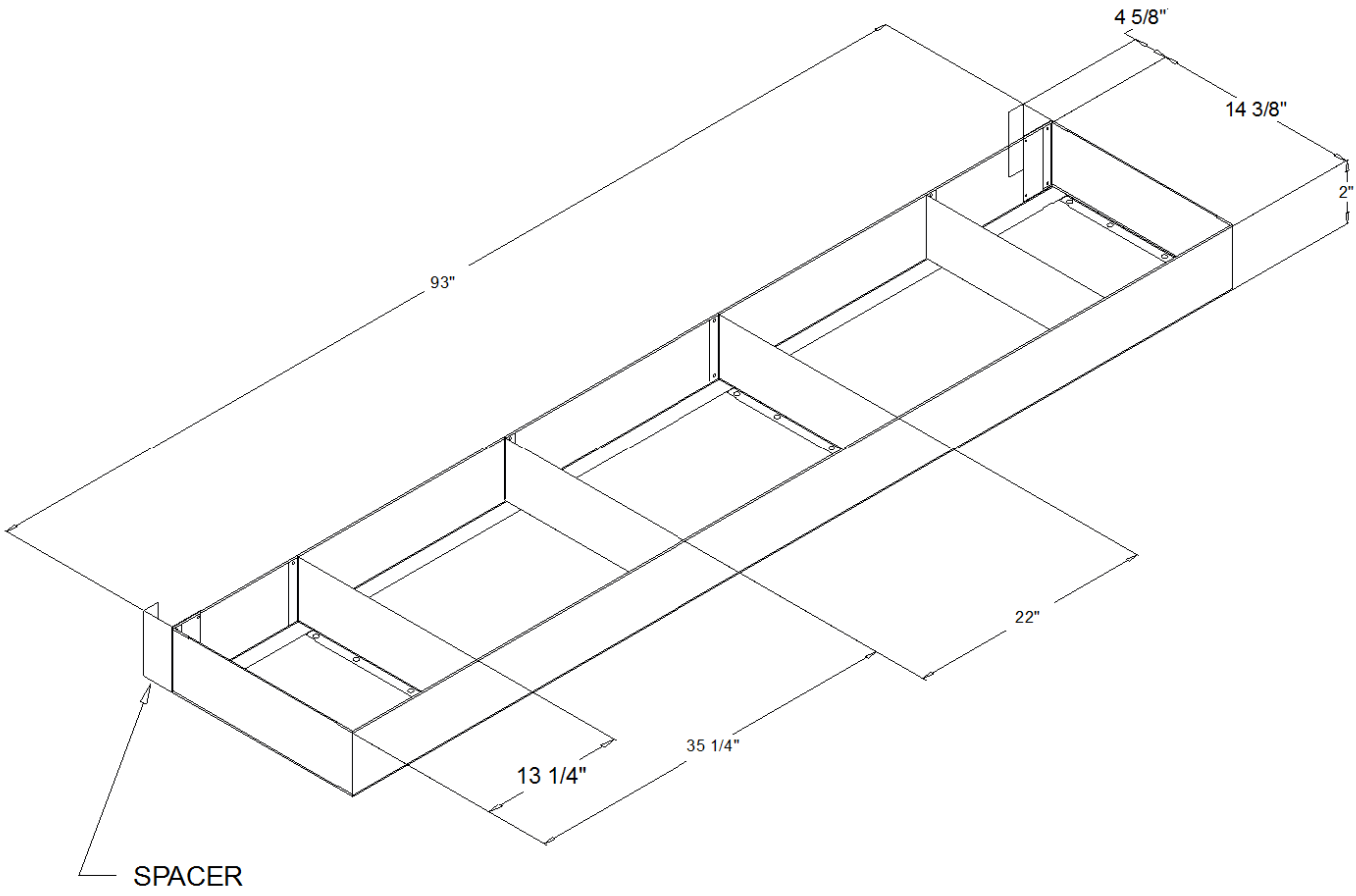




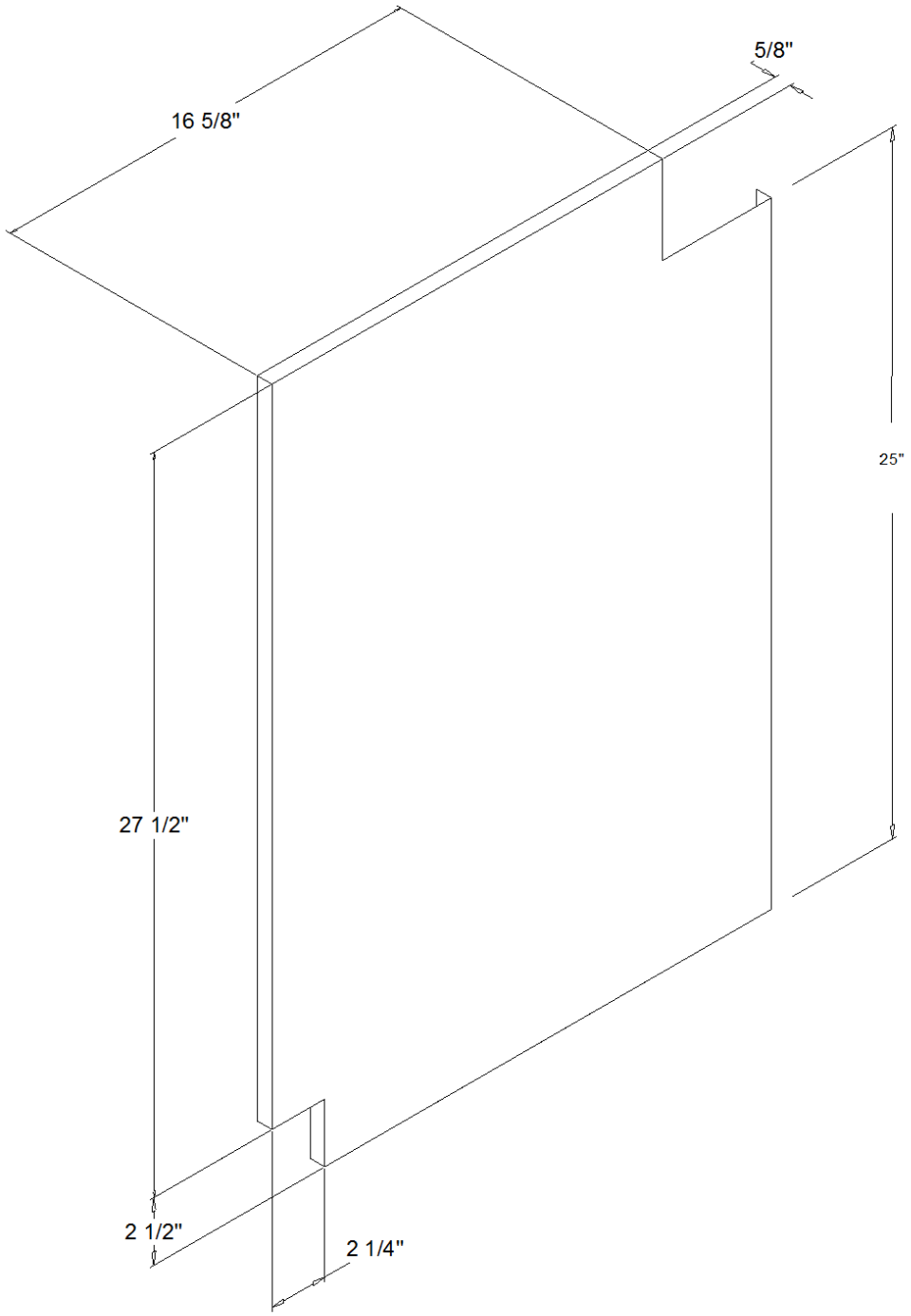




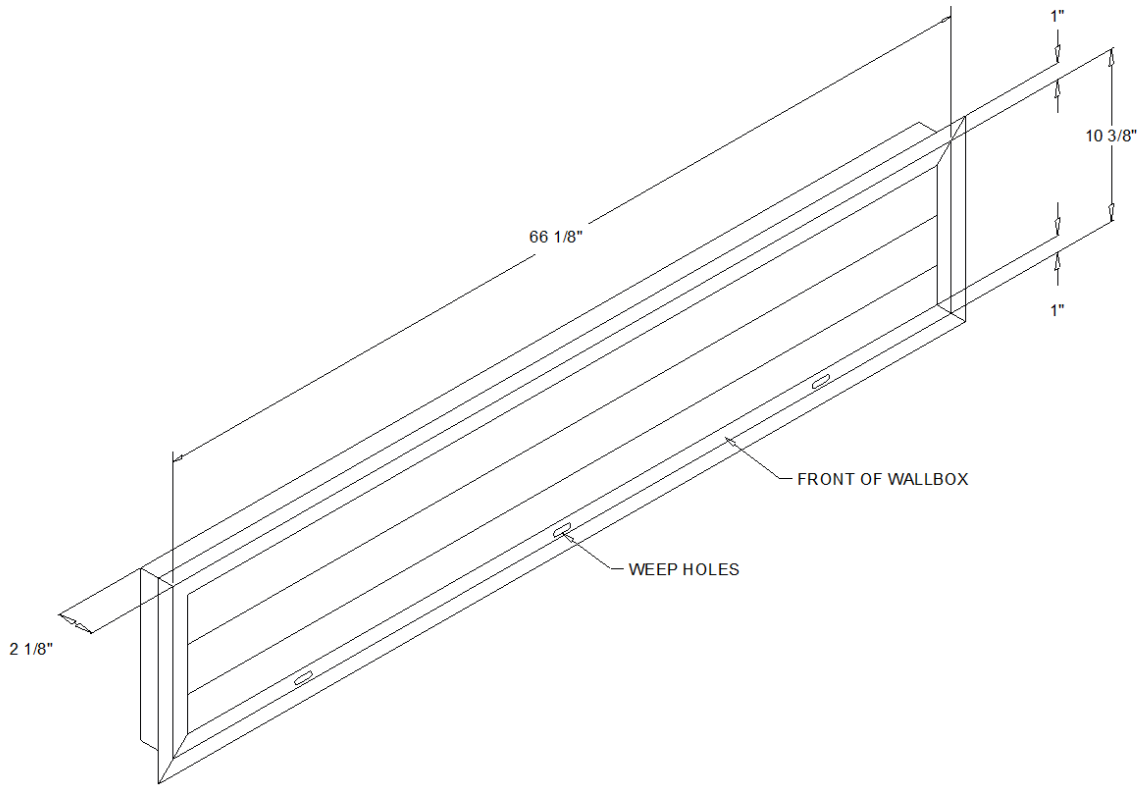
SUBBASE_

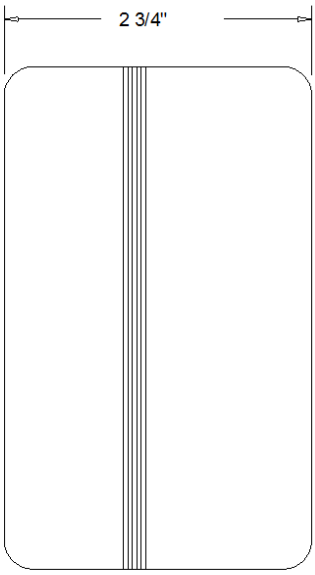


END COVER

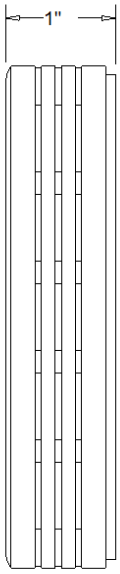


WALLBOX W/HORIZONTAL LOUVERS & FLANGE

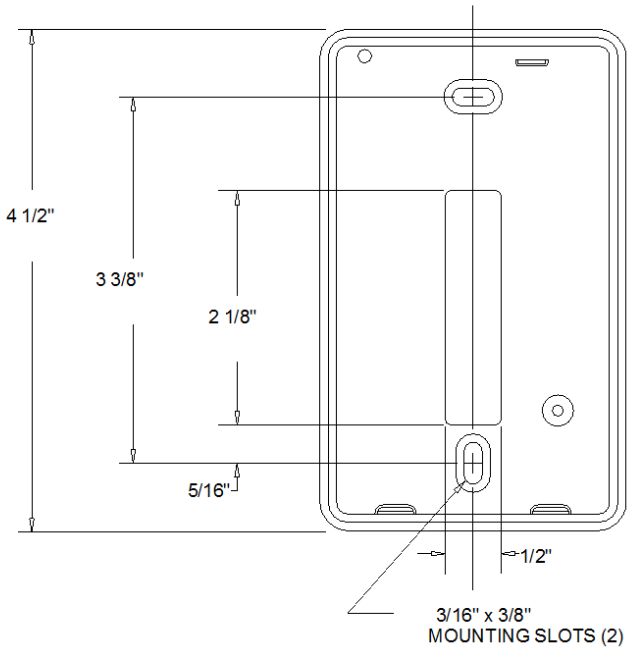




FRONT VIEW

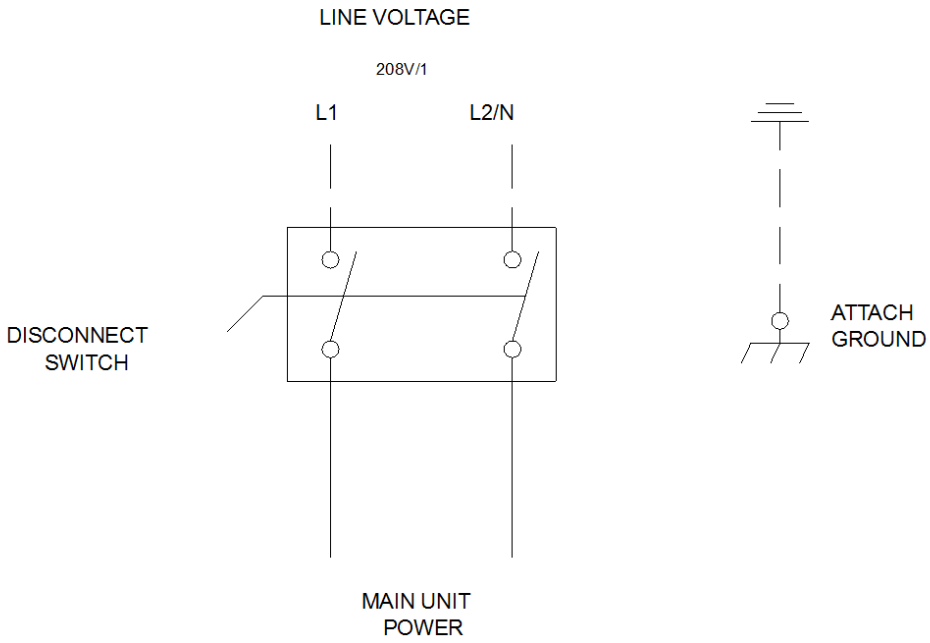


RIGHT SIDE VIEW



BACK VIEW

UNIT POWER WIRING

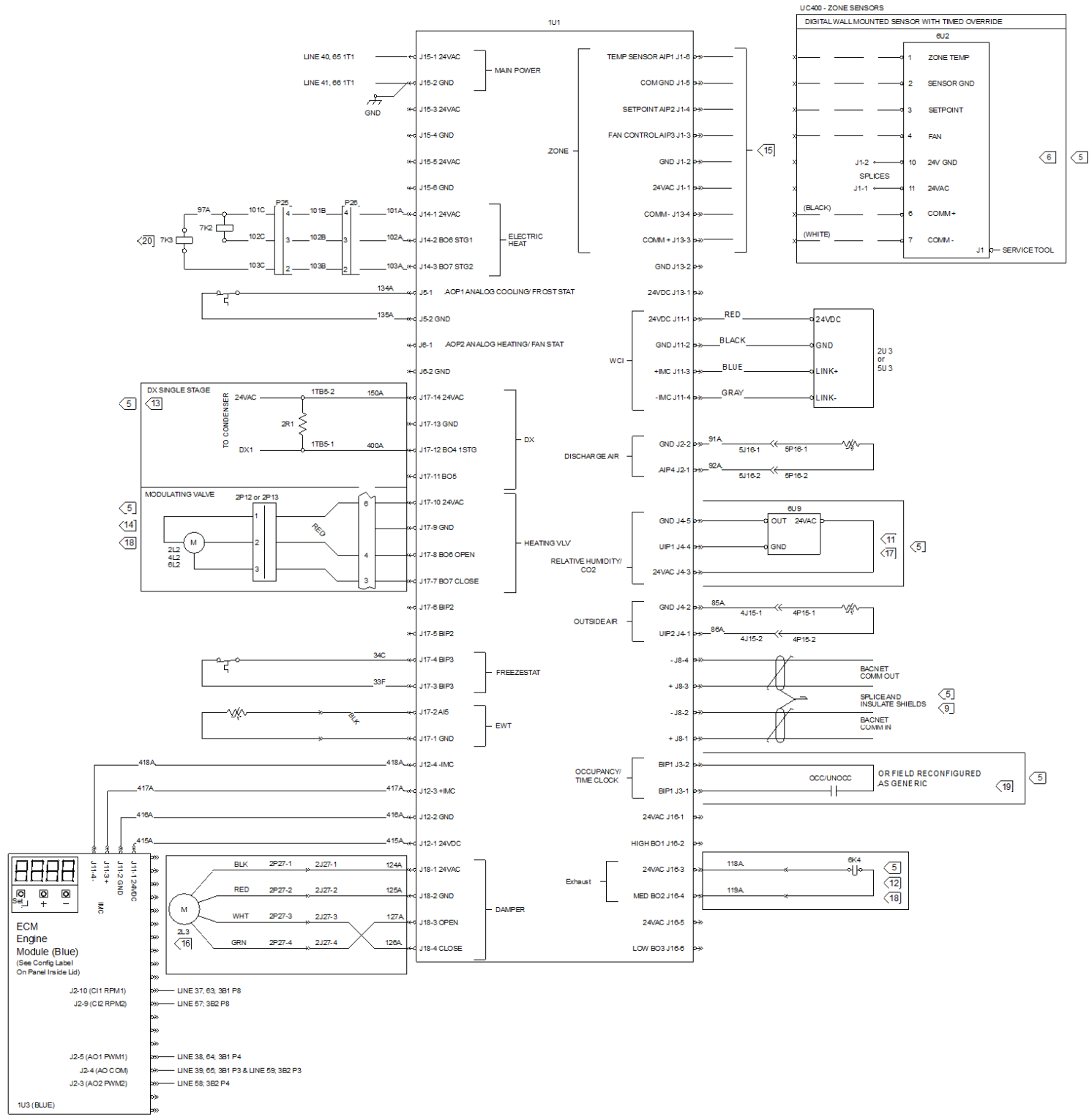


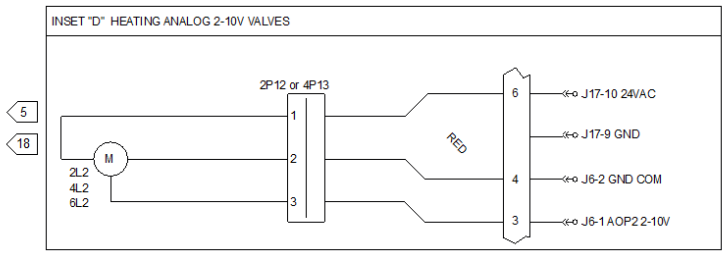
NOTES:

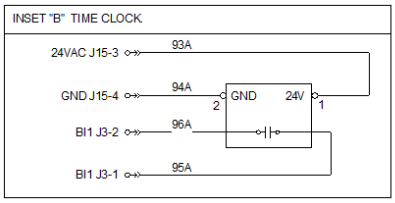
1. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY OTHERS. SOLID LINES INDICATE WIRING BY THE TRANE CO.

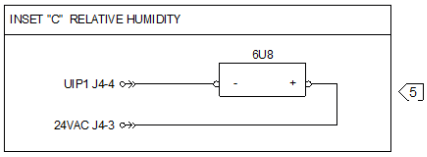
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.

⚠ WARNING	⚠ AVERTISSEMENT	⚠ ADVERTENCIA
HAZARDOUS VOLTAGE!	TENSION DANGEREUSE!	¡VOLTAJE PELIGROSO!
DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNIT'S WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.	COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VERIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.	DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCIÓN DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.
FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.	NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.	EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.


1U1
UC400 - ZONE SENSORS
DIGITAL WALL MOUNTED SENSOR WITH TIMED OVERRIDE
6U2
LINE 40, 65 1T1
LINE 41, 66 1T1
GND
J15-1 24VAC
J15-2 GND
J15-3 24VAC
J15-4 GND
J15-5 24VAC
J15-6 GND
MAIN POWER
ZONE
TEMP SENSOR AIP1 J1-6
COM GND J1-5
SETPOINT AIP2 J1-4
FAN CONTROL AIP3 J1-3
GND J1-2
24VAC J1-1
COMM- J13-4
COMM + J13-3
GND J13-2
24VDC J13-1
1 ZONE TEMP
2 SENSOR GND
3 SETPOINT
4 FAN
10 24V GND
11 24VAC
6 COMM+
7 COMM-
J1 SERVICE TOOL
J1-2
J1-1
SPLICES
(BLACK)
(WHITE)
97A
101C
101B
101A
102C
102B
102A
103C
103B
103A
P25
P26
7K2
7K3
J14-1 24VAC
J14-2 BO6 STG1
J14-3 BO7 STG2
ELECTRIC HEAT
134A
135A
J5-1 AOP1 ANALOG COOLING/ FROST STAT
J5-2 GND
J6-1 AOP2 ANALOG HEATING/ FAN STAT
J6-2 GND
WCI
24VDC J11-1
GND J11-2
+IMC J11-3
-IMC J11-4
RED
BLACK
BLUE
GRAY
24VDC
GND
LINK+
LINK-
2U 3
or
5U 3
DX SINGLE STAGE
TO CONDENSER
24VAC
DX1
2R1
1TB5-2
1TB5-1
150A
400A
J17-14 24VAC
J17-13 GND
J17-12 BO4 1STG
J17-11 BO5
DX
MODULATING VALVE
2P12 or 2P13
2L2
4L2
6L2
RED
J17-10 24VAC
J17-9 GND
J17-8 BO6 OPEN
J17-7 BO7 CLOSE
HEATING VLV
DISCHARGE AIR
GND J2-2
AIP4 J2-1
91A
92A
5J16-1
5P16-1
5J16-2
5P16-2
RELATIVE HUMIDITY/ CO2
6U9
OUT
24VAC
GND
GND J4-5
UIP1 J4-4
24VAC J4-3
OUTSIDE AIR
GND J4-2
UIP2 J4-1
85A
86A
4J15-1
4P15-1
4J15-2
4P15-2
J17-6 BIP2
J17-5 BIP2
34C
33F
J17-4 BIP3
J17-3 BIP3
FREEZESTAT
BLK
J17-2 AI5
J17-1 GND
EWT
- J8-4
+ J8-3
- J8-2
+ J8-1
BACNET
COMM OUT
SPLICE AND
INSULATE SHIELDS
BACNET
COMM IN
418A
417A
416A
415A
J12-4 -IMC
J12-3 +IMC
J12-2 GND
J12-1 24VDC
OCCUPANCY/
TIME CLOCK
BIP1 J3-2
BIP1 J3-1
OCC/UNOCC
OR FIELD RECONFIGURED
AS GENERIC
24VAC J16-1
HIGH BO1 J16-2
24VAC J16-3
MED BO2 J16-4
24VAC J16-5
LOW BO3 J16-6
Exhaust
118A
119A
6K4
J11-4-
J11-3+
J11-2 GND
J11-1 24VDC
IMC
Set
ECM
Engine
Module (Blue)
(See Config Label
On Panel Inside Lid)
1U3 (BLUE)
J2-10 (CI1 RPM1)
J2-9 (CI2 RPM2)
J2-5 (AO1 PWM1)
J2-4 (AO COM)
J2-3 (AO2 PWM2)
LINE 37, 63; 3B1 P8
LINE 57; 3B2 P8
LINE 38, 64; 3B1 P4
LINE 39, 65; 3B1 P3 & LINE 59; 3B2 P3
LINE 58; 3B2 P4
BLK
RED
WHT
GRN
2P27-1
2P27-2
2P27-3
2P27-4
2J27-1
2J27-2
2J27-3
2J27-4
124A
125A
127A
126A
2L3
J18-1 24VAC
J18-2 GND
J18-3 OPEN
J18-4 CLOSE
DAMPER







NOTES:

1 UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 ° C (77 ° F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.

2 DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.

4 ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE

5 USE CLASS 2 WIRING.

9 COMUNICATION WIRE MUST BE TRANE PART NO. 400-20-28, OR WINDY CITY OR CONNECT AIR "LEVEL 4" CABLE. MAXIMUM OF 4500 FOOT AGGREGATE RUN.
CAUTION! DO NOT RUN POWER IN THE SAME CONDUIT OR WIRE BUNDLE WITH COMUNICATION LINK. FOR ADDITIONAL INFORMATION REFER TO EMTX-EB-68.

11 CONFIGURE THE CO2 SENSOR FOR 4-20mA OPERATION USING THE OUT2 JUMPER SUPPLIED WITH THE SENSOR.

12 FOR WIRED POWER EXHAUST, 24VAC 12VA MAXIMUM.

13 FIELD INSTALLED CONDENSING UNIT CAN BE WIRED BETWEEN TERMINALS 2TB4-1 AND 2TB4-2 FOR SINGLE STAGE. REMOVE RESISTOR 2R1 PRIOR TO WIRING CONDENSER. DX1 OUTPUTS RATED 24VAC 6VA MAXIMUM.

14 WIRING SHOWN IS FOR MODULATING VALVE SECTION. SEE INSET "D" FOR HEATING 2-10V VALVE SELECTIONS.

15 SEE SHEET "UC400 - ZONE SENSORS" FOR ZONE SENSOR CONNECTIONS.

16 WIRING SHOWN IS FOR 3 WIRE MODULATING DAMPER SECTION. SEE INSET "A" FOR ERSA CONNECTIONS.

17 WIRING SHOWN IS FOR CO2 SENSOR. SEE INSET "C" FOR RELATIVE HUMIDITY SENSOR.

18 FIELD SUPPLIED ACTUATOR WIRING UTILIZES THE SAME CONNECTION POINTS AS FACTORY ACTUATOR WIRING.

19 WIRING SHOWN IS FOR OCCUPIED/UNOCCUPIED. SEE INSET "B" FOR TIMECLOCK CONNECTIONS.

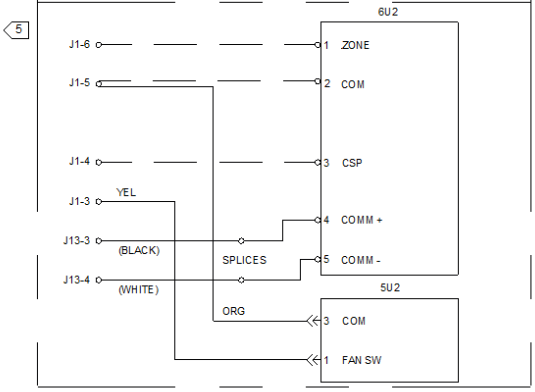
20 SEE ELECTRIC HEAT SCHEMATIC FOR ADDITIONAL ELECTRIC WIRING.

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

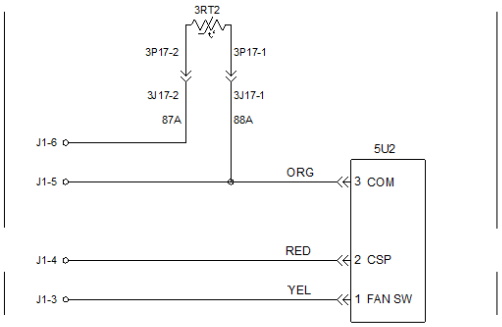
LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U3	ENGINE BOARD	115
2L2	HEATING COIL VALVE	93, 123
4L2	HEATING COIL VALVE	93, 123
6L2	FIELD INSTALLED HTG CL VLV	93, 123
7K2	EH STG 1 CONTACT	81
7K3	EH STG 2 CONTACT	82
2S8	FROSTSTAT	84
2U3	WIRELESS COM INTERFACE	86
5U3	WIRELESS COM INTERFACE	86
3RT5	DISCHARGE AIR TEMP SNSR	90
6U9	CO2 SENSOR	92
6U8	ZONE HUMIDITY SENSOR	126
3RT4	OUTSIDE AIR TEMP SENSOR	96
2S9	FREEZE-STAT	98
3RT3	ENTERING WATER TEMP SNSR	100
2C1	TIMECLOCK	120
2L3	OA DAMPER ACTUATOR	107
2R1	RESISTOR; DX STG 1 TEST	89
6K4	EXHAUST RELAY	106

UC400 - ZONE SENSORS

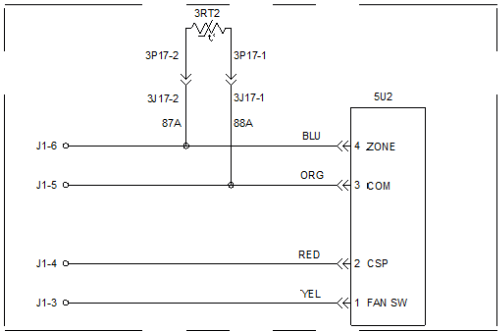
EXTERNAL UNIT OR WALL MOUNTED SENSOR (W OR W/O) TIMED OVERRIDE



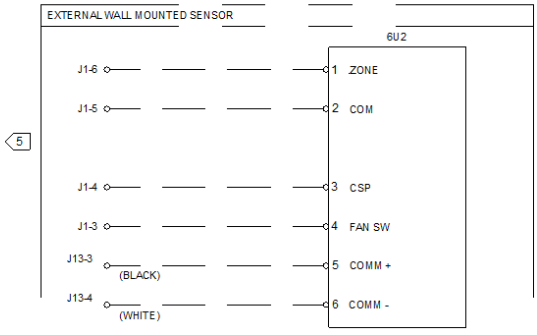
EXTERNAL UNIT MOUNTED SENSOR WITHOUT TIMED OVERRIDE



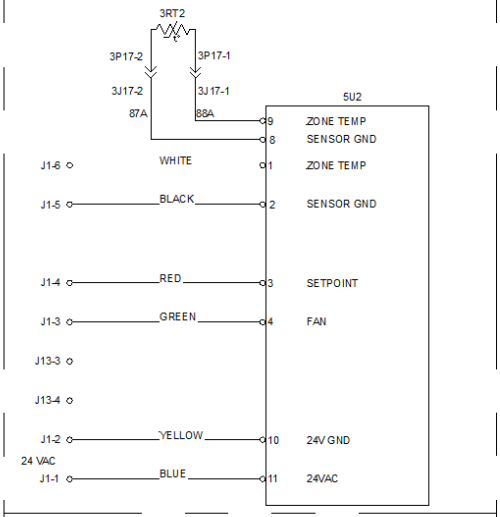
EXTERNAL UNIT MOUNTED SENSOR WITH TIMED OVERRIDE



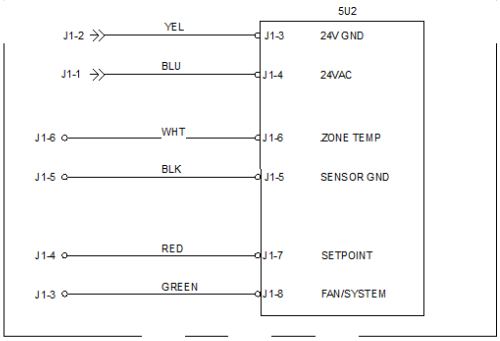
EXTERNAL WALL MOUNTED SENSOR



UNIT MOUNTED DIGITAL DISPLAY WITH TIMED OVERRIDE



WIRELESS DIGITAL DISPLAY SENSOR



NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25 °C (77 °F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. SOLID LINES INDICATE WIRING BY TRANE CO.
3. UNITS WITH ELECTRIC HEAT WILL NOT OPERATE BELOW MINIMUM REQUIRED CFM.
4. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. ALL FIELD WIRING MUST HAVE AN INSULATION VOLTAGE RATING THAT EQUALS OR EXCEEDS UNIT RATED VOLTAGE
5. USE CLASS 2 WIRING.
6. WIRING SHOWN IS FOR WALL MOUNTED (DG27=2), DIGITAL DISPLAY (DG28=3) WITH TIMED OVERRIDE (DG29=1) FOR OTHER OPTIONS SEE INSET A AND REFER TO ZONE SENSOR SELECTION CHART.

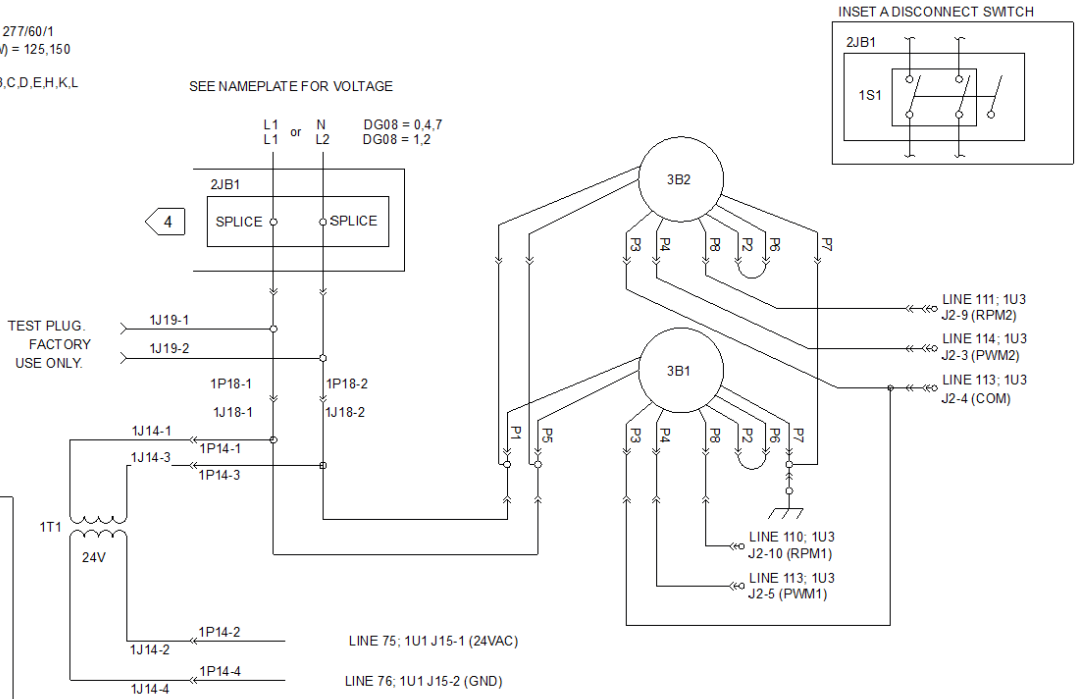
LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1U1	UC400-B	74
1U3	ENGINE BOARD	115
6U2	ZONE SENSOR MODULE	74,103
5U2	ZONE SENSOR MODULE	89,96,113,125
3RT2	RETURN AIR SENSOR	85,94,111

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

ZONE SENSOR SELECTION		
DIGIT	DIGIT VALUE	DESCRIPTION
DG27	0	NO UNIT OR WALL MOUNTED CONTROILS
DG27	1	UNIT MOUNTED
DG27	2	WALL MOUNTED
DG27	3	COMBINED UNIT AND WALL MOUNTED
DG27	4	WIRELESS SENSOR
DG28	0	NO INTERNAL OR EXTERNAL SET POINT
DG28	2	EXTERNAL
DG28	3	DIGITAL DISPLAY
DG29	0	NO TIMED OVERRIDE
DG29	1	YES, TIMED OVERRIDE

SINGLE PHASE SIZE 1250 & 1500

SELECTIONS: VUV
DIGIT 8 (VOLTAGE) = 0,1,2,7
115/60/1, 208/60/1, 230/60/1, 277/60/1
DIGIT 5,6,7 (NOMINAL AIR FLOW) = 125,150
1250 CFM, 1500 CFM
DIGIT 16 (HEATING COIL) = 0,A,B,C,D,E,H,K,L
NON ELECTRIC HEAT COILS



⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARIABLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA

¡VOLTAJE PELIGROSO!

DESCONECTE TODA LA ENERGÍA ELÉCTRICA, INCLUSO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CIERRE Y ETIQUETADO ANTES DE PROCEDER AL SERVICIO. ASEGÚRESE DE QUE TODOS LOS CAPACITORES DEL MOTOR HAYAN DESCARGADO EL VOLTAJE ALMACENADO. PARA LAS UNIDADES CON EJE DE DIRECCION DE VELOCIDAD VARIABLE, CONSULTE LAS INSTRUCCIONES PARA LA DESCARGA DEL CONDENSADOR.

EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.

NOTICE

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO THE ABOVE COULD RESULT IN EQUIPMENT DAMAGE.

AVIS

N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!

LES BORNES DE L'UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.

FAIRE DÉFAUT À LA PROCÉDURE CI-DESSUS PEUT ENTRAÎNER DES DOMMAGES À L'ÉQUIPEMENT.

AVISO

¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!

LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.

NO SEGUIR LAS INSTRUCCIONES ANTERIORES PUEDE PROVOCAR DAÑOS EN EL EQUIPO.

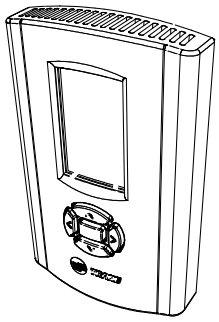
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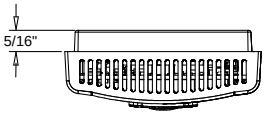
1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25° C (77° F), AT ATMOSPHERIC PRESSURE, AT 50 % RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINED ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. SOLID LINES INDICATE WIRING BY TRANE CO.
3. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS.
4. WIRING SHOWN IS FOR UNITS WITHOUT DISCONNECT SWITCH. SEE INSET A FOR UNITS WITH DISCONNECT SWITCH.
5. FIELD POWER SUPPLY CONDUCTORS MUST HAVE MINIMUM 90C INSULATION.
6. USE COPPER CONDUCTORS ONLY.

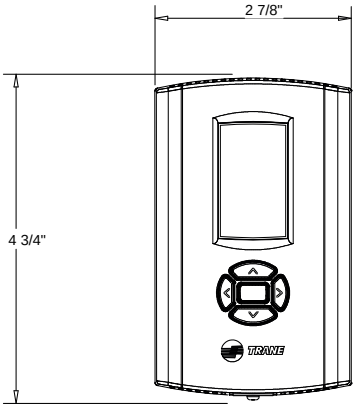
LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
SIZE 750, 1000 WITHOUT ELECTRIC HEAT		
2JB1	JUNCTION BOX	28
1S1	DISCONNECT SWITCH	28
3B1	FAN MOTOR	33
1T1	TRANSFORMER	37
SIZE 1250, 1500 WITHOUT ELECTRIC HEAT		
1S1	DISCONNECT SWITCH	51
2JB1	JUNCTION BOX	51,54
3B2	FAN MOTOR	53
3B1	FAN MOTOR	58
1T1	TRANSFORMER	62

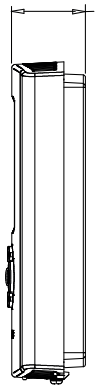
DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	LH CONTROL PANEL
2	LH END POCKET
3	AIR SECTION
4	RH END POCKET
5	TOP ACCESS PANEL
6	FIELD INSTALLED
7	RH CONTROL BOX E-HT

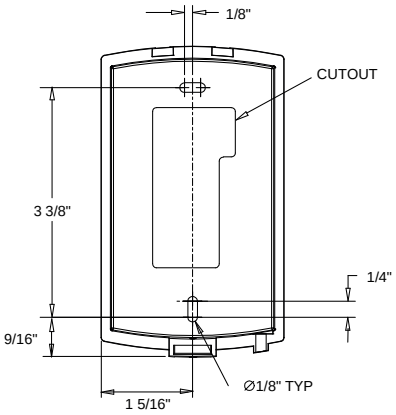
VOLTAGE SELECTION		
DIGIT	DIGIT VALUE	DESCRIPTION
DG08	0	115/60/1
DG08	1	208/60/1
DG08	2	230/60/1
DG08	3	208/60/3
DG08	4	460/60/3
DG08	7	277/60/1
DG08	8	230/60/3
DG08	S	SPECIAL VOLTAGE



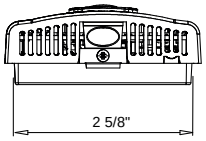








MOUNTING BASE



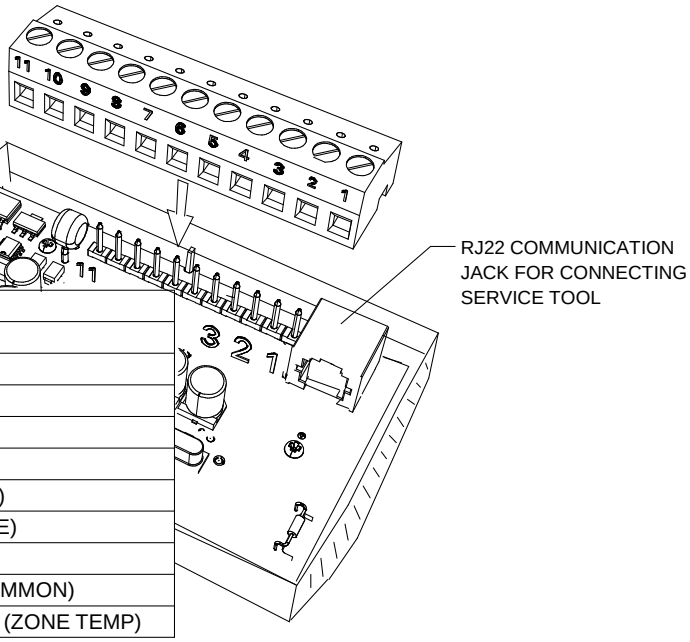
Hydronic Coil Specifications

Hydronic Main / Auxiliary Reheat Coils:
(Cooling Coil or Heating / Cooling Changeover Coil)
• Wavy plate finned.
• Hydrostatically tested at 350 psig.
• All piping packages for the main coil and auxiliary reheat coil assemblies are always supplied as a 3/4” package.

Header Sizes:
• 3/4” Nominal
• 7/8” ID

Hydronic Auxiliary Preheat Coils:
(Heating Coil)
• Wavy plate finned.
• Hydrostatically tested at 350 psig.
• All piping packages for the auxiliary preheat coil assemblies are always supplied as a 1/2” package.

Header Sizes:
• 1/2” Nominal
• 5/8” ID



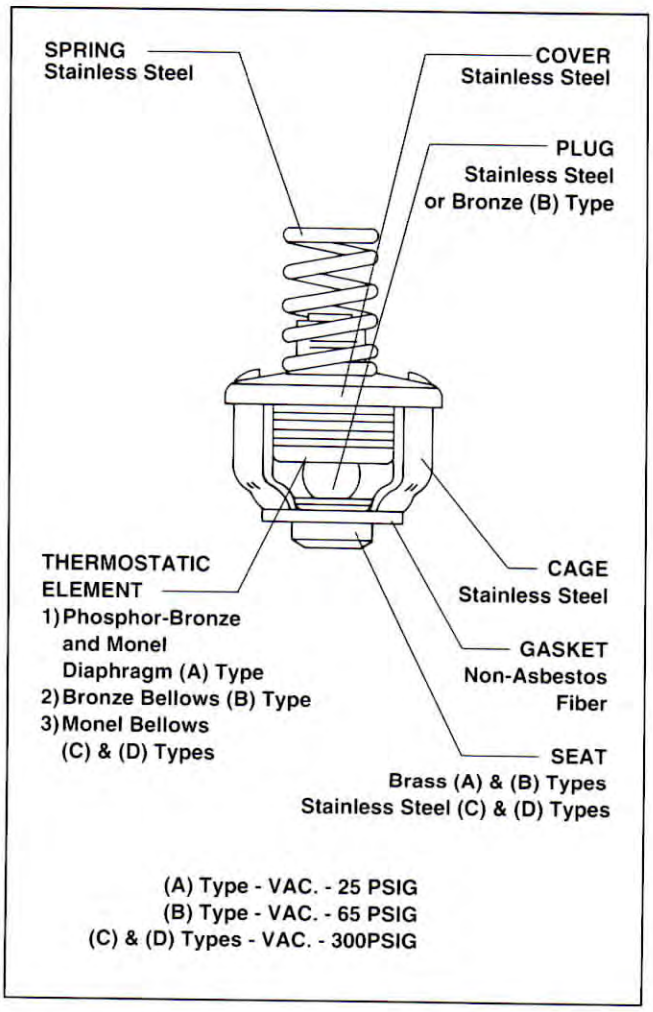
11	24 VAC/VDC
10	⏚ (GROUND)
9	
8	
7	COMM-
6	COMM+
5	HEAT SETPOINT (HSP)
4	SYS/FAN MODE (MODE)
3	SETPOINT
2	SIGNAL COMMON (COMMON)
1	ZONE TEMPERATURE (ZONE TEMP)

Barnes® & Jones INC.

Thermostatic Steam Trap Repair Elements (Cage Units) for All Makes & Models VAC - 300 PSIG

Features

- Single Source for ALL your thermostatic trap elements
- Available for over 800 makes and models
- One-piece repair reduces maintenance time and aggravation*
- No special tools needed for installation
- The only repair element available today that is calibrated to ensure maximum sensitivity in the field
- Every element is factory tested, under live steam, before shipment to you
- Improves original trap's performance with a payback in fuel savings within weeks
- Over 80 years repairing millions of steam traps.



Description

The Cage Unit comprises all working parts of a thermostatic steam trap including the seat. All parts are calibrated together under actual steam conditions at our factory and are locked into the precisely correct working relationship within a stainless steel housing. This is a one piece, stand alone, fully removable and testable "trap within a trap." There are no loose parts to contend with; gone is the potential of overtightening, undertightening, crossthreading or misaligning assorted pieces of a "repair kit."

To the user, calibrated construction of the Barnes & Jones Cage Unit offers the assurance that every element will operate with the same performance in the field as it did when tested in our factory. This guarantees a greater sensitivity than could ever be promised with a bag of uncalibrated parts or any uncalibrated element.

Along with the fuel savings that accrues with the use of a more sensitive element, the Cage Unit offers increased efficiency with maintenance as well. The one piece construction allows for removal and testing of the element outside of the original trap body. See the reverse side for testing and maintenance information.

Adaptations of the Cage Unit are available for more than 800 makes, styles and sizes of thermostatic steam traps for low, medium and high pressure service. Even if your system consists of traps from Dunham-Bush, Hoffman, Nicholson, Sarco, Warren-Webster and any other brands, Barnes & Jones Cage Units can repair them all! Ask for the "Steam Trap Repair Guide" to find the Cage Unit specifically designed to upgrade the working parts in your particular steam trap.

DO NOT be fooled by others offering a quick fix with nuggets, capsules, discs or other control devices for steam traps. Barnes & Jones has been repairing thermostatic and float & thermostatic steam traps for over 80 years and is the acknowledged leader in product performance and design.

*In some instances a new cover is needed on the first installation only. Consult the B & J Steam Trap Repair Guide.

CU93 91 Pacella Park Drive • Randolph, MA 02368 • TEL 781-963-8000 * FAX 781-963-3322

Barnes & Jones® INC. Float & Thermostatic Steam Traps Series 2000 (VAC-30 PSIG)

Features

- Variety of hook-up combinations
- Unaffected by sudden or wide pressure changes
- Responds quickly to condensate load changes
- Continuous discharge
- Condensate discharge temperature closely follows the saturated steam curve
- Function is not impaired by high back pressure
- Energy efficient
- Simple construction
- On-line repair

Description

The Barnes & Jones float and thermostatic traps, Series 2000 are designed for all types of low pressure or vacuum steam heating systems and steam process equipment. Typical applications include; unit heaters, space heaters, water heaters, pressing machines and low pressure mains and risers.

Float and thermostatic traps are specially well suited for apartments, hospitals, office buildings and schools or wherever quiet operation is necessary.



Operation

The opening and closing of the valve is caused by changes of the condensate level within the trap shell.

When the water level drops, the weight of the float closes the valve. As condensate enters the traps, the float rises and opens the valve, allowing condensate to be discharged. The float is designed to provide sufficient buoyancy to overcome the differential pressure across the valve. The internal float and valve configuration is such that the condensate level is always above the valve, creating a continuous water seal at the seat.

Air and other gasses are freely discharged as they reach the trap through the air vent. The calibrated thermostat will close the air vent immediately when the temperature surrounding the element reaches saturated steam temperature.

MATERIALS

Part	Description
Head	Cast Iron, ASTM-A278 Class 30
Body	Cast Iron, ASTM-A278 Class 30
Bolting	Steel, Grade 5
Gaskets	Non-Asbestos Fiber
Float	Stainless Steel
Plug	Stainless Steel
Seat	Brass, 15#; Stainless Steel, 30#

Construction

Barnes & Jones float and thermostatic traps are compact, of rugged design, with easy access to all interior parts. The body is cast with two inlet and two outlet pipe connections that permit four combinations of pipe hook-ups for all types of applications.* All working parts are made of corrosion resistant materials and attached to the cover casting. The repair kit consists of a complete, factory assembled head which simply bolts on for ease of repair.* No pipe connections need to be broken.

*except the 2" model which is piped through the head.

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Engineering Specifications

CAPACITIES (SHEMA)

lbs. condensate per hour.

Pipe Size	Model No.	Pressure Differential (PSIG)						
		1/4	1/2	1	2	5	10	15
3/4"	FT2015-3	70	100	140	200	210	220	230
1"	FT2015-4	175	250	350	500	525	550	575
1 1/4"	FT2015-5	425	600	850	1200	1260	1320	1380
1 1/2"	FT2015-6	850	1200	1700	2400	2520	2640	2760
2"	FT2015-8	1775	2500	3550	5000	5250	5500	5750

Note on capacity: Low pressure F & T Trap capacities are in accordance with standard adopted by the Steam Heating Manufacturer's Association (SHEMA) providing for the continuous elimination of air when the trap is operating at its maximum rating. No Safety factor need be applied. *Actual capacities are significantly greater than the SHEMA rating indicate.*

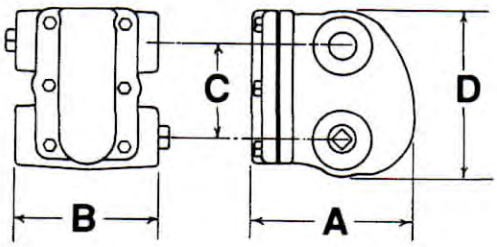
CAPACITIES (Gross)

lbs. condensate per hour.

Pipe Size	Model No.	Pressure Differential (PSIG)									
		1/4	1/2	1	2	5	10	15	20	25	30
3/4"	FT2015-3	293	387	513	683	824	1050	1129	–	–	–
1"	FT2015-4	293	387	513	683	824	1050	1129	–	–	–
1 1/4"	FT2015-5	630	808	1029	1302	1722	2100	2457	–	–	–
1 1/2"	FT2015-6	1155	1785	2520	3465	5250	6930	7980	–	–	–
2"	FT2015-8	2415	2940	3780	4883	7245	9450	11445	–	–	–
3/4"	FT2030-3	293	387	513	683	824	1050	1129	1271	1365	1439
1"	FT2030-4	293	387	513	683	824	1050	1129	1271	1365	1439
1 1/4"	FT2030-5	394	525	725	956	1260	1575	1764	1890	1995	2100
1 1/2"	FT2030-6	1050	1365	1785	2415	3570	4830	5775	6300	6930	7350
2"	FT2030-8	1365	1890	2625	3570	5460	7140	8190	9030	9765	10500

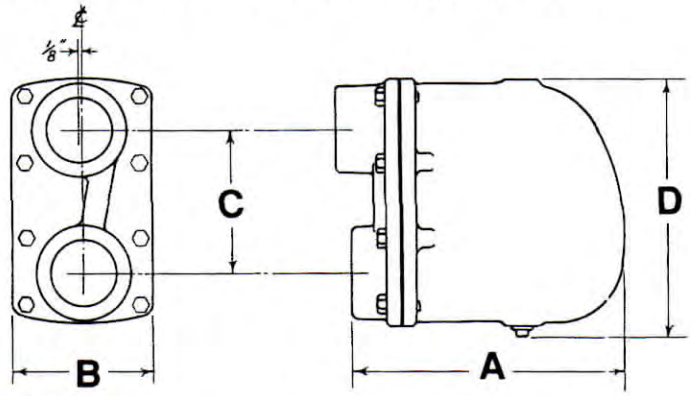
Note on capacity: Trap capacities are based on continuous discharge at stream temperature. The published figures are the result of an extensive testing program conducted in accordance with ANSI/ASME PTC 39.1 – 1980, *Condensate Removal Devices for Steam Systems*, at the B & J factory. Significantly greater capacities are realized when condensate temperature is below saturated steam temperature. Appropriate safety factors should be applied to these ratings.

NOTE: FLOAT TRAPS are available for those applications where draining liquid is the only requirement of the trap. In those instances the thermostatic air vent is replaced by a solid plug. To order, use the previous model numbers with the prefix "F" instead of "FT". All pipe sizes and pressure ratings are available.



3/4" - 1 1/2"

DIMENSIONS



2"

Size	Models	A	B	C	D	WT.
3/4"	FT2015-3, FT2030-3	5 11/16	5	3 5/16	5 5/8	11 lbs.
1"	FT2015-4, FT2030-4	5 11/16	5	3 5/16	5 5/8	11 lbs.
1 1/4"	FT2015-5, FT2030-5	6 1/8	5 1/2	3	5 3/8	12 lbs.
1 1/2"	FT2015-6, FT2030-6	8 1/4	6	3	8 1/4	24 lbs.
2"	FT2015-8, FT2030-8	10	4 7/8	4 7/8	9 1/4	22 lbs.

Barnes® & Jones INC.

Thermostatic Steam Traps for Low & Moderate Pressure Service
(VAC-25 PSIG; VAC-65 PSIG)

Features

- Heavy duty cast bronze or forged brass body
- Forged brass cover, union nut and tailpiece
- Corrosion resistant seat and plug with option of stainless steel
- All working parts factory calibrated within "Cage Unit" ensuring absolute uniformity of performance
- 100% factory tested under live steam & condensate.
- Available in angle, straightway or vertical piping patterns
- ½", ¾" and 1" Pipe sizes
- Also available, ½" inlet x ¾" outlet design.



"Cage Unit" Interior*

Description

The purpose of a steam trap is to prevent steam from passing its point of use and to allow condensate to be expelled as soon as it forms. Barnes & Jones' thermostatic steam traps perform this function better than any other traps available today. Ours are the only factory calibrated thermostatic steam traps; a claim that cannot be matched by Dunham Bush, Sarco, Hoffman, Illinois or any other manufacturer. Calibration ensures that each of our thermostatic traps snaps shut to steam and opens to condensate with a uniform sensitivity that has been proven under live steam in our factory test facility. You no longer have to worry about the tolerances of individual parts, such as the "screw in" seat, lock washers, element and cover of other traps. It is our one piece, fully removable, thermostatic element, the Cage Unit, that is the heart of our trap. The body of the trap acts merely as a housing for the Cage Unit, which performs all the work. Additionally, testing of this element can be performed out of its original trap body, in a test body, due to its stand alone, calibrated construction, thereby eliminating the need to take the trap off line for testing or repair and greatly simplifying your preventive maintenance program.

Operation

Using a diaphragm or bellows, within which is a volatile liquid, sealed under vacuum, the trap opens and closes in a modulating manner dependent upon the temperature affecting it. The trap's normal state is that of being wide open to expel air and condensate. When surrounded by steam at saturated temperature, the volatile fill has flashed, creating an internal pressure equal to the surrounding pressure. This equalization of pressures allows the bellows to expand to its natural length or "closed" position, preventing steam from passing. The presence of condensate sufficiently cools the bellows to condense the vapor within. Once again the external pressure is greater and the bellows reverts back to its contracted, or "open" position, allowing the condensate to drain from the trap, permitting more steam to enter the radiator and thus, the modulating action of the trap.

*Adaptations of the "Cage Unit" are available to renew all manufacturers' thermostatic steam traps. Call for "Steam Trap Repair Guide."

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CAPACITIES

square feet EDR

Type	Pipe Size	Orifice Dia.	Pressure Differential (PSIG)									
			1/4	1/2	1	1 1/2	2	3	5	10	15	25
122 & BJV-2L	1/2"	5/16"	92	120	168	200	228	278	320	490	610	1270
134	3/4"	5/16"	152	208	320	400	450	512	710	1040	1260	2450
147	1"	1/4"	300	430	590	700	760	824	1200	1750	2200	4100

Note on capacity: For low pressure heating system use, thermostatic traps are rated in square feet EDR (Equivalent Direct Radiation). One square foot EDR is equivalent to an output of 240 BTU per hour or 0.25 lbs. of condensate.

CAPACITIES

lbs. condensate per hour.

Type	Pipe Size	Orifice Dia.	Pressure Differential (PSIG)											
			1/4	1/2	1 1/2	2	3	5	10	15	20	40	50	60	65
EB & BJV-2M	1/2" & 3/4"	1/4"	150	200	290	440	550	1150	1540	1700	1910	2370	2960	3260	3430

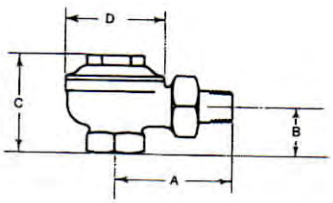
Note on capacity: Capacities shown are at 10° below saturated steam temperature and are the result of an extensive testing program conducted in accordance with ANSI/ASME PTC 39.1 – 1980, *Condensate Removal Devices for Steam Systems*, at the B & J factory. Significantly greater capacities are realized when condensate temperatures are cooler than 10° below saturation temperature.

DIMENSIONS

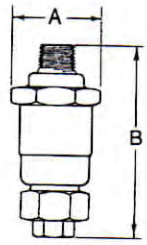
Model No.	Pipe Size	A	B	C	D	E	Wt. (lbs.)
122A	1/2"	3"	1 1/4"	2 1/2"	2 9/16"	—	1 1/3
134A	3/4"	3 3/8"	1 3/8"	2 7/8"	2 9/16"	—	1 2/3
147A	1"	3 5/8"	1 11/16"	3 1/2"	3 1/16"	—	2 3/4
2EBA	1/2"	3"	1 1/4"	3"	2 9/16"	—	1 2/3
3EBA	3/4"	3 3/8"	1 3/8"	3 3/8"	2 9/16"	—	2
122S	1/2"	3"	2"	2 1/2"	2 9/16"	1/2"	2
134S	3/4"	3 3/8"	2 1/8"	2 7/8"	2 9/16"	5/8"	1 7/8
2EBS	1/2"	3"	2	3"	2 9/16"	1/2"	2
3EBS	3/4"	3 3/8"	2 1/8"	3 3/8"	2 9/16"	5/8"	2 1/8
BJV-2L	1/2"	2 1/4"	4 3/4"	—	—	—	1 1/3
BJV-2M	1/2"	2 1/4"	4 3/4"	—	—	—	1 1/3

MATERIALS

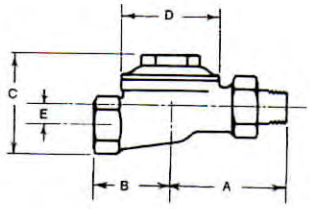
Part	122, 134, BJV-2L	147, EB, BJV-2M
Cap	Brass, ASTM CDA-377	Brass, ASTM CDA-377
Body	Brass or Bronze	Brass or Bronze
Element	Monel & Phosphor-Bronze	Phosphor-Bronze
Gaskets	Non-Asbestos Fiber	Copper And Non-Asbestos Fiber
Plug	Stainless Steel	Bronze
Seat	Brass	Brass



Angle Pattern — A



Verticle Pattern — BJV



Straight Pattern — S

Barnes & Jones INC.

Vacuum Breakers

Barnes & Jones Vacuum Breakers are simple, reliable devices that provide a positive means to automatically relieve or "break" an unwanted vacuum condition. The rugged hex design provides for long service life and ease of installation. Bubble tight sealing is assured due to the soft silicon O-ring and spring pressure against the valve.



Applications

- Air/Heat Coils for Space Heating
- Process Air Heater
- Shell & Tube Heat Exchanger
- Make-Up Air Coils
- Textile Dry Cans
- Steam Boilers
- Storage Heaters
- Jacketed Kettles
- Steam Main Zoning
- One Pipe Steam Non-Electric Valve

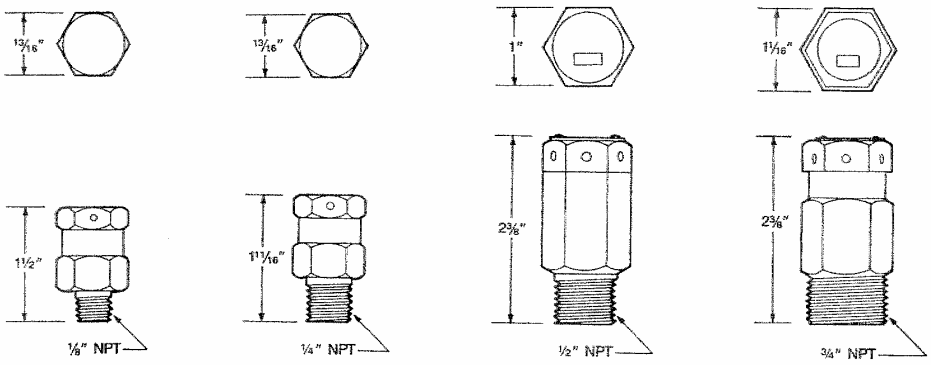


Figure 2

91 Pacella Park Drive • Randolph, MA 02368 • TEL (781) 963-8000 • FAX (781) 963-3322 • www.barnesandjones.com

Vacuum Breaker Engineering Specifications

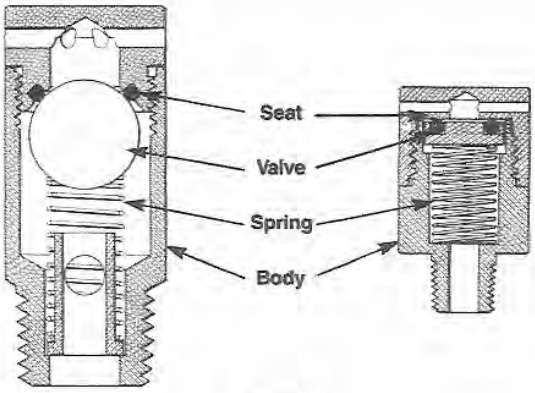


Figure 1

Materials

Model No.	Body	Spring	Valve	Seat
VB 3901	Brass	Stainless Steel	Brass and Silicon	Brass
VB 3902				
VB 3856	Brass	Stainless Steel	Stainless Steel	Silicon
VB 3875				

Models are available in four NPT Pipe Sizes. They are ⅛", ¼", ½" and ¾", all of which are rated for use with pressures up to 125 PSIG (8.6 Bar), and temperatures to 350°F (180°C). Materials of construction are listed in the table above.

Vacuum Required to Open

(INCHES OF MERCURY)

Model No.	Horizontal*	Vertical		
		 Bottom Outlet	 Top Outlet	 No Spring
VB 3901	1.27	1.25	1.75	0.2
VB 3902				
VB 3856	0.77	0.75	1.25	0.3
VB 3875				

Note on installation:** The preferred method of installation is in the ***vertical position. Horizontal installation should be used only if no other option is available and only above the water line.
Vacuum breakers should be placed at the highest practical points.

The table above lists the corresponding "break" points for the various models and positions. Barnes & Jones will Custom Engineer to customer requirements in applications that require other "break" points.

Barnes & Jones INC.

E-SAVER OPAL-R™ Series

THE E-SAVER-80R/81R TRANSFORMERS ARE OPTIMIZED FOR RETROFIT PROJECTS DELIVERING ON AVERAGE 80% ENERGY SAVINGS WHEN REPLACING OLDER UNITS

APPLICATION

E-SAVER™ - 80R and E-SAVER™ - 81R are ultra-efficient dry-type transformers that have been optimized to maximize energy savings and provide the fastest payback in the most widespread retrofit applications.

For more than a decade, Powersmiths has actively measured low-voltage transformer load profiles and losses for the thousands of transformers it has retrofitted in a wide variety of applications from K-12 schools to hospitals and college campuses, from military bases to courthouses, from mission critical high tech data centers to general commercial office buildings. In these applications, Powersmiths has found the most common profile to be a lightly loaded transformer that feeds predominately electronic equipment. Optimized specifically for this profile, E-SAVER-80R and 81R have shown to deliver an average of 80% reduction in losses per project when replacing older existing transformers.

For transformers feeding dedicated equipment like fans, motors and elevators, or heavy harmonic rich loads, see the rest of the E-Saver family as well as Powersmiths T1000.

OPAL™ - OPTIMIZED DESIGNS FOR RETROFITS

There is more to a transformer retrofit than simply matching the capacity and input/output voltages with a typical transformer from the distributor's warehouse. A transformer has much more impact in an electrical system than just efficiency, since its electrical characteristics affect fault and arc flash levels as well as inrush. In a retrofit, there are other important considerations including site conditions like footprint and internal terminal layout.

To address these needs, Powersmiths has developed a transformer design best practice called OPAL™ - Optimized Performance for the Application Load. OPAL ensures compatibility by considering the system as a whole, including goals like managing impedance, arc flash, fault level, inrush, harmonics, and more. OPAL is possible thanks to the tight feedback loop between design, onsite manufacturing, and extensive ongoing real world operating performance verification. The result is the most savings per dollar spent. Our flexible design and manufacturing process enables us to deliver solutions for the wide variety of site conditions and transformer manufacturers including footprint and internal terminal layouts.

DOE 2016 IDENTIFIES BILLIONS IN SAVINGS BEYOND NEW LEGAL MINIMUM

Most manufacturers have designed their low-voltage transformers to just meet the new U.S. Dept. of Energy law (DOE 2016), setting minimum efficiency at a single required 35% load point, under an ideal sine wave factory test profile, sacrificing performance elsewhere. The DOE quantifies savings for going beyond DOE 2016 in billions of dollars. Furthermore, the DOE states that lifecycle savings can be maximized by optimizing for real-world loading. Powersmiths OPAL™ enables customers to access these savings – backed by real-world performance verification.



E-Saver OPAL-R™ Retrofits deliver maximum energy savings and follow best practices to measure & verify lifecycle savings, and ensure hassle-free transformer replacements.

RETROFITS REQUIRE A BEST PRACTICE

To replace existing transformers cost effectively, Powersmiths uses a multi-step best practice covering the entire project cycle, from vetted project savings calculations, to comprehensive site audits and tagging, individualized product selection baseline and post installation field measurement of load profile, losses and efficiency following IPMVP protocols, and performance reports, all under the supervision of professional engineers.

GUARANTEED PERFORMANCE OVER 25 YEARS

In a world filled with small print disclaimers and limited DOE compliance testing, you can count on Powersmiths performance because we guarantee that every transformer we manufacture meets our published technical data, and furthermore, that this performance is met over the full term of the 25-year pro-rated warranty. Being able to trust that savings are both real and long-term is part of why organizations choose Powersmiths.

K-RATING IS A MODERN REQUIREMENT

Many general purpose transformers are purchased and installed since they have the lowest first cost, however, they carry a UL label on the basis of feeding only linear load. Since most connected loads today are electronic with nonlinear profiles, a low-voltage transformer needs to be K-rated in order to have a valid UL listing for most applications today. E-Savers are appropriately K-rated.

EXPANDED KVA SELECTION ENABLES RIGHT-SIZING

Powersmiths enables right-sizing of electrical infrastructure by offering a much broader selection of transformer kVA sizes. The capital cost, operating cost and footprint reductions can be dramatic - on the order of 30-50%, through smaller transformers, breakers, conductors, and distribution panels.

ENVIRONMENTAL/GREEN BUILDING/LEED®/NET ZERO

By going meaningfully beyond the DOE 2016 baseline efficiency, the E-Saver™ contributes to green building, LEED®, Net Zero and carbon footprint reduction goals. Additional benefits include our ISO14001 certified manufacturing, integrated metering and ability to integrate with the Powersmiths WOW™ Sustainability Management Platform.

CERTIFICATIONS & TESTING

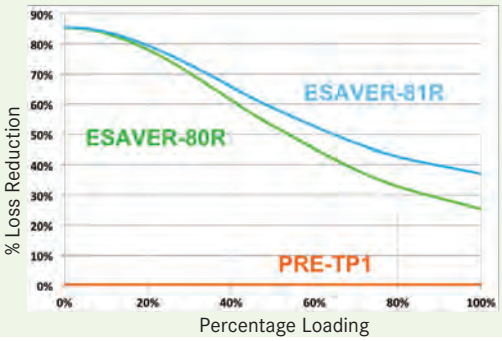
Powersmiths certifications include ISO9001 (Quality), ISO14001 (Environment) ISO17025 (Efficiency Test Lab), UL and CSA. Powersmiths has a production-integrated nonlinear load test program that enables efficiency verification under real-world conditions, as well as Certified Test Lab Profile Test Reports.

METERING & ARC FLASH OPTIONS

Integrated metering can provide information about capacity utilization, load profiles, power quality and energy use. The lockable hinged door option as well as our patented 360º Rotatable IR Port™ option enable quick and safe access to internal transformer connections, and reduces arc flash risk.

Powersmiths offers also transformers with Integrated Power Distribution, see the Energy Station TX brochure.

E-SAVER OPAL-R™ Loss Reduction Curves



KEY FEATURES

- Optimized for light, nonlinear loads found in most applications K-rated as required by UL to feed modern electronic equipment
- Retrofit Best Practice ensures a smooth retrofit with verified savings
- Significant savings beyond DOE 2016 legislation
- Electrical system consideration: impedance, inrush, fault & arc flash levels
- Available with a wide range of safety & performance features like integrated hinged doors, 360º Rotatable IR Port™, and Cyberhawk™ Metering and Logging
- Manufactured in a certified ISO 9001, ISO 14001 and ISO 17025 facility for quality, low environmental impact, and transformer efficiency testing

[1] U.S. Dept. of Energy 10 CFR Part 431, [Docket No. EERE–2010–BT–STD–0048] Energy Conservation Program: Energy Conservation Standards for Distribution Transformers, Final Rule April 18, 2013.

TECHNICAL SPECIFICATIONS

The E-Saver™-80R and 81R are ultra-efficient low-voltage dry-type transformers that meaningfully exceed the U.S. Dept. of Energy's new minimum efficiency law, commonly referred to as DOE 2016. All E-Saver transformers carry a UL Listing and CSA Approval, with application appropriate K-factor.

The aluminum wound E-Saver-80R and the copper wound E-Saver-81R are both K-factor listed per UL 1561 and are K-7 rated per C57.110. Both models are compatible with electronic equipment all the way up to full load.

E-Savers have a common-core (3-phase models), 10kV BIL, 200% rated neutral, are 60Hz rated (std), built to NEMA ST-20, UL1561, IEEE C57.110 and other applicable ANSI and IEEE standards. Both primary and secondary terminals and voltage taps (typically six 2.5%) are all front-accessible. E-Savers have a 220°C class insulation system that is NOMEX-based with an Epoxy Co-polymer impregnant with technical performance characteristics that embed lower environmental impact, long term reliability and long life expectancy. E-Savers carry OSHPD and IBC Seismic Certification. The seismic bracing option provides a higher 2.28g certification. All E-Saver models come standard in a Type 2 ventilated drip-proof indoor enclosure made of heavy gauge steel finished with epoxy powder coating for durability and low environmental impact, and are UL Listed for 2" rear clearance - a significant improvement over the typical industry 6" limit. A wide variety of enclosures and options are available.

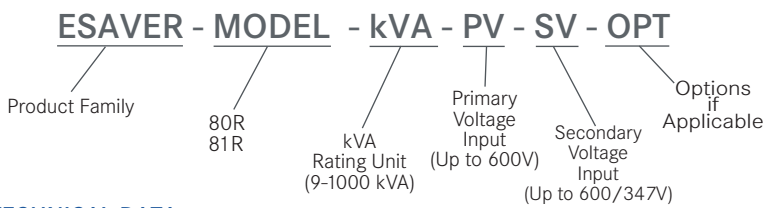
Low Noise: Keeping audible noise at a minimum is key. While the NEMA ST-20 standard sets levels referenced by industry only a type test, not a production test, is required – so transformers on actual projects may be noisy. Powersmiths builds 3dB quieter than NEMA standard values, and furthermore every unit is tested to ensure quiet operation. For very sensitive environments an additional 2dB lower noise option is available.

Management of Impedance, Inrush, Fault Level, Arc Flash: Powersmiths OPAL™ design best practice includes addressing key transformer attributes like impedance, inrush, fault level, arc flash, to ensure smooth integration into an electrical system, avoiding the negative impacts often associated with high efficiency transformers. See individual technical data sheets for comprehensive values for all parameters.

Impedance: For both the E-Saver-80R and E-Saver-81R, impedance is kept at or above 4.0% in order to manage downstream fault current and arc flash levels, and maintain compatibility with equipment interrupting capacity (kAIC) ratings. Higher impedance is available to meet specific project needs.

Inrush: Inrush currents are managed in order to avoid nuisance tripping of the primary breaker and to enable design engineers to use standard 125% rated primary protection, thereby avoiding expensive design changes that otherwise may be needed. Very Low Inrush designs are available as specific projects may require, for example some datacenter and medical applications.

ORDERING INFORMATION



TECHNICAL DATA

kVA	Audible Noise	80R, 81R Model Weight Range (lbs)	Standard Case Size (in)	Alternate Smaller Case Size (in)
15	42 dB	230-300	17.5W x 17D x 27.5H	17.5W x 14.5D x 25H
20	42 dB	260-340	25.5W x 18D x 30H	23W x 15.5D x 27.5H
25	42 dB	300-380	25.5W x 18D x 30H	23W x 15.5D x 27.5H
30	42 dB	340-420	25.5W x 18D x 30H	23W x 15.5D x 27.5H
45	42 dB	400-540	25.5W x 18D x 30H	25.5W x 16D x 29H
50	42 dB	450-600	25.5W x 18D x 30H	No Alternate
63	47 dB	500-650	31.5W x 21.5D x 40H	26.5H x 20D x 33H
75	47 dB	610-700	31.5W x 21.5D x 40H	26.5H x 20D x 33H
100	47 dB	675-900	31.5W x 21.5D x 40H	30.5H x 20D x 35H
112	47 dB	770-990	31.5W x 21.5D x 40H	30.5H x 20D x 35H
125	47 dB	875-1120	37.5W x 26.5D x 48H	33W x 23D x 38H
150	47 dB	1010-1230	37.5W x 26.5D x 48H	33W x 23D x 38H
175	52 dB	1100-1360	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
200	52 dB	1175-1450	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
225	52 dB	1295-1600	37.5W x 31.5D x 52H	34.5W x 26.5D x 42H
250	52 dB	1400-1800	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H
300	52 dB	1575-1960	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H
400	57 dB	2025-2450	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
450	57 dB	2200-2600	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
500	57 dB	2475-2900	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
600	59 dB	2725-3600	64W x 47D x 67H	51.5W x 38D x 61H
750	61 dB	3200-4300	64W x 47D x 67H	Contact Factory
850	61 dB	3600-5000	64W x 53D x 67H	Contact Factory
1000	61 dB	4200-6000	64W x 53D x 67H	Contact Factory

AVAILABLE OPTIONS

Metering: Express Logger™, SMART™ or Cyberhawk TX™ (see product cut sheets for details)
CC: Core & Coils available for OEM Integration
3R: Type 3R, sprinkler proof/outdoor ventilated enclosure
OSEC: Enclosure for outdoor public areas
SS: Painted stainless steel enclosure
NVI: Non-ventilated indoor enclosure
IRP: 360º Rotatable IR Port™
HD: Hinged Door
F50: 50 Hz design
1S: Single electrostatic shield
2S: Dual electrostatic shields
3S: Triple electrostatic shields
SPD: (120/208 V OR 277/480V)
- **PRO80:** 80kA, 7 mode, Filter
- **PRO120:** 120kA, 7 mode, Filter
- **PRO200:** 200kA, 7 mode, Filter
- **PRO240:** 240kA, 7 mode Filter
- **PROXX:** Where XX is custom ID

LKS: Lug kit, screw-type
LKC: Lug kit, compression type
VLI: Very Low Inrush
IMP: Custom Impedance
COL: Custom color
TS: Thermal sensors at 170°C and 200°C
RTR: Routine Test Report
NLT: Nonlinear Load Test with Certificate
2016TR: DOE 2016 Test Report
CTL: ISO 17025 Certified Test Lab, load profile test
SE: Sensitive environment, extra low noise
SB: Certified Seismic bracing for 2.28g (for Certificate details contact Powersmiths)
WM: Wall-mount kit up to 75kVA is available (sold separately)

NOTE: The above data applies to the standard configuration of each kVA. Selection of some options may change enclosure size and/or transformer weight. Some options may be mutually exclusive. Consult factory for detailed product data sheet for these and other configurations. Efficiencies tested according to U.S. Dept. of Energy's 10 CFR Part 431, a linear load test at 35% of nameplate capacity. Refer to technical data sheet for comprehensive information for each specific model, kVA, and option selected.

As design optimization is continuous, technical data is updated over time. Please check with Powersmiths for latest revision.

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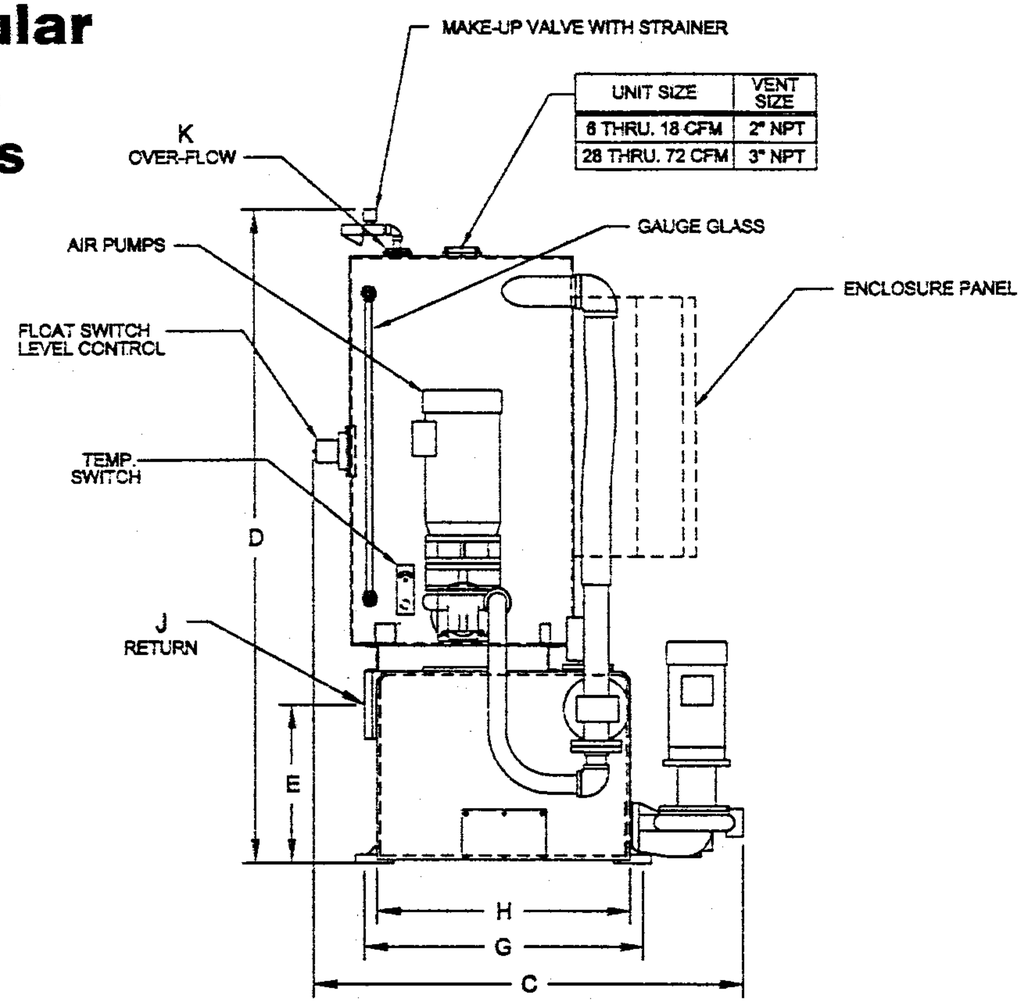
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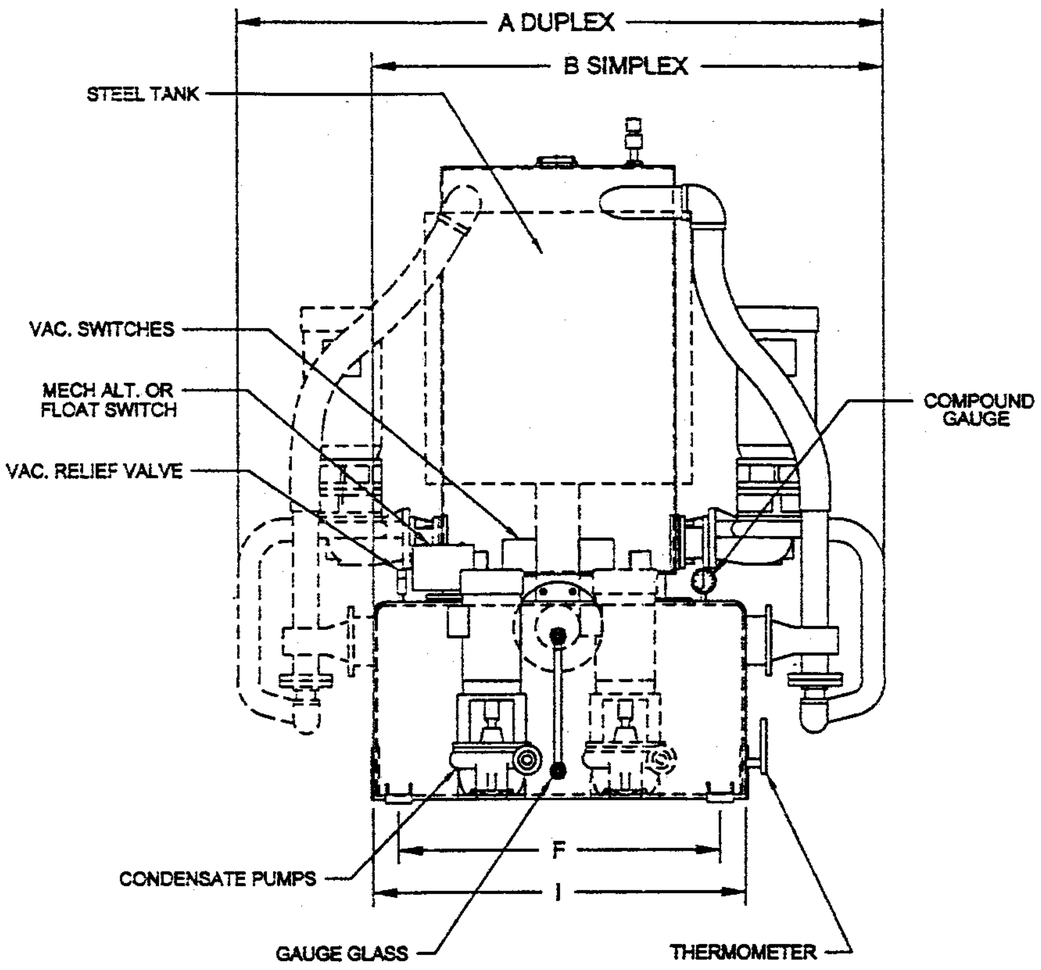
Phone: (905) 791-1493 Toll-free: (800) 747-9627 Fax: (905) 791-8870 Email: info@powersmiths.com

WWW.POWERSMITHS.COM

807-000431-156-A 02

Rectangular Cast Iron Receivers





APPROXIMATE DIMENSIONS

RECEIVER SIZE (GAL.)	A DUPLEX	B SIMPLEX	C	D 6 THRU 12 CFM	D 18 CFM	D 28 THRU 72 CFM	E	F	G	H	I	J NPT	K NPT
45	65	47	52	55	70	N/A	14½	28¾	25¾	20	28	2½	1½
65	65	47	55	60	75	N/A	19	30½	28¼	22¾	30½	3	1½
110	80	65	57	60	75	80	19½	42	32	30	42	4	1½-2

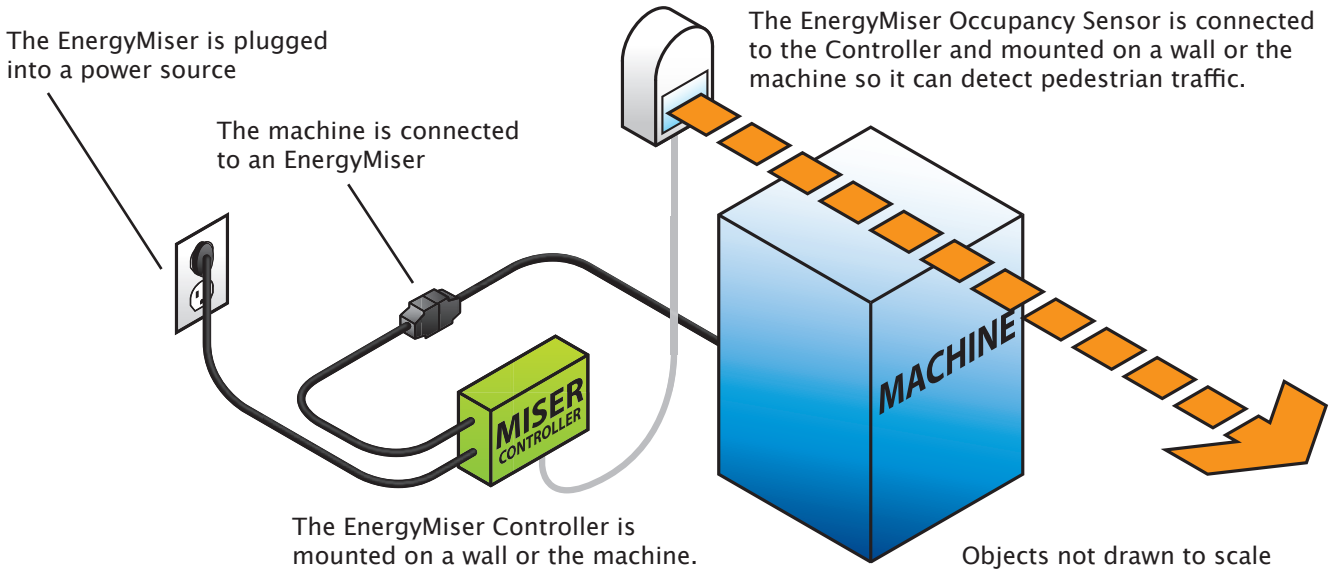
EnergyMisers

EnergyMiser® Products are easy to install devices designed to lower the energy consumption of vending machines, commercial coolers, and other "always on" machines and appliances. No other technology can compete with its price and ease of installation for the immediate energy savings that can be achieved.

- Win and retain accounts by offering energy-efficient technology
- Save clients up to $150 per machine, per year
- Typical return on investment in 12 months
- Easy retrofit field installation
- Reduction in machine energy use an average of 35-45%
- Reduced machine maintenance and longer machine lifespans
- Environmental benefits such as reducing pollution and natural resource use

How EnergyMisers Work

External EnergyMisers use a controller and a machine mounted sensor to monitor room occupancy and temperature. If 15 minutes pass without any pedestrian traffic, the EnergyMiser will power down the machine. The machine is powered back up when people return and at regular intervals to to keep the product cold. External controllers are best suited for low traffic areas.



Internal EnergyMisers use sales based intelligence to power down the cooling system while leaving lighting and controller electronics on. While the cooling system is powered down, the internal EnergyMiser monitors the room's temperature and automatically re-powers the cooling system at regular intervals to keep the product cold. Internal controllers are best suited for high traffic areas.

Who Uses EnergyMisers

Several large retailers such as Wal-Mart and Kroger have installed EnergyMiser Products at their locations. Educational facilities along with the US Government have purchased EnergyMisers through GSA. Also, many utilities offer rebates on the purchase of EnergyMiser products and several have provided customers with EnergyMiser Products at no cost through Turnkey Programs.

USA Technologies 100 Deerfield Lane, Suite 140, Malvern, PA 19355 • 800.633.0340 • www.usatech.com

EnergyMiser Products

VendingMiser®- for cold drink vending machines
VM150 - Indoor Wall Mount Controller with Occupancy Sensor
VM151 - Indoor Wall Mount Controller with 10' Repeater Cable
VM160 - Outdoor Wall Mount Controller with Occupancy Sensor and Weather-proof Enclosure
VM161 - Outdoor Wall Mount Controller with 10' Repeater Cable and Weather-proof Enclosure
VM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
VM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable
VM180 - Outdoor Controller with EZ Mount Z-Bracket, Occupancy Sensor, and Weatherproof Enclosure
VM181 - Outdoor Controller with EZ Mount L-Bracket, 10' Repeater Cable and Weatherproof Enclosure
VM2iQ - Internal VendingMiser

CoolerMiser™- for commercial glass-front coolers
CM150 - Indoor Wall Mount Controller with Occupancy Sensor
CM151 - Indoor Wall Mount Controller with 10' Repeater Cable
CM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
CM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable
CM2iQ - Internal CoolerMiser

SnackMiser®- for snack vending machines
SM150 - Indoor Wall Mount Controller with Occupancy Sensor
SM151 - Indoor Wall Mount Controller with 10' Repeater Cable
SM170 - Indoor Controller with EZ Mount Z-Bracket and Occupancy Sensor
SM171 - Indoor Controller with EZ Mount L-Bracket and 10' Repeater Cable

PlugMiser™- for most major electrical equipment
PM150 - Indoor Wall Mount Controller with Occupancy Sensor
PM151 - Indoor Wall Mount Controller with 10' Repeater Cable
PM190 - Indoor Controller with Leg Mount and Occupancy Sensor



VendingMiser VM150



CoolerMiser CM150



SnackMiser SM150



PlugMiser PM150

Visit www.energymisers.com for more information.

USA Technologies 100 Deerfield Lane, Suite 140, Malvern, PA 19355 • 800.633.0340 • www.usatech.com

Premium Efficient Motors





Product Overview and Options

Nidec Motor Corporation offers an extensive line of industrial and commercial U.S. MOTORS® brand high efficiency electric motors that meet or exceed NEMA Premium®† standards, ensuring your facility complies with local electrical codes and safety regulations.

Industrial Cast Iron Motors for Hostile, Severe Environments

- Hostile Duty Motors
- CORRO-DUTY® Motors
- 841 PLUS® Motors

Commercial Duty Motors Used In Office Buildings, Schools, and Other Federal Facilities

- Open Dripproof Motors
- UNIMOUNT® Motors

HVAC Motors for Air Moving and Conditioning Applications

- Cooling Tower Duty Motors
- Open Dripproof Motors
- UNIMOUNT® Motors

HOSTILE DUTY™ Motors



- Totally Enclosed Fan Cooled
- Three Phase, 60 Hz
- 1.00 and 1.15 Service Factor
- 1–350 HP
- 2, 4, 6, and 8 Poles
- 143–286 Frame
- Cast Iron Frame and Brackets
- Ball and Roller Bearing Options

CORRO-DUTY® Motors



- Totally Enclosed Fan Cooled
- Three Phase, 60 Hz
- 1–200 HP
- 2, 4, and 6 Poles
- 143–447 Frame
- All Cast Iron Construction

841 PLUS® Motors



- Totally Enclosed Fan Cooled
- Three Phase, 60 Hz
- 1.0 or 1.15 Service Factor
- 1–400 HP
- 2, 4, 6, and 8 Poles
- 143–447 Frame
- VBBX®† Bearing Isolators by Inpro/Seal
- Meets IEEE®† 841 GM7E-TA Specifications
- Five Year Warranty*
- Footed and C-Face Footless

Product Overview and Options *continued*

Open Dripproof Motors



- Three Phase, 60 Hz
- 1.0 and 1.15 Service Factor
- 1/4–400 HP
- 2, 4, 6, and 8 Poles
- 48–449 Frame
- Close Coupled Ratings Available

UNIMOUNT® Motors



- Totally Enclosed Fan Cooled
- Three Phase, 60 Hz
- 1.25 Service Factor
- 1/4–30 HP
- 2, 4, 6, and 8 Poles
- 50–286 Frame
- C-Face, Footed and Footless
- Removable Base 180 Frame and Above
- F2 Field Assembly
- Close Coupled Ratings Available

Hazardous Location Motors



- Totally Enclosed Fan Cooled
- Three Phase
- 1 to 200 HP
- 2, 4, and 6 Poles
- 143 to 447 Frame
- Single and Dual Label

Automotive Duty, U-frame Motors



- Totally Enclosed Fan Cooled
- Three Phase, 60 Hz
- 1/4–300 HP
- 2, 4, 6, and 8 Poles
- 56–5008 Frame
- Motors Available that Meet GM-7EQ, GM-7EH, Ford EM1 and Chrysler NPEM-105 specifications

Cooling Tower Motors



- Totally Enclosed Fan Cooled and Totally Enclosed Air Oven Options
- Three Phase, 60 Hz
- 2–100 HP
- 4, 6, 4/8 Poles
- 145–449 Frame
- Single Speed and Two Speed Options
- Motors Available that Meet Specifications for Baltimore Aircoil Company, Inc., Evapco, Inc., and SPX Cooling Technologies, Inc.

The Energy Independence and Security Act

On December 19, 2010, commercial and industrial motor manufacturers and importers will raise efficiencies to the NEMA Premium®† levels for all general purpose motors up to 600 volts, from 1 to 200 horsepower, in NEMA frame sizes. Additional categories of motors will be raised to energy efficient levels.

What does this mean for your business?

- The implementation of NEMA Premium®† and the elimination of the corresponding energy efficiency standards has removed models in both stock and configured categories.
- All customers, whether OEM, reseller or end-user need to comply.
- OEMs may require 3rd party certification of their equipment through UL® / CSA®.
- End-user will see first cost go up, but will benefit from life cycle reduction in energy costs.

We make the transition EASY

Nidec Motor Corporation's line of high performance commercial and industrial U.S. MOTORS® brand motors is designed to help industry reduce energy consumption and comply with EISA regulations. This line features upgraded open dripproof and totally enclosed motors that meet or exceed NEMA Premium®† requirements.

All high performance motors carry a nameplate including both 50 and 60 Hz operating data, a NEMA Premium®† trademark and European IE efficiency marks, providing a clear means for both users and OEM's to verify global regulatory compliance.

In addition to a full line of horizontal motors, the U.S. MOTORS® brand line of vertical motors are available at Premium efficiency levels to address customer requirements.

The NEMA Premium®† line also complies with recent Canadian and Mexican standards.

Want to learn more about motor efficiency and saving energy costs?

The online MotorPro® training tool features a new module on electric motor energy efficiency. Just visit www.usmotors.com/motorpro, and choose Module 3 for complete details on energy laws and efficiency — and on how you can reduce your energy usage and operating costs.

† All marks shown within this document are properties of their respective owners.
Note: For premium efficient vertical motor designs, visit www.usmotors.com

NIDEC MOTOR CORPORATION

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Nidec Motor Corporation trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

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SmartVFD HVAC and BYPASS

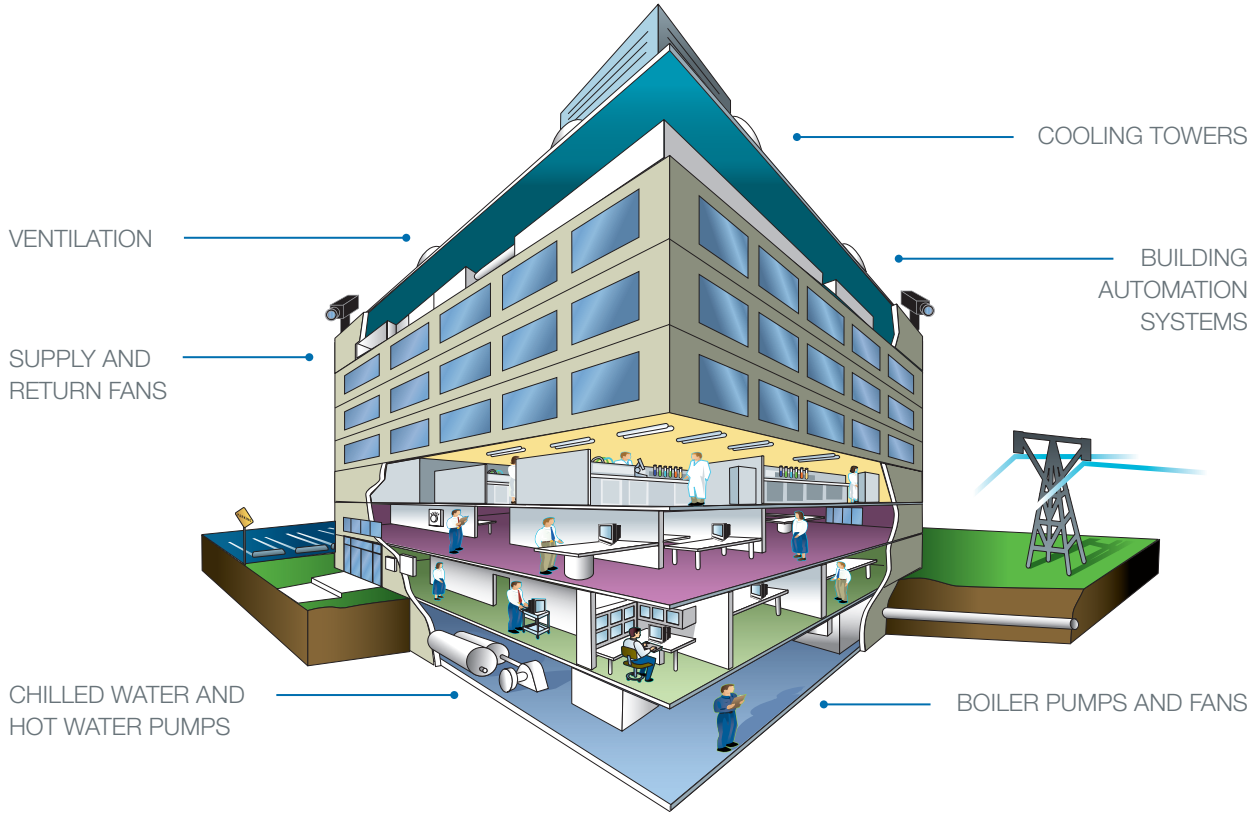
Honeywell



The Smart Choice for Energy Savings.

Saving Energy the Smart Way

Buildings consume more than 70 percent of the electricity produced in North America — and roughly half of that is used to circulate air and water. Honeywell SmartVFD HVAC, BYPASS and COMPACT variable frequency drives maximize energy savings by modulating the speed of fans and pumps. VFDs achieve these savings by operating within a building's control system or independently through its internal PID capabilities. Additionally, Honeywell's VFDs are loaded with labor-saving features such as startup wizards, PC programming, and an intuitive graphical interface that allows for faster, more accurate commissioning and reliable maintenance over the life of the drive.



BACKED BY HONEYWELL

Already among the leading names in HVAC variable frequency drives, Honeywell is pleased to deliver the SmartVFD HVAC line — the third generation of Honeywell VFDs. Designed specifically for commercial applications and backed by more than a century of Honeywell's control expertise, you can count on Honeywell's SmartVFD HVAC and BYPASS to deliver long-term service and energy savings for your customer. You simply can't find a commercial building control name with a more proven record than Honeywell.

The Smart Choice for Efficient Investment

It's a common myth that any VFD can easily be applied in a commercial application, but many VFDs are not the right tool for the job. The Honeywell SmartVFD HVAC and BYPASS are designed specifically for commercial buildings to deliver the energy savings that building owners and facility managers need with 98 percent energy efficiency, minimal labor and a fast ROI.



SMARTVFD HVAC – SMART INSTALLATION, SMART COMMISSIONING AND SMART COMMUNICATION

The Honeywell SmartVFD HVAC meets UL and cUL standards which makes installation and commissioning easy for you and energy savings easy for your customers:

Easy Communication

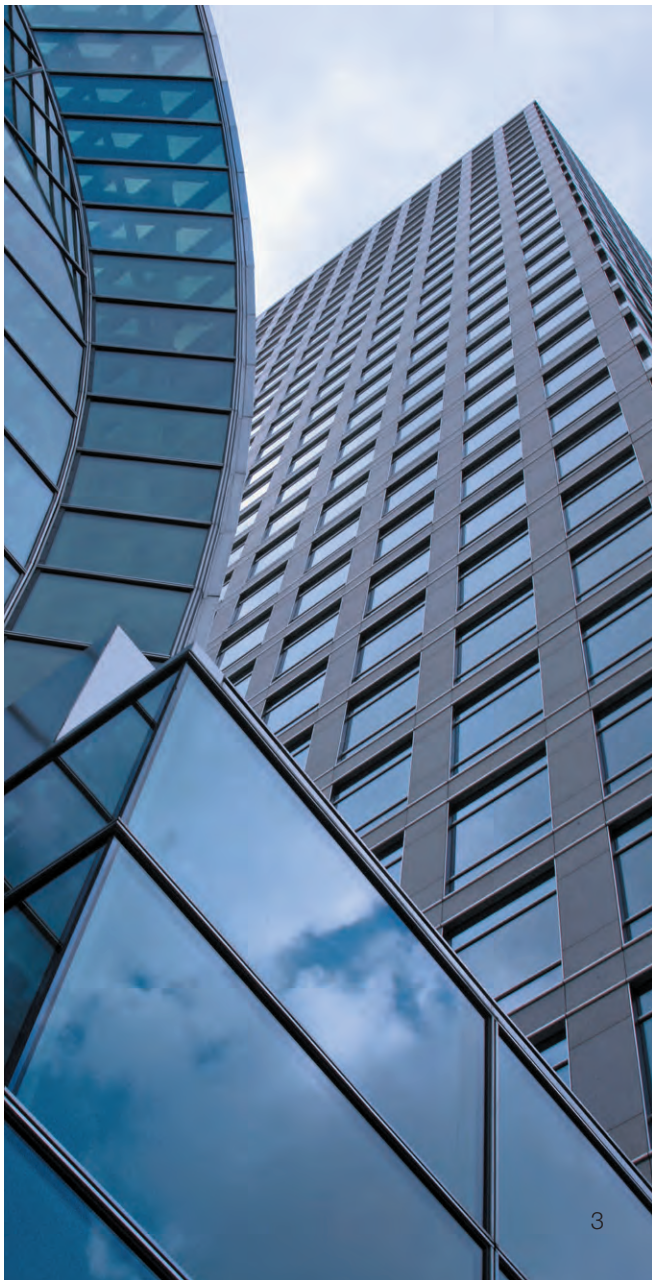
- Start-up Wizards — Set the clock and tell the VFD whether you have a pump or a fan, enter nominal motor information, and you are up and running. PID and multi-pumps wizards are also built in.
- PC Software Wizards — Commissioning, programming and troubleshooting are all a snap with the PC Software Wizards.
- Graphic Interface — The easy-to-use keypad and interface deliver menu-driven programming and monitoring for fast, uniform commissioning. It's also easy for the building owner or manager to learn and use, helping to reduce service calls. Every parameter has a built-in help feature to provide assistance while programming.
- Built-In Communications — With BACnet®, N2 and Modbus built in, your customers will enjoy a lower total installed cost and reliable communications with the building management system.
- Built-In PLC — PC based tools eliminate the need for an expensive external controller.

Built-in Protection

- DC Choke for harmonic protection.
- Standard RFI Filter — Ensures that EMC/RFI requirements are met.
- Bypass Options — Meet specifications and system critical applications with a comprehensive bypass offering.

Smart Software

- Real-Time Clock — Battery included.
- Fire Mode to improve fire safety in the building.
- Motor Switch Ride-Through — Easy, fault-free maintenance.
- Hand-Off-Auto (HOA) control built into the keypad.
- Plenum rated for install flexibility.
- 100 KA Short Circuit Current Rating (SCCR) rated.



Smart Benefits with Easy Commissioning

Honeywell SmartVFD HVAC doesn't just work in the laboratory — it works in the field. From the variety of network protocols that make integration easy, to the guided Startup and PID wizards, the design and technology of SmartVFDs make them true HVAC drives. Intuitive menus assist with commissioning, programming, troubleshooting and overall operation.

COMMUNICATION STANDARD



Integrating Honeywell SmartVFD HVAC into a building management system is a breeze. There's no need for extra cards because it offers a wide range of communications protocols right out of the box, including:

- RS485 – BACnet®, Modbus and N2
- Ethernet – BACnet/IP and Modbus/TCP
- Available options – LonWorks® and DeviceNet

HIGH-RESOLUTION GRAPHIC DISPLAY



It's not just easy on the eyes, it's also easy to use. The menu driven display shows the minimum, maximum and actual values for all parameters and allows easy uploading and downloading of parameters, and has multiple help functions and the manual built-in. In addition, there is a Local/Remote button on the keypad for built in HOA control.

DETERMINE ROOT CAUSE OF FAULTS



With the SmartVFD HVAC, troubleshooting involves very little trouble. The built in, diagnostic screen provides a description for every fault, and the actual values and references are stored at the time of the fault for easy review and problem resolution.

MONITOR SYSTEM PERFORMANCE



The data needed to analyze usage and make adjustments for maximum energy savings is right at your fingertips. Actual electricity consumption in kWh can be monitored using the VFD PC Wizard, and can be conveniently displayed in bar graphs. At any time, the user can see the actual power consumption currently in use — a great tool for managing energy savings.

Smart Configurations

For system critical applications, you must be able to select a bypass that meets the requirements of the specification. The SmartVFD BYPASS is easy to specify, select, install and commission. The SmartVFD BYPASS is UL certified and is the perfect complement to the advanced capabilities of the SmartVFD family — a combination that is both simple and smart.

SMARTVFD BYPASS CONFIGURATIONS

Our five configurations make it easy for you to select the right bypass to complete your drive package. All bundles are available in NEMA 1, NEMA 12 and ventilated NEMA 3R HOA (HAND OFF AUTO).



SmartVFD Disconnect Only

- Adds a fused disconnect to the VFD.

SmartVFD 2-Contactor Bypass

Provides an economical means of bypassing the VFD.

- Freeze/Fire/Smoke Interlock

SmartVFD 3-Contactor Bypass

Commission, service or replace the VFD without affecting the operation of the motor.

- Fused Disconnect
- Freeze/Fire/Smoke Interlock
- VFD is isolated from power with motor running in BYPASS mode
- TEST position powers the VFD without sending power to the motor

SmartVFD 3-Contactor Bypass with Auto-Bypass

The package adds the control capabilities below to the standard three contactor bypass.

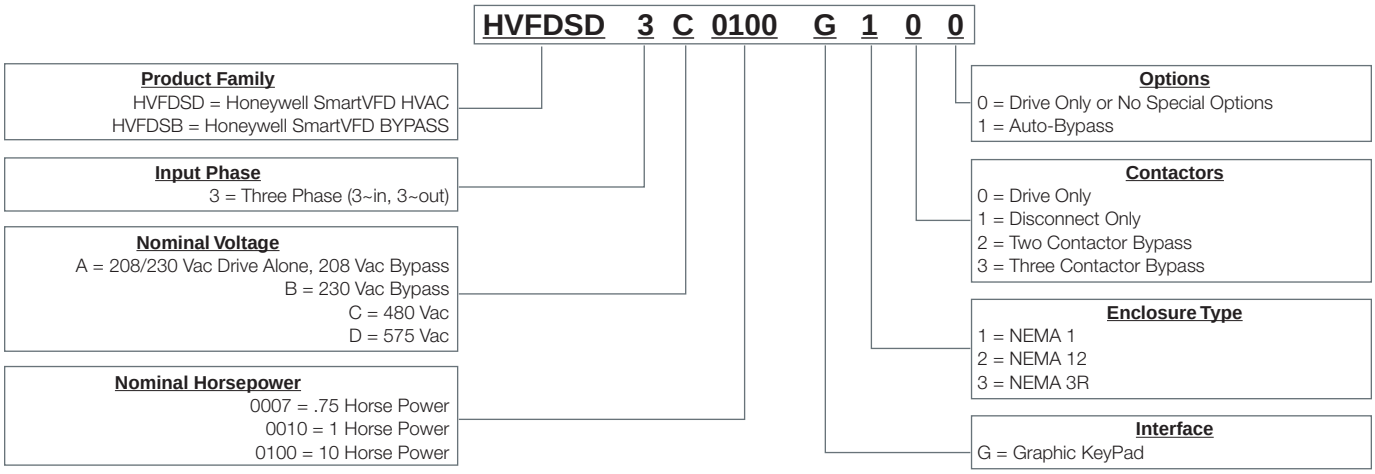
- Any VFD fault will automatically send the bypass to BYPASS mode
- A contact closure sends the bypass to BYPASS mode
- Dry contacts indicate when the bypass is in BYPASS mode, alerting the building management system

SLEEKER. SMALLER. SMARTER.

As the latest evolution of the Honeywell VFD line, the SmartVFD BYPASS is sleeker, smaller, lighter and less expensive.



Smart Selection



PICK THE RIGHT VFD FOR THE APPLICATION

- Drives are typically sized to match the horsepower rating of the motor, which will be accurate 95 percent of the time. But for the greatest accuracy, drives should be sized based upon the Full Load Amps or current draw of the motor. The VFD must have a slightly larger current rating maximum.
- The environment the drive will operate in is critical for selection. Honeywell offers NEMA 1, NEMA 12 (for dusty, dirtier environments) and NEMA 3R enclosures (for falling water or rain situations).
- Because of the complexity of VFDs, a clean, conditioned space with temperatures between 14° F and 104° F provides an environment for ideal operation. Heaters are an option in order to keep your VFD at its recommended temperature.
- Honeywell SmartVFD HVAC has a model range from 1.5-250 HP for 460 Vac, 0.75-125 HP for 208/230 Vac.
- Honeywell SmartVFD offers a standard 3-year warranty from the date of purchase.

Find all SmartVFD selection information on the following pages

SmartVFD HVAC Drive Alone

	HP	AMPS	Frame	NEMA 1 Drive Alone	NEMA 12 Drive Alone	NEMA 3R Drive Alone
460 Vac	1.5	3.4	4	HVFDSD3C0015G100	HVFDSD3C0015G200	HVFDSD3C0015G300
	2	4.8	4	HVFDSD3C0020G100	HVFDSD3C0020G200	HVFDSD3C0020G300
	3	5.6	4	HVFDSD3C0030G100	HVFDSD3C0030G200	HVFDSD3C0030G300
	4	8	4	HVFDSD3C0040G100	HVFDSD3C0040G200	HVFDSD3C0040G300
	5	9.6	4	HVFDSD3C0050G100	HVFDSD3C0050G200	HVFDSD3C0050G300
	7.5	12	4	HVFDSD3C0075G100	HVFDSD3C0075G200	HVFDSD3C0075G300
	10	16	5	HVFDSD3C0100G100	HVFDSD3C0100G200	HVFDSD3C0100G300
	15	23	5	HVFDSD3C0150G100	HVFDSD3C0150G200	HVFDSD3C0150G300
	20	31	5	HVFDSD3C0200G100	HVFDSD3C0200G200	HVFDSD3C0200G300
	25	38	6	HVFDSD3C0250G100	HVFDSD3C0250G200	HVFDSD3C0250G300
	30	46	6	HVFDSD3C0300G100	HVFDSD3C0300G200	HVFDSD3C0300G300
	40	61	6	HVFDSD3C0400G100	HVFDSD3C0400G200	HVFDSD3C0400G300
	50	72	7	HVFDSD3C0500G100	HVFDSD3C0500G200	HVFDSD3C0500G300
	60	87	7	HVFDSD3C0600G100	HVFDSD3C0600G200	HVFDSD3C0600G300
	75	105	7	HVFDSD3C0750G100	HVFDSD3C0750G200	HVFDSD3C0750G300
	100	140	8	HVFDSD3C1000G100	HVFDSD3C1000G200	HVFDSD3C1000G300
	125	170	8	HVFDSD3C1250G100	HVFDSD3C1250G200	HVFDSD3C1250G300
	150	205	8	HVFDSD3C1500G100	HVFDSD3C1500G200	HVFDSD3C1500G300
	200	261	9	HVFDSD3C2000G100	HVFDSD3C2000G200	-
	250	310	9	HVFDSD3C2500G100	HVFDSD3C2500G200	-
	HP	AMPS	Frame	NEMA 1 Drive Alone	NEMA 12 Drive Alone	NEMA 3R Drive Alone
208/ 230 Vac	.75	3.7	4	HVFDSD3A0007G100	HVFDSD3A0007G200	HVFDSD3A0007G300
	1	4.8	4	HVFDSD3A0010G100	HVFDSD3A0010G200	HVFDSD3A0010G300
	1.5	6.6	4	HVFDSD3A0015G100	HVFDSD3A0015G200	HVFDSD3A0015G300
	2	8	4	HVFDSD3A0020G100	HVFDSD3A0020G200	HVFDSD3A0020G300
	3	11	4	HVFDSD3A0030G100	HVFDSD3A0030G200	HVFDSD3A0030G300
	5	18	5	HVFDSD3A0050G100	HVFDSD3A0050G200	HVFDSD3A0050G300
	7.5	24	5	HVFDSD3A0075G100	HVFDSD3A0075G200	HVFDSD3A0075G300
	10	31	5	HVFDSD3A0100G100	HVFDSD3A0100G200	HVFDSD3A0100G300
	15	48	6	HVFDSD3A0150G100	HVFDSD3A0150G200	HVFDSD3A0150G300
	20	62	6	HVFDSD3A0200G100	HVFDSD3A0200G200	HVFDSD3A0200G300
	25	75	7	HVFDSD3A0250G100	HVFDSD3A0250G200	HVFDSD3A0250G300
	30	88	7	HVFDSD3A0300G100	HVFDSD3A0300G200	HVFDSD3A0300G300
	40	105	7	HVFDSD3A0400G100	HVFDSD3A0400G200	HVFDSD3A0400G300
	50	140	8	HVFDSD3A0500G100	HVFDSD3A0500G200	HVFDSD3A0500G300
	60	170	8	HVFDSD3A0600G100	HVFDSD3A0600G200	HVFDSD3A0600G300
	75	205	8	HVFDSD3A0750G100	HVFDSD3A0750G200	HVFDSD3A0750G300
	100	261	9	HVFDSD3A1000G100	HVFDSD3A1000G200	-
	125	310	9	HVFDSD3A1250G100	HVFDSD3A1250G200	-

SmartVFD HVAC NEMA 1 Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
460 Vac	1.5	3.4	4	HVFDSB3C0015G110	HVFDSB3C0015G120	HVFDSB3C0015G130	HVFDSB3C0015G131
	2	4.8	4	HVFDSB3C0020G110	HVFDSB3C0020G120	HVFDSB3C0020G130	HVFDSB3C0020G131
	3	5.6	4	HVFDSB3C0030G110	HVFDSB3C0030G120	HVFDSB3C0030G130	HVFDSB3C0030G131
	4	8	4	HVFDSB3C0040G110	HVFDSB3C0040G120	HVFDSB3C0040G130	HVFDSB3C0040G131
	5	9.6	4	HVFDSB3C0050G110	HVFDSB3C0050G120	HVFDSB3C0050G130	HVFDSB3C0050G131
	7.5	12	4	HVFDSB3C0075G110	HVFDSB3C0075G120	HVFDSB3C0075G130	HVFDSB3C0075G131
	10	16	5	HVFDSB3C0100G110	HVFDSB3C0100G120	HVFDSB3C0100G130	HVFDSB3C0100G131
	15	23	5	HVFDSB3C0150G110	HVFDSB3C0150G120	HVFDSB3C0150G130	HVFDSB3C0150G131
	20	31	5	HVFDSB3C0200G110	HVFDSB3C0200G120	HVFDSB3C0200G130	HVFDSB3C0200G131
	25	38	6	HVFDSB3C0250G110	HVFDSB3C0250G120	HVFDSB3C0250G130	HVFDSB3C0250G131
	30	46	6	HVFDSB3C0300G110	HVFDSB3C0300G120	HVFDSB3C0300G130	HVFDSB3C0300G131
	40	61	6	HVFDSB3C0400G110	HVFDSB3C0400G120	HVFDSB3C0400G130	HVFDSB3C0400G131
	50	72	7	HVFDSB3C0500G110	HVFDSB3C0500G120	HVFDSB3C0500G130	HVFDSB3C0500G131
	60	87	7	HVFDSB3C0600G110	HVFDSB3C0600G120	HVFDSB3C0600G130	HVFDSB3C0600G131
	75	105	7	HVFDSB3C0750G110	HVFDSB3C0750G120	HVFDSB3C0750G130	HVFDSB3C0750G131
	100	140	8	HVFDSB3C1000G110	HVFDSB3C1000G120	HVFDSB3C1000G130	HVFDSB3C1000G131
	125	170	8	HVFDSB3C1250G110	HVFDSB3C1250G120	HVFDSB3C1250G130	HVFDSB3C1250G131
	150	205	8	HVFDSB3C1500G110	HVFDSB3C1500G120	HVFDSB3C1500G130	HVFDSB3C1500G131
	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
208 Vac	.75	3.7	4	HVFDSB3A0007G110	HVFDSB3A0007G120	HVFDSB3A0007G130	HVFDSB3A0007G131
	1	4.8	4	HVFDSB3A0010G110	HVFDSB3A0010G120	HVFDSB3A0010G130	HVFDSB3A0010G131
	1.5	6.6	4	HVFDSB3A0015G110	HVFDSB3A0015G120	HVFDSB3A0015G130	HVFDSB3A0015G131
	2	8	4	HVFDSB3A0020G110	HVFDSB3A0020G120	HVFDSB3A0020G130	HVFDSB3A0020G131
	3	11	4	HVFDSB3A0030G110	HVFDSB3A0030G120	HVFDSB3A0030G130	HVFDSB3A0030G131
	5	18	5	HVFDSB3A0050G110	HVFDSB3A0050G120	HVFDSB3A0050G130	HVFDSB3A0050G131
	7.5	24	5	HVFDSB3A0075G110	HVFDSB3A0075G120	HVFDSB3A0075G130	HVFDSB3A0075G131
	10	31	5	HVFDSB3A0100G110	HVFDSB3A0100G120	HVFDSB3A0100G130	HVFDSB3A0100G131
	15	48	6	HVFDSB3A0150G110	HVFDSB3A0150G120	HVFDSB3A0150G130	HVFDSB3A0150G131
	20	62	6	HVFDSB3A0200G110	HVFDSB3A0200G120	HVFDSB3A0200G130	HVFDSB3A0200G131
	25	75	7	HVFDSB3A0250G110	HVFDSB3A0250G120	HVFDSB3A0250G130	HVFDSB3A0250G131
	30	88	7	HVFDSB3A0300G110	HVFDSB3A0300G120	HVFDSB3A0300G130	HVFDSB3A0300G131
	40	105	7	HVFDSB3A0400G110	HVFDSB3A0400G120	HVFDSB3A0400G130	HVFDSB3A0400G131
	50	140	8	HVFDSB3A0500G110	HVFDSB3A0500G120	HVFDSB3A0500G130	HVFDSB3A0500G131
	60	170	8	HVFDSB3A0600G110	HVFDSB3A0600G120	HVFDSB3A0600G130	HVFDSB3A0600G131
	75	205	8	HVFDSB3A0750G110	HVFDSB3A0750G120	HVFDSB3A0750G130	HVFDSB3A0750G131
	HP	AMPS	Frame	NEMA 1 Fused Disconnect	NEMA 1 2-Contactor Bypass	NEMA 1 3-Contactor Bypass	NEMA 1 3-Cont. Bypass + Auto-Bypass
230 Vac	.75	3.7	4	HVFDSB3B0007G110	HVFDSB3B0007G120	HVFDSB3B0007G130	HVFDSB3B0007G131
	1	4.8	4	HVFDSB3B0010G110	HVFDSB3B0010G120	HVFDSB3B0010G130	HVFDSB3B0010G131
	1.5	6.6	4	HVFDSB3B0015G110	HVFDSB3B0015G120	HVFDSB3B0015G130	HVFDSB3B0015G131
	2	8	4	HVFDSB3B0020G110	HVFDSB3B0020G120	HVFDSB3B0020G130	HVFDSB3B0020G131
	3	11	4	HVFDSB3B0030G110	HVFDSB3B0030G120	HVFDSB3B0030G130	HVFDSB3B0030G131
	5	18	5	HVFDSB3B0050G110	HVFDSB3B0050G120	HVFDSB3B0050G130	HVFDSB3B0050G131
	7.5	24	5	HVFDSB3B0075G110	HVFDSB3B0075G120	HVFDSB3B0075G130	HVFDSB3B0075G131
	10	31	5	HVFDSB3B0100G110	HVFDSB3B0100G120	HVFDSB3B0100G130	HVFDSB3B0100G131
	15	48	6	HVFDSB3B0150G110	HVFDSB3B0150G120	HVFDSB3B0150G130	HVFDSB3B0150G131
	20	62	6	HVFDSB3B0200G110	HVFDSB3B0200G120	HVFDSB3B0200G130	HVFDSB3B0200G131
	25	75	7	HVFDSB3B0250G110	HVFDSB3B0250G120	HVFDSB3B0250G130	HVFDSB3B0250G131
	30	88	7	HVFDSB3B0300G110	HVFDSB3B0300G120	HVFDSB3B0300G130	HVFDSB3B0300G131
	40	105	7	HVFDSB3B0400G110	HVFDSB3B0400G120	HVFDSB3B0400G130	HVFDSB3B0400G131
	50	140	8	HVFDSB3B0500G110	HVFDSB3B0500G120	HVFDSB3B0500G130	HVFDSB3B0500G131
	60	170	8	HVFDSB3B0600G110	HVFDSB3B0600G120	HVFDSB3B0600G130	HVFDSB3B0600G131
	75	205	8	HVFDSB3B0750G110	HVFDSB3B0750G120	HVFDSB3B0750G130	HVFDSB3B0750G131

Smart Selection

SmartVFD HVAC NEMA 12 Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
460 Vac	1.5	3.4	4	HVFDSB3C0015G210	HVFDSB3C0015G220	HVFDSB3C0015G230	HVFDSB3C0015G231
	2	4.8	4	HVFDSB3C0020G210	HVFDSB3C0020G220	HVFDSB3C0020G230	HVFDSB3C0020G231
	3	5.6	4	HVFDSB3C0030G210	HVFDSB3C0030G220	HVFDSB3C0030G230	HVFDSB3C0030G231
	4	8	4	HVFDSB3C0040G210	HVFDSB3C0040G220	HVFDSB3C0040G230	HVFDSB3C0040G231
	5	9.6	4	HVFDSB3C0050G210	HVFDSB3C0050G220	HVFDSB3C0050G230	HVFDSB3C0050G231
	7.5	12	4	HVFDSB3C0075G210	HVFDSB3C0075G220	HVFDSB3C0075G230	HVFDSB3C0075G231
	10	16	5	HVFDSB3C0100G210	HVFDSB3C0100G220	HVFDSB3C0100G230	HVFDSB3C0100G231
	15	23	5	HVFDSB3C0150G210	HVFDSB3C0150G220	HVFDSB3C0150G230	HVFDSB3C0150G231
	20	31	5	HVFDSB3C0200G210	HVFDSB3C0200G220	HVFDSB3C0200G230	HVFDSB3C0200G231
	25	38	6	HVFDSB3C0250G210	HVFDSB3C0250G220	HVFDSB3C0250G230	HVFDSB3C0250G231
	30	46	6	HVFDSB3C0300G210	HVFDSB3C0300G220	HVFDSB3C0300G230	HVFDSB3C0300G231
	40	61	6	HVFDSB3C0400G210	HVFDSB3C0400G220	HVFDSB3C0400G230	HVFDSB3C0400G231
	50	72	7	HVFDSB3C0500G210	HVFDSB3C0500G220	HVFDSB3C0500G230	HVFDSB3C0500G231
	60	87	7	HVFDSB3C0600G210	HVFDSB3C0600G220	HVFDSB3C0600G230	HVFDSB3C0600G231
	75	105	7	HVFDSB3C0750G210	HVFDSB3C0750G220	HVFDSB3C0750G230	HVFDSB3C0750G231
	100	140	8	HVFDSB3C1000G210	HVFDSB3C1000G220	HVFDSB3C1000G230	HVFDSB3C1000G231
	125	170	8	HVFDSB3C1250G210	HVFDSB3C1250G220	HVFDSB3C1250G230	HVFDSB3C1250G231
	150	205	8	HVFDSB3C1500G210	HVFDSB3C1500G220	HVFDSB3C1500G230	HVFDSB3C1500G231
	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
208 Vac	.75	3.7	4	HVFDSB3A0007G210	HVFDSB3A0007G220	HVFDSB3A0007G230	HVFDSB3A0007G231
	1	4.8	4	HVFDSB3A0010G210	HVFDSB3A0010G220	HVFDSB3A0010G230	HVFDSB3A0010G231
	1.5	6.6	4	HVFDSB3A0015G210	HVFDSB3A0015G220	HVFDSB3A0015G230	HVFDSB3A0015G231
	2	8	4	HVFDSB3A0020G210	HVFDSB3A0020G220	HVFDSB3A0020G230	HVFDSB3A0020G231
	3	11	4	HVFDSB3A0030G210	HVFDSB3A0030G220	HVFDSB3A0030G230	HVFDSB3A0030G231
	5	18	5	HVFDSB3A0050G210	HVFDSB3A0050G220	HVFDSB3A0050G230	HVFDSB3A0050G231
	7.5	24	5	HVFDSB3A0075G210	HVFDSB3A0075G220	HVFDSB3A0075G230	HVFDSB3A0075G231
	10	31	5	HVFDSB3A0100G210	HVFDSB3A0100G220	HVFDSB3A0100G230	HVFDSB3A0100G231
	15	48	6	HVFDSB3A0150G210	HVFDSB3A0150G220	HVFDSB3A0150G230	HVFDSB3A0150G231
	20	62	6	HVFDSB3A0200G210	HVFDSB3A0200G220	HVFDSB3A0200G230	HVFDSB3A0200G231
	25	75	7	HVFDSB3A0250G210	HVFDSB3A0250G220	HVFDSB3A0250G230	HVFDSB3A0250G231
	30	88	7	HVFDSB3A0300G210	HVFDSB3A0300G220	HVFDSB3A0300G230	HVFDSB3A0300G231
	40	105	7	HVFDSB3A0400G210	HVFDSB3A0400G220	HVFDSB3A0400G230	HVFDSB3A0400G231
	50	140	8	HVFDSB3A0500G210	HVFDSB3A0500G220	HVFDSB3A0500G230	HVFDSB3A0500G231
	60	170	8	HVFDSB3A0600G210	HVFDSB3A0600G220	HVFDSB3A0600G230	HVFDSB3A0600G231
	75	205	8	HVFDSB3A0750G210	HVFDSB3A0750G220	HVFDSB3A0750G230	HVFDSB3A0750G231
	HP	AMPS	Frame	NEMA 12 Fused Disconnect	NEMA 12 2-Contactor Bypass	NEMA 12 3-Contactor Bypass	NEMA 12 3-Cont. Bypass + Auto-Bypass
230 Vac	.75	3.7	4	HVFDSB3B0007G210	HVFDSB3B0007G220	HVFDSB3B0007G230	HVFDSB3B0007G231
	1	4.8	4	HVFDSB3B0010G210	HVFDSB3B0010G220	HVFDSB3B0010G230	HVFDSB3B0010G231
	1.5	6.6	4	HVFDSB3B0015G210	HVFDSB3B0015G220	HVFDSB3B0015G230	HVFDSB3B0015G231
	2	8	4	HVFDSB3B0020G210	HVFDSB3B0020G220	HVFDSB3B0020G230	HVFDSB3B0020G231
	3	11	4	HVFDSB3B0030G210	HVFDSB3B0030G220	HVFDSB3B0030G230	HVFDSB3B0030G231
	5	18	5	HVFDSB3B0050G210	HVFDSB3B0050G220	HVFDSB3B0050G230	HVFDSB3B0050G231
	7.5	24	5	HVFDSB3B0075G210	HVFDSB3B0075G220	HVFDSB3B0075G230	HVFDSB3B0075G231
	10	31	5	HVFDSB3B0100G210	HVFDSB3B0100G220	HVFDSB3B0100G230	HVFDSB3B0100G231
	15	48	6	HVFDSB3B0150G210	HVFDSB3B0150G220	HVFDSB3B0150G230	HVFDSB3B0150G231
	20	62	6	HVFDSB3B0200G210	HVFDSB3B0200G220	HVFDSB3B0200G230	HVFDSB3B0200G231
	25	75	7	HVFDSB3B0250G210	HVFDSB3B0250G220	HVFDSB3B0250G230	HVFDSB3B0250G231
	30	88	7	HVFDSB3B0300G210	HVFDSB3B0300G220	HVFDSB3B0300G230	HVFDSB3B0300G231
	40	105	7	HVFDSB3B0400G210	HVFDSB3B0400G220	HVFDSB3B0400G230	HVFDSB3B0400G231
	50	140	8	HVFDSB3B0500G210	HVFDSB3B0500G220	HVFDSB3B0500G230	HVFDSB3B0500G231
	60	170	8	HVFDSB3B0600G210	HVFDSB3B0600G220	HVFDSB3B0600G230	HVFDSB3B0600G231
	75	205	8	HVFDSB3B0750G210	HVFDSB3B0750G220	HVFDSB3B0750G230	HVFDSB3B0750G231

SmartVFD HVAC NEMA 3R Disconnect and SmartVFD BYPASS

	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
460 Vac	1.5	3.4	4	HVFDSB3C0015G310	HVFDSB3C0015G320	HVFDSB3C0015G330	HVFDSB3C0015G331
	2	4.8	4	HVFDSB3C0020G310	HVFDSB3C0020G320	HVFDSB3C0020G330	HVFDSB3C0020G331
	3	5.6	4	HVFDSB3C0030G310	HVFDSB3C0030G320	HVFDSB3C0030G330	HVFDSB3C0030G331
	4	8	4	HVFDSB3C0040G310	HVFDSB3C0040G320	HVFDSB3C0040G330	HVFDSB3C0040G331
	5	9.6	4	HVFDSB3C0050G310	HVFDSB3C0050G320	HVFDSB3C0050G330	HVFDSB3C0050G331
	7.5	12	4	HVFDSB3C0075G310	HVFDSB3C0075G320	HVFDSB3C0075G330	HVFDSB3C0075G331
	10	16	5	HVFDSB3C0100G310	HVFDSB3C0100G320	HVFDSB3C0100G330	HVFDSB3C0100G331
	15	23	5	HVFDSB3C0150G310	HVFDSB3C0150G320	HVFDSB3C0150G330	HVFDSB3C0150G331
	20	31	5	HVFDSB3C0200G310	HVFDSB3C0200G320	HVFDSB3C0200G330	HVFDSB3C0200G331
	25	38	6	HVFDSB3C0250G310	HVFDSB3C0250G320	HVFDSB3C0250G330	HVFDSB3C0250G331
	30	46	6	HVFDSB3C0300G310	HVFDSB3C0300G320	HVFDSB3C0300G330	HVFDSB3C0300G331
	40	61	6	HVFDSB3C0400G310	HVFDSB3C0400G320	HVFDSB3C0400G330	HVFDSB3C0400G331
	50	72	7	HVFDSB3C0500G310	HVFDSB3C0500G320	HVFDSB3C0500G330	HVFDSB3C0500G331
	60	87	7	HVFDSB3C0600G310	HVFDSB3C0600G320	HVFDSB3C0600G330	HVFDSB3C0600G331
	75	105	7	HVFDSB3C0750G310	HVFDSB3C0750G320	HVFDSB3C0750G330	HVFDSB3C0750G331
	100	140	8	HVFDSB3C1000G310	HVFDSB3C1000G320	HVFDSB3C1000G330	HVFDSB3C1000G331
	125	170	8	HVFDSB3C1250G310	HVFDSB3C1250G320	HVFDSB3C1250G330	HVFDSB3C1250G331
	150	205	8	HVFDSB3C1500G310	HVFDSB3C1500G320	HVFDSB3C1500G330	HVFDSB3C1500G331
	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
208 Vac	.75	3.7	4	HVFDSB3A0007G310	HVFDSB3A0007G320	HVFDSB3A0007G330	HVFDSB3A0007G331
	1	4.8	4	HVFDSB3A0010G310	HVFDSB3A0010G320	HVFDSB3A0010G330	HVFDSB3A0010G331
	1.5	6.6	4	HVFDSB3A0015G310	HVFDSB3A0015G320	HVFDSB3A0015G330	HVFDSB3A0015G331
	2	8	4	HVFDSB3A0020G310	HVFDSB3A0020G320	HVFDSB3A0020G330	HVFDSB3A0020G331
	3	11	4	HVFDSB3A0030G310	HVFDSB3A0030G320	HVFDSB3A0030G330	HVFDSB3A0030G331
	5	18	5	HVFDSB3A0050G310	HVFDSB3A0050G320	HVFDSB3A0050G330	HVFDSB3A0050G331
	7.5	24	5	HVFDSB3A0075G310	HVFDSB3A0075G320	HVFDSB3A0075G330	HVFDSB3A0075G331
	10	31	5	HVFDSB3A0100G310	HVFDSB3A0100G320	HVFDSB3A0100G330	HVFDSB3A0100G331
	15	48	6	HVFDSB3A0150G310	HVFDSB3A0150G320	HVFDSB3A0150G330	HVFDSB3A0150G331
	20	62	6	HVFDSB3A0200G310	HVFDSB3A0200G320	HVFDSB3A0200G330	HVFDSB3A0200G331
	25	75	7	HVFDSB3A0250G310	HVFDSB3A0250G320	HVFDSB3A0250G330	HVFDSB3A0250G331
	30	88	7	HVFDSB3A0300G310	HVFDSB3A0300G320	HVFDSB3A0300G330	HVFDSB3A0300G331
	40	105	7	HVFDSB3A0400G310	HVFDSB3A0400G320	HVFDSB3A0400G330	HVFDSB3A0400G331
	50	140	8	HVFDSB3A0500G310	HVFDSB3A0500G320	HVFDSB3A0500G330	HVFDSB3A0500G331
	60	170	8	HVFDSB3A0600G310	HVFDSB3A0600G320	HVFDSB3A0600G330	HVFDSB3A0600G331
	75	205	8	HVFDSB3A0750G310	HVFDSB3A0750G320	HVFDSB3A0750G330	HVFDSB3A0750G331
	HP	AMPS	Frame	NEMA 3R Fused Disconnect	NEMA 3R 2-Contactor Bypass	NEMA 3R 3-Contactor Bypass	NEMA 3R 3-Cont. Bypass + Auto-Bypass
230 Vac	.75	3.7	4	HVFDSB3B0007G310	HVFDSB3B0007G320	HVFDSB3B0007G330	HVFDSB3B0007G331
	1	4.8	4	HVFDSB3B0010G310	HVFDSB3B0010G320	HVFDSB3B0010G330	HVFDSB3B0010G331
	1.5	6.6	4	HVFDSB3B0015G310	HVFDSB3B0015G320	HVFDSB3B0015G330	HVFDSB3B0015G331
	2	8	4	HVFDSB3B0020G310	HVFDSB3B0020G320	HVFDSB3B0020G330	HVFDSB3B0020G331
	3	11	4	HVFDSB3B0030G310	HVFDSB3B0030G320	HVFDSB3B0030G330	HVFDSB3B0030G331
	5	18	5	HVFDSB3B0050G310	HVFDSB3B0050G320	HVFDSB3B0050G330	HVFDSB3B0050G331
	7.5	24	5	HVFDSB3B0075G310	HVFDSB3B0075G320	HVFDSB3B0075G330	HVFDSB3B0075G331
	10	31	5	HVFDSB3B0100G310	HVFDSB3B0100G320	HVFDSB3B0100G330	HVFDSB3B0100G331
	15	48	6	HVFDSB3B0150G310	HVFDSB3B0150G320	HVFDSB3B0150G330	HVFDSB3B0150G331
	20	62	6	HVFDSB3B0200G310	HVFDSB3B0200G320	HVFDSB3B0200G330	HVFDSB3B0200G331
	25	75	7	HVFDSB3B0250G310	HVFDSB3B0250G320	HVFDSB3B0250G330	HVFDSB3B0250G331
	30	88	7	HVFDSB3B0300G310	HVFDSB3B0300G320	HVFDSB3B0300G330	HVFDSB3B0300G331
	40	105	7	HVFDSB3B0400G310	HVFDSB3B0400G320	HVFDSB3B0400G330	HVFDSB3B0400G331
	50	140	8	HVFDSB3B0500G310	HVFDSB3B0500G320	HVFDSB3B0500G330	HVFDSB3B0500G331
	60	170	8	HVFDSB3B0600G310	HVFDSB3B0600G320	HVFDSB3B0600G330	HVFDSB3B0600G331
	75	205	8	HVFDSB3B0750G310	HVFDSB3B0750G320	HVFDSB3B0750G330	HVFDSB3B0750G331

Smart Selection

VFD Pricing/Job Estimating Tools

For additional tools you can use for the selection and pricing of VFDs, click on the "Commercial Components Estimating Tools" link at ***customer.honeywell.com.***

NEMA 1

Frame Size	HP And Voltage		Configuration	Dimensions (in)			Weight (lb)
	208/230 VAC	460 VAC		W	H	D	
4	0.75-3 HP	1.5-7.5 HP	Drive alone	5	12.9	7.5	13.2
			Disconnect	8.9	31.9	10.3	33
			2-Contactor	8.9	31.9	9.6	38
			3-Contactor	8.9	38.9	10.3	44
			3-Contactor with Auto-Bypass	8.9	38.9	10.3	46
5	5 HP 7.5 HP 10 HP	10 HP 15 HP 20 HP	Drive alone	5.7	16.5	8.4	22
			Disconnect	8.9	34.7	10.3	43
			2-Contactor	8.9	34.7	9.6	48/50/50
			3-Contactor	8.9	41.7	10.3/10.3/10.8	55.5/57/59.5
			3-Contactor with Auto-Bypass	8.9	41.7	10.3/10.3/10.8	56/57.5/60
6	15 HP 20 HP	25 HP 30 HP 40 HP	Drive alone	7.7	21.9	9	44.1
			Disconnect	12.4	45.1	11.3	50
			2-Contactor	12.4	45.1	10.1	55/59
			3-Contactor	12.4	55.2	11.3	94.5/98.5/105.5
			3-Contactor with Auto-Bypass	12.4	55.2	11.3	96.5/100.5/107.5
7	25 HP 30 HP 40 HP	50 HP 60 HP 75 HP	Drive alone	9.3	25.4	10.2	82.7
			Disconnect	20.8	51.5	13.2	100
			2-Contactor	20.8	51.5	12.2	169/179/189
			3-Contactor	20.8	59	13.2	175/184/195
			3-Contactor with Auto-Bypass	20.8	59	13.2	177/186/197
8	50 HP 60 HP 75 HP	100 HP 125 HP 150 HP	Drive alone	11.4	38	13.5	154.3
			Disconnect	25	60	16.2	200
			2-Contactor	25	60	15.2	250/265/280
			3-Contactor	25	70	16.2	285/295/331
			3-Contactor with Auto-Bypass	25	70	16.2	287/297/333
9	100-125 HP	200-250 HP	Drive alone	18.9	45.3	14.4	238.1

NEMA 12

Frame Size	HP And Voltage		Configuration	208/230 Vac Dimensions (in) & Weight (lb)				460 Vac Dimensions (in) & Weight (lb)			
	208/230 VAC	460 VAC		W	H	D	lb	W	H	D	lb
4	0.75-3 HP	1.5HP-7.5 HP	Drive alone	5	12.9	7.5	13.2	5	12.9	7.5	13.2
			Disconnect	12	37.5	11	40	12	37.5	11	40
			2-Contactor	16	37.5	11	55	16	37.5	11	53
			3-Contactor	16	37.5	11	55	16	37.5	11	53
			3-Contactor with Auto-Bypass	16	37.5	11	55	16	37.5	11	53
5	5-10 HP	10 HP 15 HP 20 HP	Drive alone	5.7	16.5	8.4	22	5.7	16.5	8.4	22
			Disconnect	12	41	11	72	12	41	11	72
			2-Contactor	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
			3-Contactor	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
			3-Contactor with Auto-Bypass	16	41/41/45	11	70/70/84	16	41/41/45	11	64/64/76
6	15-20 HP	25 HP 30 HP 40 HP	Drive alone	7.7	21.9	9	44.1	7.7	21.9	9	44.1
			Disconnect	12	46.5	13	120	12/12/16	46.5	13	120/120/136
			2-Contactor	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
			3-Contactor	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
			3-Contactor with Auto-Bypass	16/20	50.5/54.5	13	125/140	16/16/20	50.5/50.5/54.5	13	120/120/136
7	25-40 HP	50 HP 60 HP 75 HP	Drive alone	9.3	25.4	10.2	82.7	9.3	25.4	10.2	82.7
			Disconnect	16	50.5	13.5	145/160/175	16	50.5	13.5	145/160/175
			2-Contactor	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
			3-Contactor	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
			3-Contactor with Auto-Bypass	20/24/30	58.5/65.5/70.5	13.5	160/175/200	20/24/30	58.5/65.5/70.5	13.5	150/165/193
8	50-75 HP	100 HP 125 HP 150 HP	Drive alone	11.4	38	13.5	154.3	11.42	38.03	13.5	154.3
			Disconnect	Contact Customer Care				Contact Customer Care			
			2-Contactor								
			3-Contactor								
			3-Contactor with Auto-Bypass								
9	100-125 HP	180-220 HP	Drive alone	18.9	45.3	14.4	238.1	14.37	45.27	18.9	238.1

NEMA 3R

Frame Size	HP And Voltage		Configuration	Dimensions (in)			Weight (lb)
	208/230 VAC	460 VAC		W	H	D	
4	0.75-3 HP	1.5-7.5 HP	Drive alone	20.5	20	10.5	39
			Disconnect	20.5	20	12	43
			2-Contactor	24.5	24	10.5	49
			3-Contactor	24.5	24	12	54
			3-Contactor with Auto-Bypass	24.5	24	12	54
5	5-10 HP	10-20 HP	Drive alone	20.5	24	10.5	58
			Disconnect	20.5	24	12	61
			2-Contactor	24.5	24	10.5	72
			3-Contactor	28.5	30	12	78
			3-Contactor with Auto-Bypass	28.5	30	12	78
6	15-20 HP	25-40 HP	Drive alone	28.5	36	10.5	80
			Disconnect	28.5	36	12	88
			2-Contactor	28.5	36	10.5	118
			3-Contactor	34.5	36	12	124
			3-Contactor with Auto-Bypass	34.5	36	12	124
7	25-40 HP	50-75 HP	Drive alone	28.5	48	12.5	130
			Disconnect	28.5	48	14	149
			2-Contactor	28.5	48	12.5	185
			3-Contactor	40.5	48	14	193
			3-Contactor with Auto-Bypass	40.5	48	14	193
8	50-75 HP	100-150 HP	Drive alone	40.5	60	12.5	299
			Disconnect	40.5	60	14	340
			2-Contactor	40.5	60	12.5	430
			3-Contactor	40.5	60	14	440
			3-Contactor with Auto-Bypass	40.5	60	14	440

Honeywell SmartVFD HVAC and SmartVFD BYPASS are smaller, sleeker and require a smaller footprint than other manufacturers. They are specifically designed for your HVAC application.

Smart Accessories

SmartVFD Accessories

Accessory	Description	Drive Used with
32006630-001/U	LON Communication Card (NXOPTC4)	SMART
HVFDSDOPT1AI2AO/U	1 x AI, 2 x AO (isolated, D- and E- slot compatible)	SMART
HVFDSDOPT1RO5DI/U	1 x RO, 5 x DI (42-240 VAC, D- and E- slot compatible)	SMART
HVFDSDREP2RO1T/U	2 x RO + Thermistor (B- slot compatible)	SMART
HVFDSDOPT2RO1T/U	2 x RO + Thermistor (D- and E- slot compatible)	SMART
HVFDSDOPT3RO/U	3 x RO (D- and E- slot compatible)	SMART
HVFDSDBATTERY/U	Battery Package, 5 pcs, for Real Time Clock	SMART
HVFDSDREP3RO/U	3 x RO (B- slot compatible)	SMART
HVFDSDOPT6DI/U	6 x DI / DO Programmable (D- and E- slot compatible)	SMART
HVFDSDTRAINER/U	SmartVFD HVAC Training Demonstration Kit	SMART
HVFDSDGRAPHICKP/U	SmartVFD HVAC Replacement Graphical Keypad	SMART
HVFDSDMOUNTKIT/U	SmartVFD HVAC Panel Mount Kit for NEMA 12 Install 3 Meter Cable	SMART
HVFDSDNEMA12FR4/U	SmartVFD HVAC NEMA 12 Kit Frame 4	SMART
HVFDSDNEMA12FR5/U	SmartVFD HVAC NEMA 12 Kit Frame 5	SMART
HVFDSDNEMA12FR6/U	SmartVFD HVAC NEMA 12 Kit Frame 6	SMART
HVFDSDFLANGEFR4/U	SmartVFD HVAC Flange Mounting Kit for Frame 4	SMART
HVFDSDFLANGEFR5/U	SmartVFD HVAC Flange Mounting Kit for Frame 5	SMART
HVFDSDFLANGEFR6/U	SmartVFD HVAC Flange Mounting Kit for Frame 6	SMART
HVFDSDFLANGEFR7/U	SmartVFD HVAC Flange Mounting Kit for Frame 7	SMART
HVFDSDFANFR4/U	SmartVFD HVAC Frame 4 Replacement Fan	SMART
HVFDSDFANFR5/U	SmartVFD HVAC Frame 5 Replacement Fan	SMART
HVFDSDFANFR6/U	SmartVFD HVAC Frame 6 Replacement Fan	SMART
HVFDSDFANFR7/U	SmartVFD HVAC Frame 7 Replacement Fan	SMART
HVFDSDINSTALLFR4/U	SmartVFD HVAC Replacement Installation Accessories Frame 4	SMART
HVFDSDINSTALLFR5/U	SmartVFD HVAC Replacement Installation Accessories Frame 5	SMART
HVFDSDINSTALLFR6/U	SmartVFD HVAC Replacement Installation Accessories Frame 6	SMART
HVFDCABLE/U	SmartVFD Compact Commissioning Cable and USB Adaptor	COMPACT & SMART

See the Big Picture

With an optional Micro Communication Adapter (MCA), you can turn your computer into a window to easily setup, operate, monitor and diagnose your SmartVFD drives. Just download the free PC Tool software from customer.honeywell.com, then use the adapter to connect to the drive.

PROGRAMMING AND COMMISSIONING

You'll have it all at your fingertips:

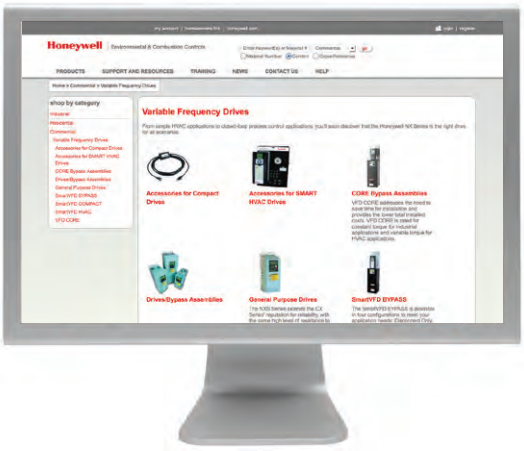
- Upload and download parameters to the SmartVFD drive for viewing and editing with maximum, minimum and default values for each parameter
- Directly control the drive to run it through its paces
- Save parameters for offline editing
- Directly control the drive speed in real time

MONITORING AND DIAGNOSTICS

See it all onscreen:

- Monitor parameters in real time
- Save screen shots and export values to a spreadsheet
- Pause a real-time monitoring window to capture accurate data
- For diagnostic assistance, view detailed active faults, the fault history (up to 40 stored faults), and I/O states

Smart Contacts and Websites



Honeywell Take-Off Service

1. Submit your information in one of the following ways:
   a) E-mail to takeoff.service@honeywelll.com (preferred)
   b) Fax toll-free to 1-877-880-3386
2. Include your desired turn-around time
3. Take-Off Service staff will send you a confirmation that your e-mail or fax was received. We always attempt to have your request finished as soon as possible. Please note, however, that the quality of the submitted information largely determines the turn-around time. We will work closely with you to ensure that we have enough information to move forward as quickly as possible.
4. Following take-off completion, a final product schedule spreadsheet will be returned to you that includes:
   - Complete product schedule
   - Base Price
   - Directions on how to order Honeywell products
   - Links to product submittals
   - Quote identification number

Main VFD Website
customer.honeywell.com/VFD

VFD Technical Hotline
763-954-6464 or
888-516-9347 option 4
techmail@honeywell.com

VFD for Consulting Engineer Site
specifyhoneywell.com/product.resources

Literature Ordering for VFD
literature.honeywell.com

Honeywell Promotional Materials
honeywell.promocollection.com

Buildings University Online and Face-to-Face Training
customer.honeywell.com/buildingsuniversity

New Product and Programs Website
beyondinnovation.honeywell.com

Learn More
For more information on Honeywell Variable Frequency Drives, contact your local Honeywell distributor, your Honeywell sales representative, call 1-800-466-3993 or visit **customer.honeywell.com/VFD**.

Automation and Control Solutions
In the U.S.:
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422-3992

In Canada:
Honeywell Limited
35 Dynamic Drive
Toronto, Ontario M1V 4Z9

In Latin America:
Honeywell
9315 N.W. 112th Avenue
Miami, FL 33178
www.honeywell.com

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67-7505 PM
February 2013
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AM CONSERVATION GROUP, INC.

DUAL SPRAY SWIVEL AERATOR



Product Highlights

Our Dual Spray Swivel Aerator allows for directing the water flow where it's needed most providing greater efficiencies. It offers two stream options: a full force multiple stream and a splash-free bubble stream and a contains a 360° swivel helping to reduce water use and boosts water pressure.

Product Details

- Dual threaded
- Fits most male and female threaded faucets
- Available in bulk, individually packaged or in contractor ten packs

Item Code	Flow Rate	Finish	Dual Stream		Dual Thread		Case Qty	Certifications	
			Compact	Extended	Male	Female		ASME A112.18.1/CSA B125.1	Low Lead
FA035-C-1.5	1.5 gpm	Chrome	Aerated	Multi-spray	15/16" -27	55/64" -27	250	Yes	Yes
FA035-C-2.0	2.0 gpm	Chrome	Aerated	Multi-spray	15/16" -27	55/64" -27	250	Yes	Yes

Certification and Performance Requirements

- Low lead compliant (AB-1953)
- ANSI specification A112.18.1, CSA, CEC, DOE
- Meets Performance Requirements for:
  California Energy Commission
  Department of Environmental Conservation
  Canadian Standards Association,
  Federal, State and Local plumbing standards

water efficiency

2301 Charleston Regional Parkway • Charleston, South Carolina 29492 • 800.GOOD.BUY • 800.777.5655
sales@amconservationgroup.com • www.amconservationgroup.com

Pressure Compensating Bubble Spray Faucet Aerator



Our Niagara Conservation branded Pressure Compensated Bubble Spray Aerators are an innovative water-saving solution designed to accommodate both male and female applications. These faucet aerators save water and energy by producing forceful streams at a reduced flow rate that minimizes the amount of energy needed to heat hot water.

Features

- All brass chrome plated dual threaded body
- Fits most male and female threaded faucets, Male: 15/16-27, Female: 55/64-27
- Pressure compensating technology guarantees a consistent flow rate across a wide range of pressure
- Bubble Spray
- 10 year warranty**

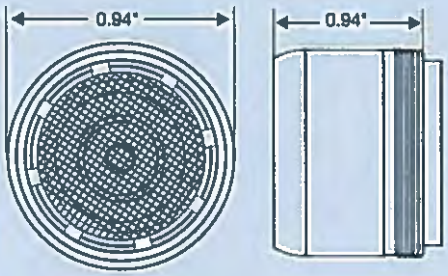
Certification and Performance Requirements

- ASME A112.18.1 / CSA B125.1; ANSI/NSF 61

Certified by CSA Group

Model #	Spray	Finish	Flow Rate	Watersense	Case Qty
N3210B-PC	Aerated Bubble	Chrome	1.0 GPM	Yes	500
N3104-PC	Aerated Bubble	Chrome	1.5 GPM	Yes	500

Dimensions



*Dimensions are subject to change

Potential Annual Savings[1]

	Flow Rate	Water	Electric Heating	Gas Heating
Dollar Savings	1.0 GPM	$104	$67	$37
Utility Savings	1.0 GPM	10,512 Gallons	594 kWh	33 Therms
Dollar Savings	1.5 GPM	$51	$39	$21
Utility Savings	1.5 GPM	6,132 Gallons	347 kWh	19 Therms

Factors in calculating savings potential

- 3 person households each person using a faucet 8 minutes per day 365 days per year (AWWARF Residential Study)
- Comparing water use with these aerator vs. a standard 2.2 GPM unit
- US city average water and sewer cost of $8.3 per 1,000 gallons (study done by AUS Consulting Group 2011)
- Average cost of electricity 0.113c per kWh (Energy Star Nov 2013 Lightbulb Calculator — http://www.energystar.gov/ia/products/prod_lists/lamps_savings)
- Average cost of gas $1.137 per therm (Bureau of Labor Statistics April 2014)
- Calculations done by http://www.fishnick.com/savewater/tools/watercalculator

**WARRANTY DETAILS

AM Conservation Group, Inc. guarantees to the original purchaser or recipient of an aerator that it is free from defects in material and workmanship for a period of 10 years. AM Conservation Group, Inc. will at our choice replace any part of the aerator which is in our opinion defective provided that the product has not been abused, misused, altered, or damaged after its purchase. This includes damage due to the use of tools or harsh chemicals. In the event a product has been discontinued, AM Conservation Group, Inc. will replace it with what we determine to be the closest product. AM Conservation Group, Inc. is not responsible for labor charges, installation, or other consequential cost. AM Conservation Group, Inc.'s responsibility shall not exceed the original cost of the product.

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sales@amconservationgroup.com • www.amconservationgroup.com

Water Efficiency

HydraMetrics
TRADE MARK
INVESTING IN THE INTELLIGENT USE OF WATER

MATERIAL SUBMITTAL

SCOPE OF WORK

The scope of work in this project will emphasize **increasing the operational performance** of the systems with the **minimum water required** to create sustainable savings. Essentially, we will make what you have work better! The end result of this system upgrade has many benefits including:

- Increased consistency and performance of the systems
- Reduction of maintenance costs and plumbing infrastructure upgrades
- Significant reduction in water consumption
- Sustainable savings that can be measured and verified
- Project implementation processes that reduce your risk and liability

FLUSHOMETER VALVES

Flushometer valves are common devices that meter the amount of water that flows through toilets and urinals. During our project, we will recommission, rebuild, and/or replace your flushometer valves.

Base Efficiency –Valve Recommissioning

On the newest flushometers, we will replace the internal flushometer valve diaphragm kits, allowing our technicians to variably adjust water flow to meet the requirements of each individual fixture. In doing so, we will utilize new, chemical-resistant materials that are designed to resist the effects of chloramines and sediments in the water supply. Through recommisioning of the valves, we use a revolutionary **Filter System**, a diaphragm design proven to reduce the likelihood of "run-on" due to sediments in the water supply. Finally, we will modify the fixture itself to optimize the flush sequence and eliminate unnecessary consumption, thus creating savings.

Benefits to Valve Recommissioning

- *Improved flushing effectiveness; all fixtures will operate at the "right" amount of water.*
- *Use of new chemical-resistant diaphragm kits.*

Maintenance Upgrade – Valve Rebuild

On newer fushometers, we will **rebuild** your flushometer assemblies by replacing all "wear" parts, those components that often require maintenance. In doing so, we establish a new "baseline" of maintenance. We will only use components that are designed and tested to resist rigors of substantial use, as well as the effects of chloramines and sediments in water. We are able to employ the use of revolutionary **Filter Systems**, a diaphragm design proven to reduce the likelihood of "run-on" due to sediments in the water supply. This approach translates into long life and significantly reduces maintenance for years to come.

Benefits to Valve Rebuild

- ***True Water Efficiency.***
- ***Improved Flushing Effectiveness.*** *All fixtures will operate at the "right" amount of water.*
- ***New Internal Components.*** *We replaced all "rubber" gaskets with state-of-the-art materials that are proven effective in resisting the effects of chemicals in water. By replacing all internal components, we establish a new baseline of maintenance; all fixtures now have new components that will resist the rigors of substantial use. This translates into significantly reduced maintenance for years to come.*
- ***Long-Life Handle.*** *We replaced the existing handle with a single piece, chemical resistant, ADA-compliant handle. These new handles employ a state-of-the-art design that has proven to be less susceptible to the effects of abuse and substantial use. Moreover, through use of this handle, all flushometers will now be ADA compliant.*

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INVESTING IN THE INTELLIGENT USE OF WATER

Material Submittal

Infrastructure Upgrade – New Flushometer



HydraMetrics' **Diaphragm Flushometer** replacement represents a true domestic plumbing system upgrade. If HydraMetrics opts for Diaphragm Valve Replacement, we'll utilize chemical-resistant components from **Zurn Industries.**

Through replacement of the internal flushometer valve diaphragm kit, HydraMetrics will variably adjust water flow to meet the requirements of the individual fixture (each fixture receives individual attention). In doing so, we will optimize the flush sequence and eliminate unnecessary consumption, thus providing a financial benefit to you. The results will be invisible to end-users, but very apparent on the water bill.

In addition, we'll replace all "wear" parts, those components that often require maintenance. In doing so, we establish a new "baseline" of maintenance. Where possible, we use components that are designed and tested to resist rigors of substantial use, as well as the effects of chloramines and sediments in water. Of course, this approach translates into long life and significantly reduced maintenance for years to come!

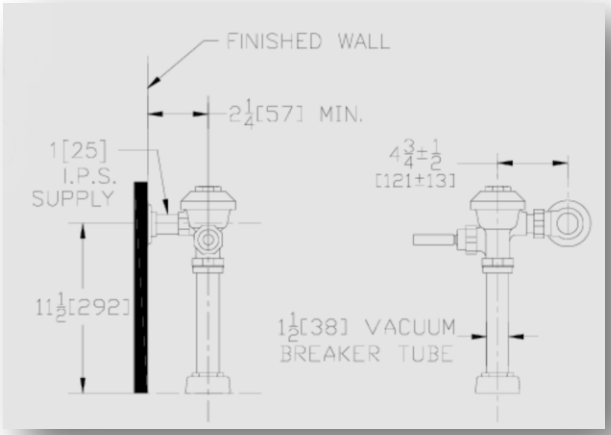
This improvement also goes beyond a basic "maintenance upgrade" by providing new flushometer valve bodies. Through application of new flushometer valves, we employ the use of revolutionary **Filter Systems**, diaphragm design proven to reduce the likelihood of "run-on" due to sediments in the water supply.

Benefits of Flushometer Replacement

- ***Improved flushing effectiveness****; all fixtures will operate at the "right" amount of water.*
- ***Use of new, chemical-resistant diaphragm kits****.*
- ***New Valves!*** *Given the new design and chrome finishes involved, new valves are aesthetically pleasing, providing the perception of an updated restroom environment. Beyond that, new brass valves are free from the mineral deposits that negatively affect valve operation.*
- ***Long-Life Handle.*** *As we replace the flushometer, we also replace the existing handle with a single piece, chemical resistant, ADA-compliant handle. These new handles employ a state-of-the-art design that has proven to be less susceptible to the effects of abuse and substantial use.*

Diaphragm Flushometer Technical Information

1. **Flushometer Type**
   a) Exposed, quiet diaphragm-type, chrome-plated flushometer valves with a polished exterior.
2. **Handle**
   a) ADA-compliant handle with a non-hold open feature.
3. **Covers**
   a) **Valve Body Cover.** Chrome-plated polished exterior.
   b) **Inside Cover.** Plastic; proven in laboratory testing to withstand a minimum of one million flush cycles.
4. **Diaphragm Kit**
   a) Diaphragm and all internal seals are made of chloramine-resistant materials.
   b) Clog-resistant diaphragm.
5. **Vacuum Breaker**
   a) High backpressure vacuum breaker.



6. **Tailpiece.**
   a) Adjustable, o-ring style.
   b) Chrome-plated polished exterior.
7. **Flush Tube Assembly**
   a) Chrome-plated polished exterior.
   b) Spud coupling.
8. **Control Stop**
   a) Supply stop valve with internal siphon-guard protection, stainless steel screw and spring.

Zurn Industries - Diaphragm Flushometer Components

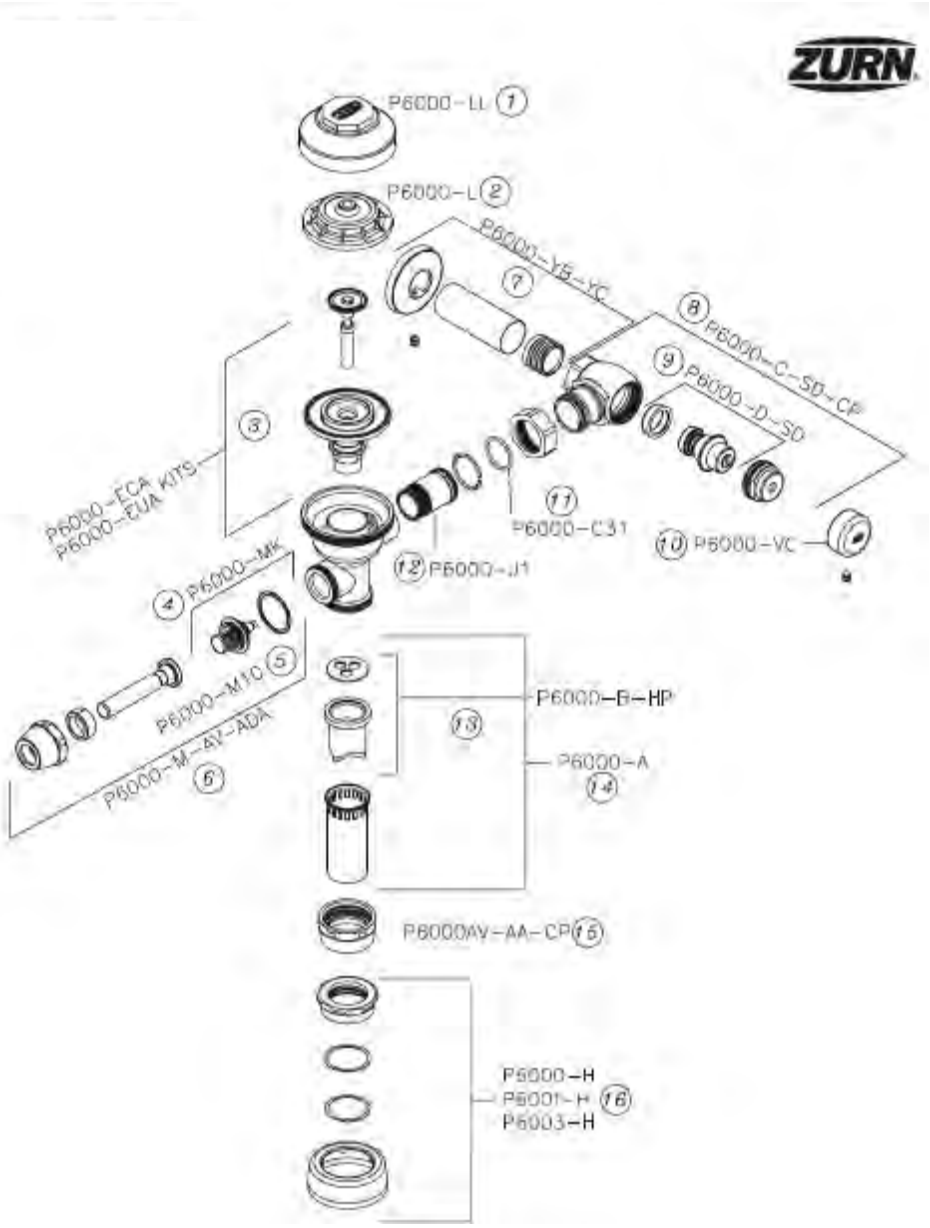
Assembly	Part Number	Manufacturer/Supplier	Description
Handle	P6000-MK	Zurn Industries	Handle Repair Kit (item 4)
	P6000-M10	Zurn Industries	Handle Gasket (item 5)
	P6000-M-ADA	Zurn Industries	ADA-Compliant Handle Assembly (item 6)
Covers	P6000-LL	Zurn Industries	Valve Body Cover (item 1)
	P6000-L	Zurn Industries	Plastic Inside Cover (item 2)
Diaphragm Kit Assembly	P6000-ECA (Toilet) P6000-EUA (Urinal)	Zurn Industries	Diaphragm Kits (item 3)
Valve Body	P6000-19	Zurn Industries	Valve Body
Vacuum Breaker Assembly	P6000-A	Zurn Industries	Vacuum Breaker Flush Tube (item 14)
	P6000-B-HP	Zurn Industries	Vacuum Breaker Repair Kit (item 13)
Tailpiece Assembly	P6000-C31	Zurn Industries	Tailpiece O-Ring (item 11)
	P6000-J1	Zurn Industries	Tailpiece Assembly (item 12)
Flush Tube Assembly	P6000-A	Zurn Industries	Vacuum Breaker Flush Tube (item 14)
	P6000-AA-CP	Zurn Industries	Vacuum Breaker Nut (item 15)
	P6000-H (1½") P6001-H (1¼") P6003-H (¾")	Zurn Industries	Spud Escutcheon & Coupling Assembly (item 16)

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Material Submittal

Flushometer Scope

- **Base Efficiency–Valve Recommissioning:** Remove/replace **diaphragm kit** (item 3) and **inner cap** (item 2).
- **Maintenance Upgrade–Valve Rebuild:** Remove and replace **diaphragm kit** (item 3), **pressure vacuum breaker** (item 13), **inner cap** (item 2), **handle assembly** (item 6), and **O-ring** (item 11).
- **Infrastructure Upgrade–New Valve X-Body:** Remove/replace **flushometer valve assembly** (items 1-6, 11-13).
- **Spud Replacement:** Remove and replace the fixture **spud.**
- **Flushtube Replacement:** Remove and replace vacuum breaker tube assembly (items 14-16)



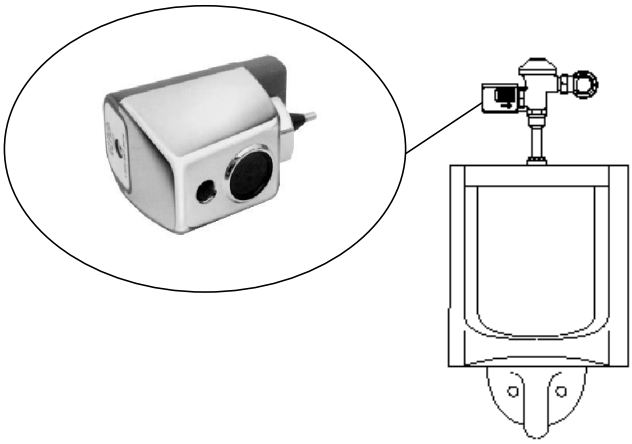
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Material Submittal

Diaphragm Hands-Free Flushing

In the interest of customer satisfaction and housekeeping/infection control, you opted to install hands-free systems on the flushometers. Application of new infrared technology creates a “hands-free” environment, easing end-user concern about germ transfer via physical contact with restroom equipment. Infrared technologies also eliminate several other “restroom issues,” by ensuring that fixtures are used as intended (e.g. urinals are flushed after use, thus reducing odor and housekeeping). The hands-free device sends out a continuous infrared beam that is reflected back by the presence of a person in front of the urinal or toilet. “Object Lock” technology differentiates between someone walking past the unit or actually using the fixture.

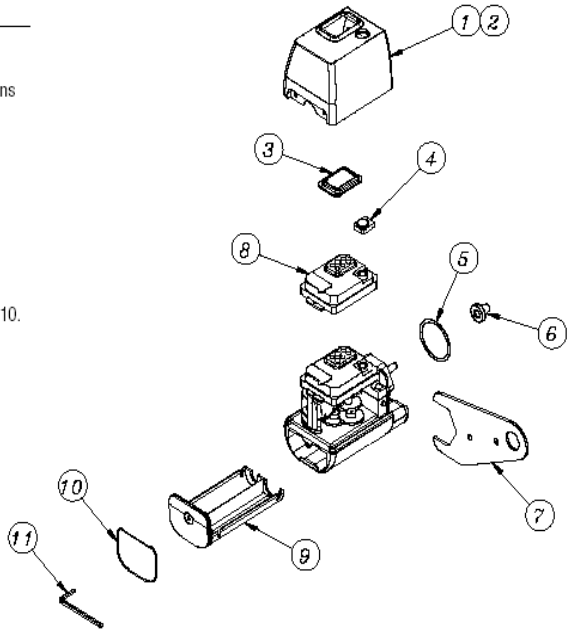
Infrared Hands-Free Flush Component		
Part Number	**Manufacturer/Supplier**	**Long Description**
ZERK-CPM	Zurn Industries	Sensor-Operated Retrofit Closet/Urinal Systems



Parts Identification

1. Chrome Plastic Cover
2. Chrome Metal Cover
3. Replacement Sensor Lens
4. Courtesy Button Cap*
5. Collar Gasket*
6. Seal*
7. Handle Nut Wrench
8. Sensor Module
9. Battery Drawer
10. O-Ring*
11. Allen Wrench

*Repair Kit Items 4, 5, 6, and 10.



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MATERIAL SUBMITTAL

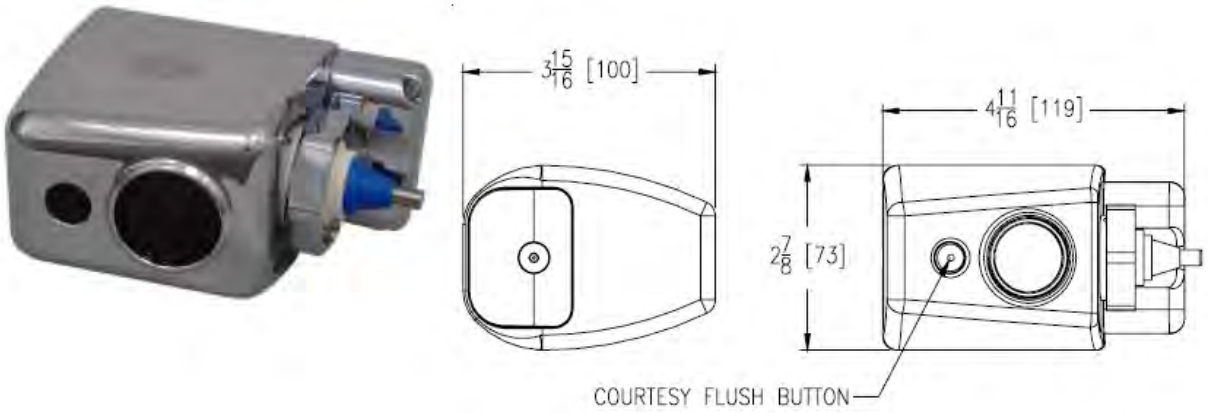
ZURN®

AquaSense®

TAG _____

ZERK-CPM

E-Z Flush Automatic Retrofit Kit For Closet and Urinal Valves



Suffix Options (Check/Specify Appropriate Options)

____	**-LY**	Delaney Valve Retro Fit
____	**-HMK**	Highmount Adapter
____	**-GM**	Sloan/Gem Valve Retro Fit
____	**-MC**	Metroflush/Crown Valve Retro Fit
____	**-CB**	Cambridge Brass Retro Fit
____	**-PB**	Polished Brass PVD Finish
____		Other

ENGINEERING SPECIFICATION: ZURN ZERK-CPM E-Z Flush AquaSense® Retrofit Kit- The AquaSense "A" E-Z Flush Unit is designed to provide automatic flushing for urinal and/or water closet flush valves. The unit features a 6VDC motor actuator with automatic infrared sensor, user-in view L.E.D., low battery indicator light, switchable 24 hour auto-flush and three second delay flush to deter false flushing, 10 degree angled sensor for optimum user detection, courtesy flush button, high impact resistant polycarbonate housing, impact resistant glass lens and chrome plated metal cover. The unit comes complete with 4 "C" size batteries, wrench for installation and allen key for the battery compartment. The E-Z Flush electronics are ultra energy efficient for optimal battery life.

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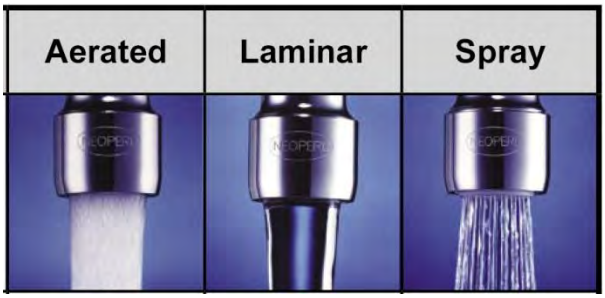
MATERIAL SUBMITTAL

FLOW CONTROLS

The flow control devices we will install are of a robust construction. Moreover, these devices are **pressure independent**; they provide end users with the same level performance at all pressures between 20 and 80 psi.

Post-Retrofit Sink Flows and Patterns

Proposed Post-Retrofit Sink Flows and Patterns			
		Flow and Pattern	
Sink Application	Application Example	Flow Rate (gpm)	Flow Pattern
Lavatory Sink - Public	Public Restroom	0.5	Spray
Multi-Purpose Sink	Dorm/Barracks	1.0	Aerated
General Use Sink	Break Room	1.5	Aerated
Multi-Purpose Sink	Patient Room	1.0	Laminar
General Use Sink	Break Room	1.5	Laminar



Benefits

- ***Pressure Independent Performance.*** *End users will enjoy the same level of performance regardless of incoming pressure (flow rate is constant at pressures between 20 and 80 psi).*
- ***Long-Life.*** *Because our flow components are robust in their construction, these devices will serve well for years to come. Furthermore, we protect the longevity of these products by applying tamper-resistant technology.*
- ***One Size Fits All.*** *As we apply our flow control technology, we will modify all faucets (using various adapters) to use one size device (55/64" female and/or male). This will enable the maintenance of only one flow control in stock.*

Installed Components – Flow Controls

What follows is a listing of the components we will replace.

Category	Part Number	Manufacturer/ Supplier	Description	Notes
Faucet Flow Controls	1371405 1370405	Neoperl	0.5 gpm Pressure Compensating Flow Control; vandal-resistant	Lavatory Sinks
	1171405 1170405	Neoperl	1.0 gpm Pressure Compensating Flow Control; vandal-resistant	Multi-Purpose Sinks
	1111405 1110405	Neoperl	1.5 gpm Pressure Compensating Flow Control; vandal-resistant	General Use Sinks
	3131406 3130406	Neoperl	1.0 gpm Pressure Compensating Careguard Laminar Flow Control; vandal resistant	Multi-Purpose Sinks
	3141406 3140406	Neoperl	1.5 gpm Pressure Compensating Careguard Laminar Flow Control; vandal resistant	General Use Sink
Screen Washer	P-AWSCN	Whedon Products	Stainless Steel, Conical Screen Washer	All Sinks

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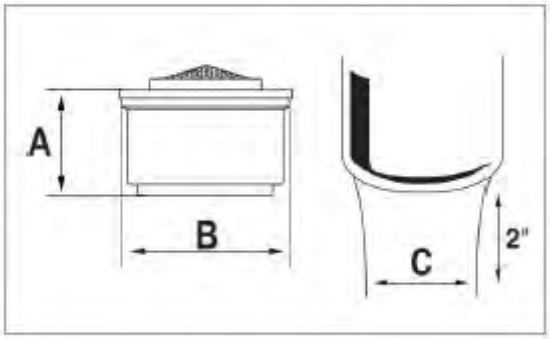
MATERIAL SUBMITTAL

PCA® Spray
Faucet Attachment - 0.5 gpm max
Pressure Compensating **Regular Size**

Features and Benefits

- Watercolours® design: Color coding to identify flow rate and stream pattern.
- Provides non-splashing, non-aerated spray.
- Pressure compensating for constant flow from 20 to 80 psi.
- Anti-clogging dome screen filters sediment and particles.
- Also compatible with regular and vandal proof M22 and M24 metric housing.
- Available housing finishes: unplated, chrome and PVD.
- Marking: Roll mark (custom and/or statutory marks) or laser for vandal proof housings only (custom logo and/or statutory mark).





Certifications

ANSI/NSF 61
ASME A112.18.1M and CSA B125

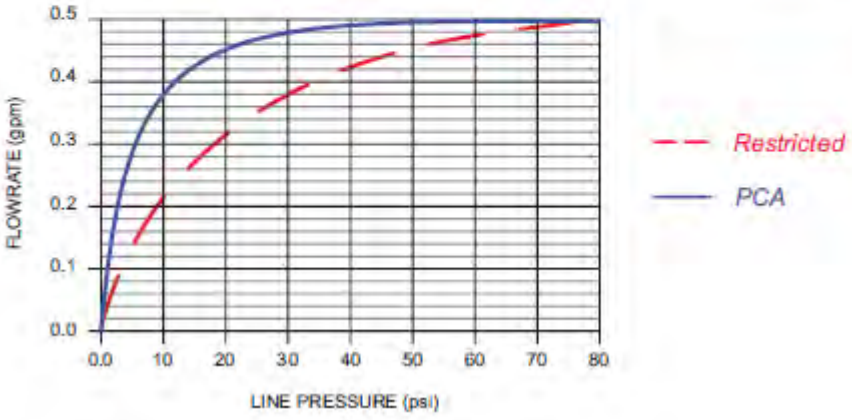
Color Code

Dome	Flow Regulator	Basket
White	Lime Green	Dark Gray

Dimensions

No	mm	In
A	13.00	.512
B	19.95	.785
C	≈ 25	≈ 1

Flow Rate Curve



Technical Data

Materials:	Body	Acetal
	O-ring	EPDM
	Washer	EPDM
Max temperature:		150°F
Max pressure:		125 psi
Wetted surface area:		2831.3 mm²

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INVESTING IN THE INTELLIGENT USE OF WATER

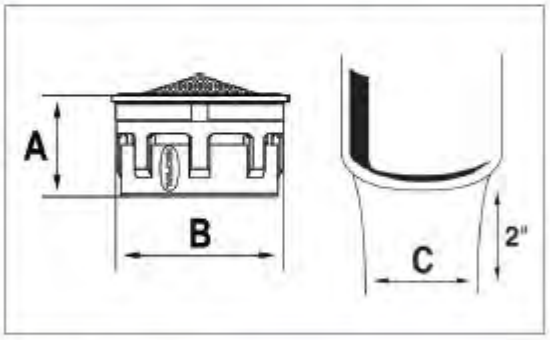
MATERIAL SUBMITTAL

PCA® Perlator®
Faucet Aerator - 1.0 gpm max
Pressure Compensating **Regular Size**

Features and Benefits

- Watercolours® design: Color coding to identify flow rate and stream pattern.
- Patented construction provides a splash-free stream, well aerated and soft to the touch.
- Pressure compensating for constant flow from 20 to 80 psi.
- Integrated anti-liming Honeycomb replaces conventional wire mesh screens prone to lime build up.
- Anti-clogging dome screen filters sediment and particles.
- Also compatible with regular and vandal proof M22 and M24 metric housing.
- Available housing finishes: unplated, chrome and PVD.
- Laser marked housings: Custom logo and/or statutory marking.





Certifications

ANSI/NSF 61
ASME A112.18.1M and CSA B125
Meets CALGreen requirements
WaterSense

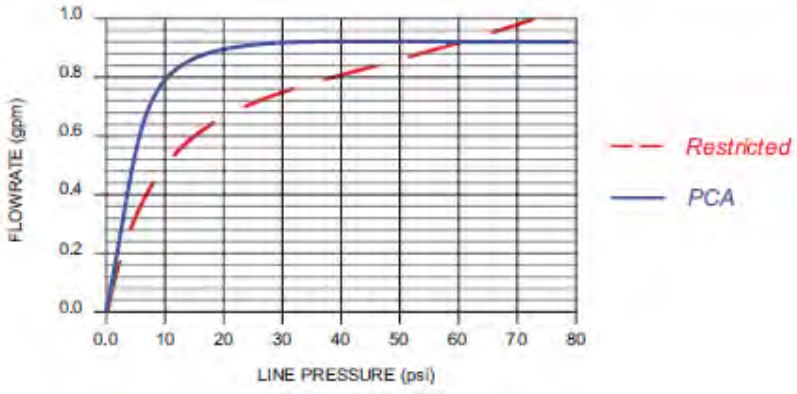
Color Code

Dome	Flow Regulator	Basket
Clear	Blue	Dark Gray

Dimensions

No	mm	In
A	12.00	.472
B	19.97	.786
C	≈ 13	≈ 1/2

Flow Rate Curve



Technical Data

Materials:	Body	Acetal
	O-ring	EPDM
	Washer	EPDM
Max temperature:		150°F
Max pressure:		125 psi
Wetted surface area:		4653.0 mm²

HydraMetrics
TRADE MARK
INVESTING IN THE INTELLIGENT USE OF WATER

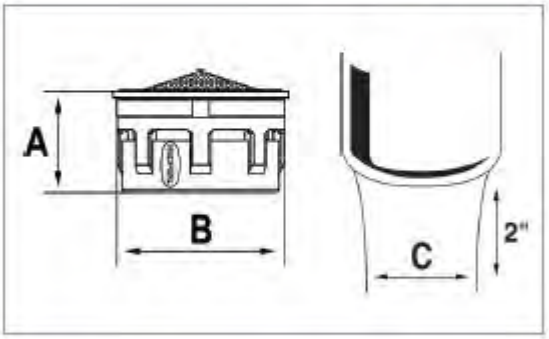
MATERIAL SUBMITTAL

PCA® Perlator®
Faucet Aerator - 1.5 gpm max
Pressure Compensating **Regular Size**

Features and Benefits

- Watercolours® design: Color coding to identify flow rate and stream pattern.
- Patented construction provides a splash-free stream, well aerated and soft to the touch.
- Pressure compensating for constant flow from 20 to 80 psi.
- Integrated anti-liming Honeycomb replaces conventional wire mesh screens prone to lime build up.
- Anti-clogging dome screen filters sediment and particles.
- Also compatible with regular and vandal proof M22 and M24 metric housing.
- Available housing finishes: unplated, chrome and PVD.
- Laser marked housings: Custom logo and/or statutory marking.





Certifications

ANSI/NSF 61
ASME A112.18.1M and CSA B125
Meets CALGreen requirements
WaterSense

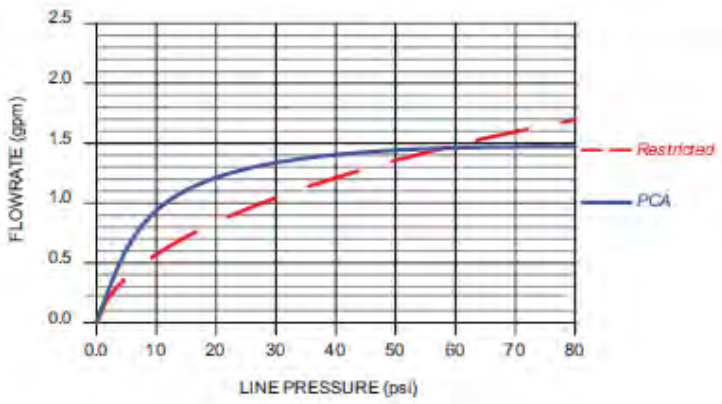
Color Code

Dome	Flow Regulator	Basket
Clear	Green	Dark Gray

Dimensions

No	mm	In
A	12.00	.472
B	19.97	.786
C	≈ 13	≈ 1/2

Flow Rate Curve



Technical Data

Materials:	Body	Acetal
	O-ring	EPDM
	Washer	EPDM
Max temperature:		150°F
Max pressure:		125 psi
Wetted surface area:		4653.0 mm²

HydraMetrics
TRADE MARK
INVESTING IN THE INTELLIGENT USE OF WATER

MATERIAL SUBMITTAL

TANK TOILETS

HydraMetrics couples superior products with superior knowledge and experience; we understand that the tank toilet is a **system**, and that all components of this system must work in concert with one another to provide desired operational results.



Tank Toilet Retrofit Upgrade

We will be replacing all "wear" parts[1], those components that often require maintenance. In doing so, we establish a new "baseline" of maintenance. We only use components that are designed and tested to resist rigors of substantial use, as well as the effects of chloramines and sediments in water. This approach translates into long life and significantly reduced maintenance for years to come.

Benefits

- ***True Water Efficiency.*** *Improved flushing effectiveness; all fixtures now operate at the "right" amount of water.*
- ***Chemical Resistant Flapper.*** *Use of new flapper assemblies manufactured with state-of-the-art Sanaprene thermal plastic elastomers. In independent laboratory testing, these materials have been proven to resist the chemicals in water.*
- ***New Wear Parts.*** *All installed components have been designed and tested to withstand the chemicals in your water.*
- ***New Baseline of Maintenance.*** *All fixtures now have new, long lasting components.*

Installed Components – Tank Toilets

What follows is a listing of the components we will replace when performing our project.

Part Number	Manufacturer / Supplier	Description
550	HydroClean	Fill Valve
HM6000	HydraMetrics	Flapper Assembly(float, flapper, chain, etc)
684	Fluidmaster	Fluidmaster Sure-Fit Tank lever, Chrome
S-1-12DLF	BrassCraft	Supply Line, 3/8" Compression x7/8" Ballcock Nut

[1] Flapper, ballcock/fill valve assembly, supply line, and handle.

HydraMetrics
TRADE MARK
INVESTING IN THE INTELLIGENT USE OF WATER

Material Submittal

Tank Toilet Component Technical Information

Fill Valve

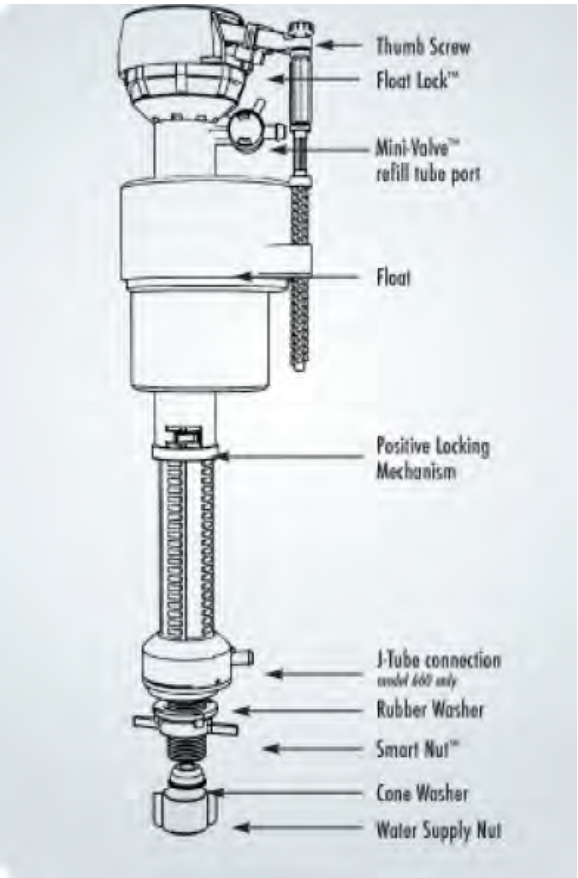
- Height adjusts 9"-14".
- Refills quickly, quietly.
- Corrosion-resistant material.
- Bowl refill adjustment prevents wasteful overfilling.
- Anti-siphon, code approved.

Tank Lever

- Trims/bends to fit most front, side and angle-mount tanks.
- Self-tightening lock-nut won't loosen over time.
- Three finishes: White, Chrome, or Polished Brass.

Supply Line

- Braided Stainless Steel.
- No Kink design allows for standard and non-standard rough-ins.
- Burst-Proof design up to 120 psi.



Warranty and Future Maintenance

As the savings generated by this upgrade is necessary to fund the overall upgrades to your facilities – it is critical these savings continue to be delivered. Like most energy saving improvements and upgrades, the ability to sustain savings over time will rely on proper maintenance of the equipment. Also important to note is any improper maintenance of these plumbing systems could also degrade the performance of the fixtures. Our *"Recommissioning of Existing Plumbing Systems"* is an engineered solution that will greatly simplify future maintenance AND lower the cost of future maintenance - as well as saving both water and money. As part of the project we will deliver "hands on" training sessions, a video of the training for your future reference, a complete O&M Manual, and an initial inventory of parts needed to provide the proper maintenance. In addition to our standard warranty, **HydraMetrics provides a 10 year warranty** on the following key water saving maintenance components! This further reduces your future maintenance costs and helps to ensure the proper procedures are kept in place. These procedures will be covered in detail during the on-site staff training sessions, but following is a brief overview of each system and the required maintenance;

Flushometers (Toilets and Urinals):
The valve should have wear parts maintained rather than replacing the complete valve. This requires installing a new diaphragm, which is **included in our 10 year warranty**. It is not necessary to replace the entire +/- $100 valve assembly (rather than our recommended warranty diaphragm). That is not only an unnecessary cost, but could result in the use of more water. Also, in most cases, the new valve may not provide the performance that was realized from our engineered solution and/or may require multiple flushes to evacuate debris. If it is necessary to replace the valve body (brass piping assembly), please use the diaphragm kit from the original re-commissioned valve you are replacing.

If a complete china fixture (toilet or urinal) is replaced, we recommend the use of any current off-the-shelf low flow model with the appropriate matching valve.

Tank Toilets:
If a flapper, or the flipper seal in the top of the fill valve, needs to be replaced, they are **included in our 10 year warranty**. The procedure to do this is detailed in our O&M manual. If either is improperly replaced, water consumption could increase and/or the toilet will not flush properly.

Sinks:
The filter screens of flow controls (aerators) installed during our project are also **included in our 10 year warranty**. Normal maintenance is to simply remove and backwash to displace any collected debris, and then reinstall (or replace if required). We recommend removing flow controls when complete faucets or sinks are being replaced, and put them on the new faucets being installed. New faucets *may* come with aerators – but typically are measured to be flowing in excess of 1 to 2 gallons per minute and will result in degrading the water savings.

Showers:
Routine maintenance on showerheads consists of cleaning any scale deposit that may accumulate periodically. The standard recommended showerheads are included **in our 10 year warranty** for material and workmanship quality defects.

HydraMetrics Support:
Proper maintenance is critical to the sustainability of the savings that is required to fund this project. Equally important, proper maintenance will also ensure the continued peak performance of these plumbing systems. Additionally, we can also offer the following optional services to assist the site staff in their efforts to develop and deliver the proper maintenance:

- Telephone support and assistance
- Additional maintenance training
- Recommissioning services

HydraMetrics
TRADE MARK
INVESTING IN THE INTELLIGENT USE OF WATER

Domestic Water Efficiency Submittal

Sample Project

HydraMetrics, LLC
P.O Box 250
Circle Pines, MN 55014
Phone: (651) 653-6845
www.hydrametrics.com

September 19, 2013

SECTION 08 87 00 – NIGHT VISION SUN CONTROL WINDOW FILMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Abrasion-resistant, solar control, reflective window film. Film is designed to reduce gain of solar heat energy through window by reflecting more to the exterior than interior. Traditional metalized films reflect equally both inside and outside, where you need it, and less to the inside. The Night Vision line reflects more to the outside, where you need it, and less to the inside, where you do not need it. 3M Night Vision, carbon impregnated polyester layer provides outstanding heat rejection performance.

1.2 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide reflective films that comply with the following:

SPECIFIER NOTE: RETAIN APPROPRIATE PRODUCT REQUIREMENTS BELOW. DELETE REQUIREMENTS NOT REQUIRED FOR PROJECT.

Scope (Night Vision)	NV-15	NV-25	NV-35	NV-45
Thickness				
(mils)	2.5	2.5	2.5	2.5
(inches)	0.0020	0.0020	0.0020	0.0020
Emissivity	0.70	0.72	0.74	0.78
U Value	1.04	1.05	1.06	1.06
Visible Light Transmission	15%	25%	35%	45%
Visible Reflection				
Interior	19%	13%	12%	8%
Exterior	43%	29%	18%	9 %
Ultraviolet Transmission	<1%	<1%	<1%	<1%
Shading Coefficient	0.29	0.39	0.49	0.63

B. Film Attributes: The following attribute information is based upon 1/4 inch (6 mm) clear glass unless indicated otherwise:

1. Adhesive System: Pressure sensitive, weatherable, acrylate adhesive applied uniformly over surface opposite abrasion resistant coated surface.
   a. Viewing film from a distance of 10 feet (3 m) at angles up to 45 degrees from either side of glass, film shall not appear distorted.
2. Flammability: Class A Interior Finish for Buildings Materials for both Flame Spread Index and Smoke Development Values per ASTM E84.
3. Abrasion Resistance: Surface coating resistant to abrasion, with less than 5 percent increase of transmitted light haze resulting per ASTM D1044 using 100 cycles, 500 grams of weight, and CS10F Calbrase Wheel.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data including installation instructions and cleaning methods.

B. Warranty: Manufacturer's standard limited warranty indicating warranty coverage.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer will ensure proper quality control during production, shipping, and inventory, clearly identify and label each film core with product designation and run number.

B. Deliver materials to Project site with manufacturer's labels intact and legible.

1.5 QUALITY ASSURANCE

A. Dealer and Applicator Qualifications: Provide documentation that dealer and applicator are authorized by manufacturer of window film to install window films.
   1. Provide reference list of 5 projects of similar size on which applicator has installed window films. Include on the list the following:
      a. Name of building.
      b. Name and telephone number of management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.

1.6 WARRANTY

A. Warrant materials and workmanship for 12 years against defects after completion and final acceptance of Work.
   1. Repair defects from faulty materials or workmanship developed during guarantee period, or replace with new materials, at no expense to Owner.
   2. Warranty covers the following:
      a. Film will maintain solar reflective properties without cracking, crazing, delaminating, peeling, or discoloration.
      b. Glass failure due to thermal shock fracture of glass (maximum value $500.00 per window) provided film is applied to recommended types of glass and failure occurs within 60 months from start of application. Glass failures shall reviewed by film manufacturer prior to replacement.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements, provide products from f the following manufacturer:
   1. 3M Building & Commercial Services Division (B&CSD).
   2. 3M Center Building 223-2S-24.
   3. St. Paul, MN 55144-1000.
   4. 3M B&CSD Point of Contact: Michael Hassenauer, 651-737-1053.

2.2 MATERIALS

A. Film Material: Film material consists of an optically clear metallized polyester film which may be laminated to a clear polyester film. Provide films with acrylic abrasion-resistant coating over surface of film for enhanced durability.
   1. Film Color: Derived from metal coating and/or components, and product will not contain conventional dyed polyester.
   2. Provide uniform film, without noticeable pin holes, streaks, thin spots, scratches, banding, or other optical defects. Variation in total transmission across width, at any portion along length, shall not exceed 2 percent over average. Density of film across web is not to exceed plus or minus 2 percent. Provide film with no evidence of coating voids.

SPECIFIER NOTE: RETAIN APPROPRIATE FILM TYPE IN SUBPARAGRAPH BELOW. DELETE FILM TYPES NOT REQUIRED FOR PROJECT.

B. Acceptable Products: 3M™ Sun Control Window Films.
   1. 3M Night Vision NV-15
   2. 3M Night Vision NV-25
   3. 3M Night Vision NV-35
   4. 3M Night Vision NV-45

PART 3 - EXECUTION

3.1 EXAMINATION

SPECIFIER NOTE: RETAIN APPROPRIATE PROJECT OPTION IN PARAGRAPH BELOW. DELETE OPTION NOT REQUIRED.

A. Examine glass surfaces to receive film and verify that they are free from defects and imperfections, which will affect final appearance. Correct and note such deficiencies to [**Owner**] [**Architect**] prior to commencing film application.

3.2 PREPARATION

A. Use protective tarps and drop cloths to cover interior finishes near window.

B. Turn off or cover heating and air conditioning ventilation ducts.

C. Clean window and window framing thoroughly with cleaning solution consisting of 90 percent water and 10 percent ammonia. Blade inside surface of window glass with industrial razors to insure removal of foreign contaminants.
   1. Tape and seal cracked and deteriorating window sealant.

D. Place towel or other absorbent material on window sill or sash to absorb moisture accumulation generated by film application.

E. Thoroughly rinse glass from top to bottom with pressure spray tank.

F. Squeegee entire glass surface.

G. Dry glass edges and window frames using a lint-free towel.

3.3 INSTALLATION

A. Install window films per manufacturer's written instructions.
   1. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
   2. Spray slip solution, composed of one capful of Johnson® Baby Shampoo or Joy® Dishwashing Liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
   3. Apply film to glass and lightly spray film with slip solution.
   4. Squeegee to remove water. Squeegee from top to bottom of window.
   5. Spray slip solution to film and squeegee a second time.
   6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
   7. Wipe frame edge dry
   8. Inspect installation to insure proper application.
   9. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING

A. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

B. After installation, remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

END OF SECTION

SECTION 08872

ARCHITECTURAL WINDOW FILM

For best results, display hidden notes to specifier by clicking TOOLS / OPTIONS / VIEW / HIDDEN TEXT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior Window Film.

B. Decorative Window Film.

C. Privacy Window Film.

1.2 RELATED SECTIONS

A. Section 08500 - Windows: Windows to receive architectural window film.

B. Section 08600 - Skylights: Glass Skylights to receive architectural window film.

C. Section 08800 - Glazing: General Glazing applications to receive architectural window film.

D. Section 08900 - Glazed Curtain Walls: Curtain Walls to receive architectural window film.

1.3 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals, 1997 Edition.

B. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.

C. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.

D. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

E. ASTM G 26 - Standard Practice for Performing Accelerated Outdoor Weatherizing for Non-metallic Materials Using Concentrated Natural Sunlight.

1.4 PERFORMANCE REQUIREMENTS

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
   1. Flame Spread: 25, maximum.

2. Smoke Developed: 450, maximum.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of ____ (#) properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer’s standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: 3M Window Films; 3M Center Bldg. 0223-02-S-24, St. Paul, MN 55144-1000. ASD. 3M Window Film Contact: Michael Hassenauer. Tel: (651) 737-1053. Fax: (651) 736-0611. Email: mjhassenauer@mmm.com. Web: http://www.3m.com/windowfilm.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 COMBINATION PATTERNED FILM

A. Fasara - Illumina Decorative / Privacy Glazing Film:
   1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
   2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 49 percent.
   3. Visible Light Rejected (ASTM E 903): Not less than 19 percent.
   4. Solar Heat Reduction: Not less than 14 percent.
   5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.62.
   6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

2.3 DOT PATTERNED FILM

A. Fasara - Aura 9 Decorative / Privacy Glazing Film:
   1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
   2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 83 percent.
   3. Visible Light Rejected (ASTM E 903): Not less than 8 percent.
   4. Solar Heat Reduction: Not less than 7 percent.
   5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.94.
   6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

B. Fasara - Luna 6 Decorative / Privacy Glazing Film:

1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 44 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 21 percent.
4. Solar Heat Reduction: Not less than 15 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.67.

C. Fasara - Luna 9 Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 39 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 23 percent.
4. Solar Heat Reduction: Not less than 16 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.63.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

D. Fasara - Luna Cell Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 31 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 24 percent.
4. Solar Heat Reduction: Not less than 17 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.59.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

E. Fasara - Luna Pico Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 32 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 24 percent.
4. Solar Heat Reduction: Not less than 17 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.60.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

F. Fasara - Vista Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 69 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 16 percent.
4. Solar Heat Reduction: Not less than 13 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.80.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

2.4 LINE PATTERNED FILM

A. Fasara - Arpa Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 46 percent.

3. Visible Light Rejected (ASTM E 903): Not less than 22 percent.
4. Solar Heat Reduction: Not less than 17 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.66.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

B. Fasara - Leise Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 74 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 8 percent.
4. Solar Heat Reduction: Not less than 7 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.94.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

C. Fasara - Fine Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 46 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 25 percent.
4. Solar Heat Reduction: Not less than 19 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.62.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

D. Fasara - Shutie Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 52 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 21 percent.
4. Solar Heat Reduction: Not less than 17 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.69.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

2.5 SINGLE PATTERNED FILM

A. Fasara - Altair Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 52 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 16 percent.
4. Solar Heat Reduction: Not less than 12 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.73.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

B. Fasara - Chamonix Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 47 percent.

3. Visible Light Rejected (ASTM E 903): Not less than 29 percent.
4. Solar Heat Reduction: Not less than 20 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.67.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

C. Fasara - Fine Crystal Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 83 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 8 percent.
4. Solar Heat Reduction: Not less than 7 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.93.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

D. Fasara - Lausanne Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 82 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 9 percent.
4. Solar Heat Reduction: Not less than 8 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.90.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

E. Fasara - Luce Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 31 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 25 percent.
4. Solar Heat Reduction: Not less than 17 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.59.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

F. Fasara - Mat Crystal I Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 83 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 8 percent.
4. Solar Heat Reduction: Not less than 8 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.91.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

G. Fasara - Milano Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 59 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 17 percent.
4. Solar Heat Reduction: Not less than 21 percent.

5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.75.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

H. Fasara - Opaque White Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 6 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 52 percent.
4. Solar Heat Reduction: Not less than 41 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.29.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

I. Fasara - Oslo Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 77 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 9 percent.
4. Solar Heat Reduction: Not less than 8 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.89.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

J. Fasara - Rikyu Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 47 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 18 percent.
4. Solar Heat Reduction: Not less than 13 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.69.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

K. Fasara - Sagano Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 53 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 16 percent.
4. Solar Heat Reduction: Not less than 12 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.75.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

L. Fasara - San Marino Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 28 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 27 percent.
4. Solar Heat Reduction: Not less than 42 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.55.

6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

M. Fasara - Vega Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 49 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 16 percent.
4. Solar Heat Reduction: Not less than 12 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.71.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

N. Fasara - Yamato Decorative / Privacy Glazing Film:
1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
2. Visible Light Transmission (ASTM E 903, ASTM E308): Not more than 52 percent.
3. Visible Light Rejected (ASTM E 903): Not less than 15 percent.
4. Solar Heat Reduction: Not less than 11 percent.
5. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): Not less than 0.75.
6. 3M Window Film Point of Contact - Michael Hassenauer 651-737-1053. Email: mjhassenauer@mmm.com.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

3M Window Films

1. Product Name

Prestige Window Films

2. Manufacturer

3M™ Building Safety Solutions Window Film
3M Center, Building 0223-02-5-24
Saint Paul, MN 55144-1000
(800) 430-1704
www.3m.com/windowfilm

3. Product Description

BASIC USE

3M™ offers a large selection of window films to meet a variety of requirements. 3M window films reject heat and block nearly all of the sun's harmful ultraviolet rays, and many are recommended by The Skin Cancer Foundation as effective UV protectants. 3M window films resist peeling, bubbling, scratching and abrasion and are backed by warranties that are among the most comprehensive available.

3M's premium Prestige Window Films are specifically designed to increase indoor comfort, lower energy costs and reduce the harmful effects of the sun's rays on interior furnishings in both commercial and residential applications. With 4 film styles from which to choose, Prestige films were tested using the Total Solar Energy Rejected - On Angle test and were proven to perform their best at the hottest part of the day when the sun is high. They reject up to 97% of the sun's infrared light and block 99.9% of the sun's harmful ultraviolet rays. This helps to keep buildings and homes cool, reduces energy demands and prevents premature refinishing or replacement of carpet, hardwood floors, furniture, art and window coverings due to sun and UV damage.

Prestige Window Films have low reflectivity, with 2 styles being less reflective than the glass they cover. Because they are manufactured without metals, these films are not susceptible to corrosion in coastal environments and do not interfere with mobile phone reception.

COMPOSITION & MATERIALS

Prestige Window Films have a nominal thickness of 2 mil and are composed of optically clear polyester. They contain at least 220 layers and have an acrylic pressure sensitive adhesive on one side and an acrylic abrasion resistant coating on the other. The film incorporates infrared-absorbing carbon and is uniform without noticeable pinholes, streaks, thin spots, scratches, banding or other optical defects. The variation in total transmission across the width at any portion along the length does not exceed 2% over the average.

TYPES & SIZES

- Prestige 70 - Clear film
- Prestige 60 - Clear film
- Prestige 50 - Lightly tinted film
- Prestige 40 - Lightly tinted film

Prestige Window Films are available in 100' (30 m) rolls, in widths of 40", 50" and 72" (1016, 1270 and 1829 mm).

BENEFITS

- Helps protect products from fading caused by UV rays
- Rejects solar heat even during the hottest part of the day, increasing comfort and saving energy
- Metal-free composition helps to prevent film corrosion in coastal environments and prevents interference with mobile phone reception
- Tinted and clear film options are available
- Available in 2 models that reflect less light than glass
- Resists abrasion

4. Technical Data

APPLICABLE STANDARDS

ASTM International (ASTM)

- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- ASTM E308 Standard Practice for Computing the Colors of Objects by Using the CIE System
- ASTM E903 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres (Withdrawn 2005)
- ASTM G26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000)

APPROVALS

The Skin Cancer Foundation

PHYSICAL PROPERTIES

Emissivity and u-value properties are determined based upon the established calculation procedure defined by the 1997 ASHRAE



(American Society of Heating, Refrigerating and Air-Conditioning Engineers) Handbook of Fundamentals. See Table 1 for details concerning the physical properties of Prestige Window Films.

FIRE PERFORMANCE

Prestige Window Films meet Class A requirements for surface burning characteristics when tested in accordance with ASTM E84:

- Flamespread - 25 maximum
- Smoke developed - 450 maximum

5. Installation

PREPARATORY WORK

Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

Provide clear access to work areas. Verify that site conditions are acceptable for installation. Do not proceed with installation until unacceptable conditions are corrected.

Examine glass surfaces to receive the new film and verify that they are free from defects and imperfections that will affect the final appearance. Correct and/or note all such deficiencies prior to applying the film.

Use protective tarps or drop cloths to cover interior furnishings, floor, carpet, window ledges and walls near the window(s) receiving the film installation. Turn off or cover heating, air conditioning and ventilation ducts to reduce dirt and dust in the air or on the glass.

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Place toweling or other absorbent material on the window sill or sash to absorb moisture generated by the cleaning and film application process. Clean the window and window framing thoroughly with a neutral cleaning solution. If the window putty or seal is old and cracked, tape or seal it prior to washing the glass. Using a solution comprised of 90% water to 10% ammonia, clean glass with a blade scraper or industrial razor to ensure the removal of contaminants. Thoroughly rinse the glass from top to bottom with water from a pressure spray tank. Squeegee the entire glass surface. Dry the glass edges and window frames using a lint-free towel.

METHODS

Measure the glass and cut the film edges neatly and squarely to fit, or cut the film 1" (25.4 mm) wider and longer for trimming to size after positioning. No edge seal is required.

Mix a film slip solution comprised of 1 capful of baby shampoo or dishwashing liquid to 1 gallon (3.8 L) of water. Spray the solution on the glass and film to facilitate proper film positioning. Use no more soap than is needed to provide slip. Apply film to the glass and lightly spray it with the slip solution. Use polyplastic bladed squeegees to remove excess water and to maximize the bonding of the pressure sensitive adhesive.

Trim the film to size if needed before using the squeegee a second time, making sure to use a new blade tip after 3 - 4 cuts. Spray the slip solution to the film and squeegee a second time. Bump the film edge with a lint-free towel wrapped around the edge of a 5-way tool. Wipe the frame edge dry.

After installation, the film may have a dimpled appearance from residual moisture. Under reasonable weather conditions, the film will dry flat within 30 days.

PRECAUTIONS

Use all necessary means to protect the film before, during and after installation.

BUILDING CODES

Installation must comply with the requirements of all applicable local, state and federal code jurisdictions.

6. Availability & Cost

AVAILABILITY

Contact 3M Building Safety Solutions Window Film for information on local availability, or reference the 3M online tool under Customer Support - Where to Buy at http://solutions.3m.com

COST

Budget installed cost information may be obtained from 3M Building Safety Solutions Window Film.

7. Warranty

Prestige Window Films are warranted by 3M for a period of 15 years in that the film will maintain solar reflective properties without cracking, crazing, delaminating, bubbling, peeling or discoloring. In the event that the product is found to be defective under warranty, the seller will replace such quantity of the film proved to be defective, and will additionally provide the removal and reapplication labor free of charge. 3M also warrants against glass failure due to thermal shock glass fracture. This is warranted to a maximum value of $500 per window, provided the film is applied to recommended types of glass and the failure occurs within 60 months from the start of application. Any glass failure must be reviewed by 3M prior to replacement.

Complete warranty terms and conditions are available from the manufacturer. For details, consult 3M Building Safety Solutions Window Film.

8. Maintenance

The film may be washed 30 days after application using common window cleaning solutions, including ammonia solutions. Abrasive cleaning agents and bristle brushes that could scratch the film must not be used. These films may also be cleaned with a mild dishwashing soap. Synthetic sponges, squeegees or soft cloths are recommended.

9. Technical Services

Technical assistance, including more detailed information, product literature, test results, project lists, assistance in preparing project specifications and arrangements for application supervision, is available by contacting 3M Building Safety Solutions Window Film.

10. Filing Systems

- Reed First Source
- MANU-SPEC®
- Additional product information is available from 3M Building Safety Solutions Window Film upon request.

TABLE 1 PHYSICAL PROPERTIES

Model	PR 70	PR 60	PR 50	PR 40
Thickness	> 2 mil	> 2 mil	> 2 mil	> 2 mil
Emissivity (ASHRAE)	0.78	0.78	0.78	0.78
U-value (ASHRAE)	0.99	0.99	0.99	0.99
Visible light transmission (ASTM E308)	68%	61%	50%	39%
Visible reflection – Exterior (ASTM E903)	9%	8%	8%	7%
Visible reflection – Interior (ASTM E903)	9%	8%	7%	6%
Ultraviolet rejected (ASTM E903)	> 99.9%	> 99.9%	> 99.9%	> 99.9%
Infrared energy rejected (ASTM E308, E903)	97%	97%	97%	97%
Luminous efficacy (ASTM E903)	1.17	1.11	0.98	0.83
Shading coefficient – at 90 degrees (normal incidence) (ASTM E903)	0.58	0.55	0.51	0.47
Total solar energy rejected (TSER) at 90 degrees (normal incidence) (ASTM E903)	50%	52%	56%	59%
TSER – 60 degree angle (ASTM E903)	59%	61%	63%	66%

Note: Performances are based upon 1/4" (6.4 mm) clear glass.

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SECTION 08870

WINDOW FILM

Display hidden notes to specifier. (Don't know how? Click Here)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety and security films.

1.2 RELATED SECTIONS

A. Section 08500 - Windows; windows to receive architectural window film.

B. Section 08600 - Skylights; glass skylights to receive architectural window film.

C. Section 08800 - Glazing; general glazing applications to receive architectural window film.

D. Section 08900 - Glazed Curtain Walls; curtain walls to receive architectural window film.

1.3 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

B. ASTM International (ASTM):
1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
3. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
4. ASTM D 2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
5. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
6. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
7. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.

8. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
9. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
10. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

C. Window 5.2 - A Computer Tool for Analyzing Window Thermal Performance; Lawrence Berkeley Laboratory.

D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

E. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.

F. GSA Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.

G. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.

H. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 PERFORMANCE REQUIREMENTS

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
1. Flame Spread: 25, maximum.
2. Smoke Developed: 450, maximum.

B. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calbrase Wheel.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each film specified, submit film samples representing manufacturer's film type for the project.

D. Verification Samples: For each film specified, two samples representing film color and pattern.

E. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
   4. Provide an application analysis to determine available energy cost reduction and savings.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: 3M Window Film , which is located at: 3M Center Bldg. 0235-02-S-27 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-480-1704; Tel: 651-733-2222; Fax: 651-737-3446; Email: pneumann@mmm.com; Web: www.3m.com/windowfilm

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 CLEAR SAFETY AND SECURITY WINDOW FILM

A. Clear Safety and Security Window Film: 3M Safety S70 (SH7CLARL) Safety and Security Window Film. Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.
   1. Physical / Mechanical Performance Properties:
      a. Film Color: Clear.
      b. Thickness: Nominal 7.0 mils (0.18 mm).
      c. Tensile Strength (ÅSTM D 882): 25,000 psi.
      d. Break Strength (ÅSTM D 882) (Per Inch Width): 175 lbs.
   2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
   3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
   4. Identification: Labeled as to Manufacturer as listed in this Section.
   5. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
      a. Visible Light Transmission (ÅSTM E 903): 86 percent.
      b. Visible Reflection (ÅSTM E 903): Not more than 10 percent.
      c. Ultraviolet Transmission (ÅSTM E 903): Less than 1 percent.
      d. Solar Heat Gain Coefficient (ÅSTM E 903): 0.79.
   6. Impact Resistance for Safety Glazing: Tested on 1/8 inch (3 mm) annealed glass.
      a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
   7. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
      a. GSA Rating with minimum blast pressure and impulse of 4 psi and 28 psi.msec: “3B” (Low Hazard / High Protection).
      b. GSA Rating with minimum blast pressure and impulse of 10 psi and 89 psi.msec, respectively: “3B” (Low Hazard / High Protection).

PART 3 EXECUTION

3.1 EXAMINATION

A. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   1. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance:

B. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 08870

WINDOW FILM

Display hidden notes to specifier. (Don't know how? Click Here)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety and security films.

1.2 RELATED SECTIONS

A. Section 08500 - Windows; windows to receive architectural window film.

B. Section 08600 - Skylights; glass skylights to receive architectural window film.

C. Section 08800 - Glazing; general glazing applications to receive architectural window film.

D. Section 08900 - Glazed Curtain Walls; curtain walls to receive architectural window film.

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A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

B. ASTM International (ASTM):
1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
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8. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
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10. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

C. Window 5.2 - A Computer Tool for Analyzing Window Thermal Performance; Lawrence Berkeley Laboratory.

D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

E. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.

F. GSA Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.

G. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.

H. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 PERFORMANCE REQUIREMENTS

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
1. Flame Spread: 25, maximum.
2. Smoke Developed: 450, maximum.

B. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calbrase Wheel.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each film specified, submit film samples representing manufacturer's film type for the project.

D. Verification Samples: For each film specified, two samples representing film color and pattern.

E. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
   4. Provide an application analysis to determine available energy cost reduction and savings.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: 3M Window Film , which is located at: 3M Center Bldg. 0235-02-S-27 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-480-1704; Tel: 651-733-2222; Fax: 651-737-3446; Email: pneumann@mmm.com; Web: www.3m.com/windowfilm

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 CLEAR SAFETY AND SECURITY WINDOW FILM

A. Clear Safety and Security Window Film: 3M Safety S140 (SH14CLARL) Safety and Security Window Film. Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.
   1. Physical / Mechanical Performance Properties:
      a. Film Color: Clear.
      b. Thickness: Nominal 14.0 mils (0.36 mm).
      c. Tensile Strength (ÅSTM D 882): 25,000 psi.
      d. Break Strength (ASTM D 882) (Per Inch Width): 350 lbs.
   2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
   3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
   4. Identification: Labeled as to Manufacturer as listed in this Section.
   5. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
      a. Visible Light Transmission (ASTM E 903): 85 percent.
      b. Visible Reflection (ÅSTM E 903): Not more than 10 percent.
      c. Ultraviolet Transmission (ÅSTM E 903): Less than 1 percent.
      d. Solar Heat Gain Coefficient (ÅSTM E 903): 0.78.
   6. Windstorm Protection
      a. Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 50 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
   7. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
      a. GSA Rating with minimum blast pressure and impulse of 7 psi and 36 psi.msec, respectively: “3B” (Low Hazard / High Protection).
      b. GSA Rating with minimum blast pressure and impulse of 11 psi and 55 psi.msec, respectively: “3B” (Low Hazard / High Protection).
   8. Forced Entry Protection: Independent lab testing according to UL 972 protocol (Multiple Impact Test).
      a. Annealed Glass (1/4 inch) - Pass
      b. Tempered Glass (1/4 inch) - Pass

PART 3 EXECUTION

3.1 EXAMINATION

A. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   1. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance:

B. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 08870

WINDOW FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety and security films.

1.2 RELATED SECTIONS

A. Section 08500 - Windows; windows to receive architectural window film.

B. Section 08600 - Skylights; glass skylights to receive architectural window film.

C. Section 08800 - Glazing; general glazing applications to receive architectural window film.

D. Section 08900 - Glazed Curtain Walls; curtain walls to receive architectural window film.

1.3 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

B. ASTM International (ASTM):
1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
3. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
4. ASTM D 2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
5. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
6. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
7. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.
8. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance

and Transmittance of Materials Using Integrating Spheres.

9. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
10. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

C. Window 5.2 - A Computer Tool for Analyzing Window Thermal Performance; Lawrence Berkeley Laboratory.

D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

E. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.

F. GSA Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.

G. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.

H. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 PERFORMANCE REQUIREMENTS

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
   1. Flame Spread: 25, maximum.
   2. Smoke Developed: 450, maximum.

B. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calbrase Wheel.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each film specified, submit film samples representing manufacturer's film type for the project.

D. Verification Samples: For each film specified, two samples representing film color and pattern.

E. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
   4. Provide an application analysis to determine available energy cost reduction and savings.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: 3M Window Film , which is located at: 3M Center Bldg. 0235-02-S-27 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-480-1704; Tel: 651-733-2222; Fax: 651-737-3446; Web: www.3m.com/windowfilm

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MICROLAYERED SAFETY AND SECURITY WINDOW FILM WITH SUN CONTROL

A. Micro-layered Safety and Security Window Film with Sun Control: 3M Ultra Night Vision S25 Safety and Security Window Film with Sun Control. Optically clear polyester film comprised of 28 micro-layers, laminated to a metalized multi-layered polyester film. Additional film layer is added for color and performance, with a durable abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film color is derived from the metal coating and the product will not contain dyed polyester.
   1. Film Type: Ultra NV S25.
   2. Physical / Mechanical Performance Properties (nominal):
      a. Film Color: Tinted - Derived from metal coatings.
      b. Thickness: Nominal 6.0 mils (0.15 mm).
      c. Tensile Strength (ÅSTM D 882): 30,000 psi.
      d. Break Strength (ASTM D 882) (Per Inch Width): 120 lbs.
      e. Tear Resistance (ASTM D 1004): Greater than 780 lbs.
      f. Puncture Propagation Tear (ÅSTM D 2582): 7.5 lbs.
      g. Young's Modulus (ÅSTM D 882): 500 kpsi
   3. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
      a. Visible Light Transmission (ASTM E 903): 27 percent.
      b. Visible Reflection (ÅSTM E 903): Not more than 28 percent.
      c. Ultraviolet Transmission (ÅSTM E 903): Less than 1 percent.
      d. Solar Heat Gain Coefficient (ÅSTM E 903): 0.38.
   4. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
   5. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
   6. Identification: Labeled as to Manufacturer as listed in this Section.
   7. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6.4 mm) annealed glass.
      a. Safety Rating (CPSC 16 CFR, Part 1201): Category I
      b. Safety Rating (ANSI Z97.1): Class B, Unlimited Size.
   8. Windstorm Protection:
      a. Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTM E 1996 and E 1886) at 70 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
      b. Film shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 50 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
   9. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
      a. GSA Rating with minimum blast pressure and impulse of 4 psi and 28 psi.msec, respectively: “3B” (Low Hazard / High Protection).

PART 3 EXECUTION

3.1 EXAMINATION

A. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   1. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance:

B. Do not proceed with installation until glass surfaces have been properly prepared and

deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 08870

WINDOW FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety and security films.

1.2 RELATED SECTIONS

A. Section 08500 - Windows; windows to receive architectural window film.

B. Section 08600 - Skylights; glass skylights to receive architectural window film.

C. Section 08800 - Glazing; general glazing applications to receive architectural window film.

D. Section 08900 - Glazed Curtain Walls; curtain walls to receive architectural window film.

1.3 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

B. ASTM International (ASTM):
1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
3. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
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5. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
6. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
7. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.
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and Transmittance of Materials Using Integrating Spheres.

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A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
   1. Flame Spread: 25, maximum.
   2. Smoke Developed: 450, maximum.

B. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calbrase Wheel.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each film specified, submit film samples representing manufacturer's film type for the project.

D. Verification Samples: For each film specified, two samples representing film color and pattern.

E. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film.
      e. Amount of film installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
   4. Provide an application analysis to determine available energy cost reduction and savings.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: 3M Window Film , which is located at: 3M Center Bldg. 0235-02-S-27 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-480-1704; Tel: 651-733-2222; Fax: 651-737-3446; Web: www.3m.com/windowfilm

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MICROLAYERED SAFETY AND SECURITY WINDOW FILM WITH SUN CONTROL

A. Micro-layered Safety and Security Window Film with Sun Control: 3M Ultra Prestige PR S70 Safety and Security Window Film with Sun Control. Optically clear polyester film comprised of 28 micro-layers, laminated to different clear multi-layered polyester film containing at least 220 layers with a pressure sensitive adhesive on one side and durable acrylic abrasion resistant coating on the other side. Films contain no metals, but so contain infrared-absorbing carbon, metal oxide particles, or both.
   1. Physical / Mechanical Performance Properties (nominal):
      a. Film Color: Clear with at least 220 layers.
      b. Thickness: Nominal 6.0 mils (0.15 mm).
      c. Tensile Strength (ÅSTM D 882): 30,000 psi.
      d. Break Strength (ASTM D 882) (Per Inch Width): 120 lbs.
      e. Tear Resistance (ASTM D 1004): Greater than 780 lbs.
      f. Puncture Propagation Tear (ÅSTM D 2582): 7.5 lbs.
      g. Young's Modulus (ÅSTM D 882): 500 kpsi.
   2. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
      a. Visible Light Transmission (ÅSTM E 903): 69 percent.
      b. Visible Reflection (ASTM E 903): Not more than 10 percent.
      c. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
      d. Solar Heat Gain Coefficient (ASTM E 903): 0.50.
      e. TSER - 60 Degree Angle - 59 percent.
   3. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
   4. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
   5. Identification: Labeled as to Manufacturer as listed in this Section.
   6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6.4 mm) annealed glass.
      a. Safety Rating (CPSC 16 CFR, Part 1201): Category I.
      b. Safety Rating (ANSI Z97.1): Class B, Unlimited Size.
   7. Windstorm Protection:
      a. Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 70 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
      b. Film shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 50 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
   8. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
      a. GSA Rating with minimum blast pressure and impulse of 4 psi and 28 psi.msec, respectively: “3B” (Low Hazard / High Protection).
      b. GSA Rating with minimum blast pressure and impulse of 7 psi and 36 psi.msec, respectively: “2” (No Hazard / Very High Protection).

PART 3 EXECUTION

3.1 EXAMINATION

A. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   1. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance:

B. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

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A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

APPENDIX 4 SAFETY MANAGEMENT PLAN

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HSE Safety Management Plan

Prepared by:	Ian Hanley
Signature:	Ian Hanley
Date:	6/1/20
HSE Manager:	
Signature:	
Date:	
Customer:	Montclair School District
Signature:	
Date:	

NOTE: A SIGNED AND ACCEPTED COPY IS TO BE KEPT ON SITE AND ON CONTRACT FILE.

INTRODUCTION

The Health, Safety & Environmental (HSE) Site Management Plan is an integral part of all work and site specific procedures for all Honeywell operations. Honeywell is committed to developing safety systems which ensure the highest standard of health and safety for all employees. We aim to continually improve the systems of work and strive for best practice in the area of health, safety and environment. Honeywell aims to control risk through the implementation of an effective HSE Site Management Plan and Program.

The objective of this document is to establish a plan for implementing the company safe operations management program. The plan is intended to minimize losses, meet regulatory compliance requirements and to implement site health, safety and environmental regulations established by the Customer.

Honeywell demonstrates its commitment to health and safety by making all levels of management accountable for all health and safety issues. We attribute the success of effective safety systems to the ability to communicate the agreed standards of performance between employees and management. Honeywell's commitment to health, safety and the environment can be viewed at **Attachment 1: Honeywell HSE Commitment Statements**.

1. Plan Deployment

The HSE Plan is one component of Honeywell's Safe Operations Management (SOM) program. The HSE Plan, and its relevant components and references specific to this project, should be reviewed with the Customer, Honeywell representatives and subcontractors/contractors to ensure effective deployment of the SOM program. This includes:

(1) On-site meeting between Customer and Honeywell representative(s) and subcontractors.
(2) Customer and Honeywell representative(s) and subcontractors are briefed and understand the Safety Management Plan:
    a) Site information,
    b) Hazard and risk assessments,
    c) HSE training,
    d) Activity schedules,
    e) Measures of HSE performance.
(3) Plan is to be reviewed on a quarterly basis to ensure Management of Change.
(4) Plan shall be maintained to ensure that relevant information is available to employees, contractors, customers, clients and the public concerning the effects of the Company's activities and materials on the safety and health of people and impact on the environment.
(5) Communication and management systems shall be developed, implemented and maintained throughout each site to facilitate continuous improvement in performance.

(6) Active consultation and communication with employees and contractors in the improvement of health, safety and environmental work.

Honeywell Management Systems are the property of Honeywell and must be maintained in accordance with Honeywell Information Security guidelines. Clients wishing to view any components of the Honeywell Operating System (external to Safe Operations Management) can request to do so by contacting the Honeywell Project Manager, who will assess the request and where deemed appropriate, arrange for viewing of the relevant Honeywell information.

2. Revision Sheet

When changes are made to this document, the revision sheet must be revised and all controlled copies of the document updated and distributed per the Distribution List.

Revision	Date	Description
Initial Draft	6/1/20	Initial Document

3. Distribution List

One hard copy will be maintained for the assigned contract on site. Electronic copy can be distributed, upon request.

Copy	Name	Organization & Title	Email Address
1	Tim Laverick	Honeywell Project Manager	Timothy.Laverick@Honeywell.com
2	Sharon Arents	Honeywell HSE Leader	Sharon.Arents@Honeywell.com
3	Bob Letso	Honeywell PM Leader	Robert.Letso@Honeywell.com
4	John Eschmann	Customer Project Manager	jeschmann@montclair.k12.nj.us

4. Contents

Introduction
Section 1 Site Information
Section 2 Site Hazards and Safety Management Plan
Section 3 Site Requirements
Section 4 Site HSE Activity Schedule
Section 5 Site HSE Performance
Section 6 Contract Form and Attachments

SECTION 1 – SITE INFORMATION & HSE ADMINISTRATION

5. Contract – Scope of Work Description

Project name:	**Montclair School District ESIP**
Customer name and address:	**Montclair School District** **22 Valley Rd, Montclair, NJ 07042**
Scope of work (summary):	Lighting & electrical upgrades, mechanical upgrades, building envelope improvements, and building management system upgrades.
Start Date:	TBD
Completion Date:	TBD

6. Key Project Contacts (List all Honeywell Employees & Contractors)

Honeywell Project Manager	Tim Laverick	Timothy.Laverick@Honeywell.com 908-635-3853
Honeywell Project Administrator	Ian Hanley	Ian.Hanley@Honeywell.com 973-222-0206
Honeywell Branch Project Manager	Jim Perez	James.Perez@Honeywell.com 862-465-1052
Honeywell Regional HSE Leader		
Customer Project Manager	John Eschmann	jeschmann@montclair.k12.nj.us 973-509-4044
Customer Project Manage		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		
Subcontractor Project Manager		

7. Customer HSE Reporting

Honeywell will report HSE performance to the Customer, if required, as defined in the scope of work and/or contract. Reporting topics may include:

- Customer requested HSE metrics at customer request,
- Incidents/injuries, Safety Observation System events,
- Summary of HSE Project Manager site reviews/audits, Contractor audit results

8. Cardinal Rules – Unacceptable Behaviors & Attitudes

The Cardinal Rules shall be displayed at all Honeywell locations, including field offices and also at designated Honeywell offices within the Customer site. All employees are to adhere to the Cardinal Rules which can be viewed at **Attachment 2: Honeywell Cardinal Rules**.

9. Responsibilities, Authority & Resources

Management & Resources

The Honeywell Project Manager is responsible for the implementation of the Honeywell Health, Safety and Environment Plan requirements and shall maintain and monitor programs aimed at continuous improvement of HSE performance. Appropriate health, safety and environmental support and resources shall be available to assist project and service managers to discharge their responsibilities.

Honeywell Project Manager Responsibilities

Each PM is accountable for implementation of Honeywell's HSE Policy. Specific responsibilities are:

- Supports and promotes jobsite safety through leadership and example.
- Becomes involved in task safety analysis in order to identify any hazards and manage the associated risks prior to work being done.
- Ensures the completion of job hazard analysis prior to the beginning of any work including review and approval.
- Insist upon employee's and subcontractor's compliance with established safety rules, correcting any unsafe acts or conditions, and implementing corrective or disciplinary actions as necessary for the effective functioning of the safety program.
- Ensure all team members are trained in safe work procedures.
- Ensure regular hazard inspections are carried out within areas under their control.
- Verify that employees and subcontractors implement the designated site safe work procedures/systems.
- Ensure approved Honeywell employee protective equipment is issued and proper instruction given as to its use, maintenance and storage.
- Be involved in formal as well as informal safety audits and monitor contractor and site safety performance on a regular basis.
- Ensure that all accidents and injuries are reported and investigated.
- Identify cause of non-compliance and investigate/document actions to correct safe work method deficiencies or rectify inappropriate workplace behaviors, including consultation, counselling, training and/or disciplinary action.
- Preparation and regular review of work procedures.

All Honeywell Employee Responsibilities

Employees have a duty to cooperate in the achievement of a safe and accident free workplace, through:

- Cooperating in fulfilment of the obligations placed on Honeywell International.
- Identify all tasked and prepare risk assessments.
- Working with care for their own safety and that of others who may be affected by their actions
- Reporting unsafe conditions and behaviours.
- Wear and maintain any issued personal protective equipment (PPE) when necessary.
- Assisting in the investigation of any accidents with the objective to prevent recurrence.
- Maintain a safe working environment for all Honeywell/Contractor employees that may be utilized for this project.
- Report all safety issues or events directly to the Honeywell Project Manager.

Subcontractors shall be responsible for complying with all Subcontractor Responsibilities

Subcontractors shall be responsible for complying with all statutory obligations and shall exercise all possible care for the health and safety of their personnel and other persons at the workplace who may be affected by their activities. Subcontractors shall at all times comply with Honeywell's HSE policy and procedures. As a condition of employment all employees are expected to work in a safe and responsible manner. The employee is ultimately responsible for his or her own safety. All contractors shall provide the employee with all the necessary training and PPE, but the employee must make the proper choices when performing an assigned task. Any issues not covered by this Safety Plan should be communicated to the relevant Honeywell representative. The Contractor's personnel will have responsibilities, which include but may not be limited to the following:

- Establishing safety responsibilities for their site personnel including their subcontractors.
- Insisting and ensuring correct and safe practices are used at all times.
- Providing adequate resources, personnel, equipment, time and funds to ensure the objectives of the safety plan are met.
- Completing the required work authorization forms and safety permits for each activity.
- Following safety rules and verbal instructions. Ask superintendent questions when any uncertainty exists.

- Ensuring their site personnel are suitably trained to effectively carry out their HSE responsibilities.
- Using tools in a safe and appropriate manner in accordance with their design; inspecting them for damage prior to each use.
- Ensuring safety auditing and performance reporting requirements specified by Honeywell are met.
- Reporting any unsafe acts or conditions, correcting them whenever possible.
- Reporting all injuries, incidents and near misses immediately, no matter how minor.

Project Employee/Contractor List

The Honeywell Project Manager will maintain the **Attachment 3 Site Project Contractor/Employee List**. All Contractors and Honeywell Employees working on site, listed or not, have a duty to cooperate in the achievement of a safe and accident free workplace.

10. Site Facilities

Honeywell Designated Areas

All designated Honeywell areas, if any, at the customer site must be maintained by Honeywell staff to ensure these facilities are kept in a clean and hygienic condition for the duration of the contract. At a minimum, these areas are to be inspected weekly to identify any workplace hazards or risks and to ensure minimum standards are maintained. If there is a Honeywell office you are required to post the Honeywell Commitment Statement and Cardinal Safety Rules. Depending on local or federal requirements ensure regulatory postings are current.

Security

Honeywell employees must meet all customer security requirements. This may include visitor badges, access training, appropriate regulatory and/or customer documentation, background checks, registry upon arrival and departure, etc. Badges are to be worn above the waist and in a visible position at all times while on site.

11. Honeywell Staff Training

Training needs shall be identified and training delivered to ensure that the project and service managers have the appropriate health, safety and environmental management skills. Honeywell employees shall be instructed in safe systems of work to ensure they work with proper regard for the safety, health, and protection of themselves, others and the environment. The Honeywell Project Manager is responsible for identifying the specific training requirements of their team members and ensuring the required training is undertaken. This training may be either Honeywell internal training, or training specific to the project location provided by the customer, provided the minimum content requirements are met. The minimum required training for the project scope of work is listed in Section 3 of this safety management plan.

12. Contractor Work Authorization & Permits

Contractor Sign-in & Work Authorization

Contractors must complete the Contractor Safety Declaration and Work Authorization Form with required risk assessments and permits prior to commencing work. Low risk work can be undertaken by contractors without direct authorization given that the relevant Honeywell Project Manager is aware of the:

1) Scope of work.
2) Time the work is to be undertaken.
3) Workers performing the work.

Attachment 4: Contractor Safety Declaration & Work Authorization Form
Attachment 5: Safety Permit Applications

13. Accident / Incident Events

Reporting of Accident / Incident Events

Honeywell Employees & Contractors must adhere to the following reporting requirements,

(1) Globally contact the Honeywell Project Manager
(2) Honeywell employees only - Call the HSE Hotline at 1-866-466-1765
(3) Honeywell Project Manager will contact the customer safety manager if required.
(4) The Honeywell HSE Manager must be contacted should any of these events occur.
    a. All injuries and incident events
    b. Release of dangerous goods or hazardous substances to the environment
(5) Certain incidents must also be reported to the relevant local workplace safety or environmental protection authorities in accordance with local legislation.

Incident Investigation of Accident / Incident Events

Honeywell Representative must follow the following criteria after an accident or incident occurs.

(1) Conduct an incident investigation in accordance with Honeywell injury and incident investigation requirements in consultation with the regional HSE manager and affected employee(s).
(2) Ensure implementation and close out of short and/or long-term corrective actions to prevent re-occurrence.
(3) Present to Honeywell Project Management Leader and HSE Manager all planned corrective actions.

Attachment 6: Incident Investigation Report

14. Safety Observation System Events

Safety Observations must be submitted to the Honeywell Project Manager by any Honeywell employee using the **Attachment 7 Safety Observation Form**. Safety Observation is an unplanned event or condition that could have reasonably resulted in personal injury or illness, equipment or property damage, an environmental excursion, or when a safety control measure is challenged or ignored.

15. Site Evacuation Procedures

The Honeywell site specific **Emergency Response Plan, Attachment 17** shall be prepared, if a customer equivalent response plan is not available. The Honeywell Project Manager shall review and incorporate the emergency response plan into the Safety Management Plan. Either the Honeywell or Customer site specific emergency response plan shall be followed and this plan shall be communicated to all Honeywell employees, contractors, and visitors prior to working at the project site. For any Honeywell-occupied spaces such as a job trailer, leased office space or warehouse used during the course of a project, Honeywell shall complete a Honeywell site specific Emergency Risk Assessment by checking the appropriate boxes, then complete a site specific Emergency Response Plan as explained in the Emergency Response Procedure.

SECTION 2 – SITE RISK ASSESSMENT TOOLS

16. Hazard Reporting

It is the responsibility of all employees to immediately report any unsafe act or condition to the Honeywell Project Manager. Honeywell actively encourages all employees and contractors to report hazards. The strength of our Health, Safety Management Plan relies on the ability of Honeywell employees and contractors to report hazards. At each site, all hazards that are identified by employees or contractors shall be communicated immediately to the Honeywell Project Manager. In the event that the hazard is considered significant, it must be reported immediately to the appropriate Customer representative.

17. Site Assessment Tools

Identify Site Hazards

Hazards associated with contracted scope of work shall be identified and documented in the **Attachment 8 hazard assessment site inventory**. The Hazard Assessment Site Inventory should include all identified hazards for the scope of work on this contract. The Hazard Assessment is used to prepare task and generic risk assessments or contractor authorizations.

Risk Assessment & Contractor Work Authorization Forms

Each hazard must be assessed according to the risk calculator listed on the **Attachment 9 Risk Assessment Form** to ensure the hazards are categorized as low, medium or high risks. Risk exposure to hazards in the work environment is determined by consequence and severity resulting in a low, medium or high risk level. **[**Click **HERE** for sample Risk Assessments / Safe Work Procedures.**]**

Risk assessments and contractor work authorization forms include a list of control measures which need to be developed and made readily available for the duration of the work. Hazards shall be controlled to ensure that consequent risks are eliminated or reduced as far as is reasonably practicable. Control measures shall be reviewed and monitored for their effectiveness. Continuous consultation should occur with all employees and contractors on site to ensure that hazards are identified and controls implemented.

Control measures will be selected in accordance with both established Field Risk Assessment Forms and the “Hierarchy of Control Measures” aimed at eliminating the hazard or hazardous activity. The most desirable

control measure must be selected using the control hierarchy, in this order, elimination, substitution, engineering control, administrative control and personal protective equipment.

Tasks assessed as a high risk will require notifying the Honeywell Project Manager prior to commencement of work. The Honeywell Project Manager will evaluate the task for personal safety issues. All relevant activity check sheets and permits shall be completed in advance, and applicable guidelines, procedures, and/or work instructions will be reviewed and followed prior to and during the performance of the tasks.

Both contract and site specific data should be reviewed for inclusion in the orientation process to ensure key hazards/risks and any expectations in relation to the hazard elimination/risk management are communicated to the relevant employees and contractors.

The Honeywell Project Manager shall ensure that risk assessment and contractor authorization forms are implemented where required and ensure a quality standard of service is provided. Honeywell has developed a list of safety procedures for site work that facilitate compliance to legislative requirements. After the contractor completes the work authorization form the contractor may use previously completed Honeywell and/or the customer field risk assessment forms, provided that the contractor understands the procedure and takes ownership of the field risk assessment forms. All field risk assessment forms need to be reviewed by each employee prior to commencement of work.

Field Risk Assessment Forms identified are assessed for any potential risks of personal injury or injury to others, and property damage or environmental damage. Risk Assessments are separated into generic and task specific functions. The following are only examples and do not include all tasks that may apply at the customer or Honeywell location,

- Generic Field Risk Assessment Forms include common steps that are prepared once and can be used at multiple locations,
  - Climbing a ladder, working from a scaffold, scissor lifts, aerial lifts, man lift, etc.
  - Safe driving to/from customer locations
  - Personnel safety at customer locations, including walking on site
  - Roof Work
  - Mobilization of personnel, equipment or heavy components
  - Working on operating equipment
- Task Specific Field Risk Assessment Forms are prepared for a unique task at the customer site,
  - Equipment specific Lock Out / Tag Out, of electrical, mechanical, hydraulic, pneumatic, gravity, gas tie-ins, refrigerant servicing, etc.
  - Working from heights involving fall protection
  - Demolition of Electrical Cabling, equipment, etc.
  - Working in areas (e.g., installation, demolition) with live power or active control / fiber-optic cable, including junction boxes, where there is a substantial possibility of interrupting a live circuit.

18. Site Specific Field Risk Assessment Form Inventory

The Project Manager is responsible for keeping an inventory of the completed risk assessments and contractor work authorizations for the scope of work of this contract using the table provided in the hazard assessment site survey Attachment 8. This includes specific Field Risk Assessment Forms identified as a result of the completed Risk Assessments and Contractor Work Authorization Forms. All contract personnel are required to be familiar with the procedures and when they are to be used. These procedures must be followed at all times when the identified major risk activity is performed. Full records are to be kept for every major risk activity performed.

SECTION 3 – Site Requirements, HSE Training, Licenses and Competency

19. Customer Site Orientation

General Requirements

All Honeywell employees and contractors working on the customers sites will complete the customer site orientation, if required by the customer. Honeywell contractor orientations shall be managed by the Honeywell Project Manager to ensure that all orientations, including site safety management plan requirements are received and accepted by contractors and Honeywell staff, documented as being completed, and maintained in this plan for all contract personnel as required by Honeywell.

Orientation Schedule

The following orientations must be completed:

Orientation	Orientation Frequency	Key Contact(s)
Contractor Orientation	Prior to commencement of work. Complete **Site Orientation Form Attachment 10** with contractors & their employees Prior to commencement of work. Complete **Attachment 12 Field Safety Checklist** which document potential hazards. Review Contractor Work Authorization Forms with required safety permits.	Tim Laverick Ian Hanley
Honeywell Employee Orientation	1. Prior to commencement of work and annually. Complete required monthly training modules per **Attachment 11 Training Register**. 2. Document employee having completed Risk Assessment Forms with required safety permits.	Tim Laverick Ian Hanley

20. HSE Training, Licenses & Certificate of Competency

Honeywell Staff, Contractors and Sub-contractors

Both Honeywell Staff and contractors are required to complete the Attachment 11 Training Register as proof of completion of the required training. Honeywell employees are required to complete **Attachment 15 Vehicle, Tool, & PPE Inspection Checklist**. Additional training requirements may be required by local regulations. If applicable, this must be verified as completed before commencing work at the site. Training must be completed prior to performing site specific task or activities. All contractors and Honeywell employees are required to be currently licensed in accordance with state and local requirements to perform the work and activities associated with the contract scope of work.

SECTION 4 – Site HSE Activity Schedule

21. Honeywell Project Manager HSE Activity Schedule

1) Conduct Safety Inspections:
    a) Attachment 12 Field Safety Checklist – Project Manager to complete prior to starting work onsite and annually.
    b) **Attachment 13 Behavioral Observation Checklist** – Project Manager to complete periodically to assess Honeywell field employees during scheduled construction.
    c) **Attachment 14 Contractor Safety Checklist** – Project Manager to complete periodically to assess Contractor safety compliance.
2) Attend Customer safety meetings and audits, as scheduled.
3) Report Safety Observations to the HSE Manager and Customer.
4) Document and approve all Risk Assessments, Contractor Work Authorizations and required safety permits.

SECTION 5 – Site HSE Performance

22. HSE Metrics

The following HSE metrics will be documented and maintained during project construction,

- Attendance at weekly contractor safety meetings.
- Number of safety audits performed and completed.
- Number (and %) of safety audit items in conformance with requirements.
- Number and types of injuries, illnesses, and safety observation events noted during the project.

SECTION 6 – Contract Forms and Tools

23. Contract Forms and Tools

Contracts Forms, Tools and Procedures

The following list includes all pertinent safety forms for the use of initiating and maintaining safe work practices as described in this Safety Management Plan. These forms are also included in the following pages of this section.

Attachment No.	Document Name	Time to Complete:	Frequency	Responsible to Complete
–	Safety Management Plan (SMP)	Start of contract	Once for each phase/contract	Honeywell PM
1	HSE Commitment Statements	Start of contract	Once with SMP	Honeywell PM (Post on-site)
2	HSE Cardinal Rules	Start of contract	Once with SMP	Honeywell PM (Post on-site)
3	Site Employee/Contractor list	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell PM
4	Contractor Work Authorization Form	Booking Date – Before Installation	Update as needed throughout project duration	All Subcontractors
5	Safety Permit Applications	Before performing task that requires it.	As required throughout installation	Contractor / Honeywell Field Employees
6	Incident Investigation Report Form	Within 24 hours of incident.	As required throughout project duration	Honeywell PM
7	Safety Observation Form	Throughout Project Duration	Monthly	All Honeywell Employees
8	Hazard Assessment Site Inventory	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell PM
9	Risk Assessment Form	Booking Date – Before Installation	Update as needed throughout project duration	Honeywell Field Employees
10	Site Orientation Form	Booking Date – Before Installation	Once with SMP	Honeywell PM
11	Training Register	Booking Date – Before Installation	Once with SMP	Honeywell PM
12	Field Safety Checklist	Booking Date – Before Installation	Done once for all trades, Update as needed throughout project duration	Honeywell PM
13	Behavioral Observation Checklist	Throughout installation	Monthly while Honeywell field employees are working	Honeywell PM
14	Contractor Safety Checklist	Throughout installation	Monthly while subcontractors are working	Honeywell PM
15	Vehicle, Tool, & PPE Inspection Checklist	Throughout project duration	Quarterly	Honeywell PM/Employees
16	Site Specific Emergency Plan	Booking Date – Before Install	Once with SMP	Honeywell PM

SMP Attachment 1: HSE HBS Commitment Statement

Honeywell

Sustainable Opportunity Policy
Honeywell's Commitment to Health, Safety and the Environment

By integrating health, safety and environmental considerations into all aspects of our business, we protect our employees, our communities and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop technologies that expand the sustainable capacity of our world. Our health, safety and environmental management systems reflect our values and help us meet our business objectives.

- We protect the safety and health of our employees, and minimize the environmental footprint of our operations through efforts to prevent illness, injury and pollution.
- We actively promote and develop opportunities for expanding sustainable capacity by increasing energy and water efficiency, improving security and safety, and reducing emissions of harmful pollutants.
- We are committed to compliance with all of our health, safety, environmental and legal requirements everywhere we operate.
- Our commitment to health, safety and the environment is an integral aspect of our design of products, processes and services, and of the lifecycle management of our products.
- Our management systems apply a global standard that provides protection of both human health and the environment during normal and emergency situations.
- We identify, control and endeavor to reduce emissions, waste and inefficient use of resources, including energy and water.
- We are open with stakeholders and work within our communities to advance laws, regulation and practices that safeguard the public.
- We abide by the company's own strict standards in cases where local laws are less stringent.
- Our senior leadership and individual employees are accountable for their role in meeting our commitments.
- We measure and periodically review our progress and strive for continuous improvement.

These are our commitments to health, safety, and the environment, and to creating Sustainable Opportunity everywhere we operate.

Darius Adamczyk
CEO

John Rajchert
President HBS

SMP Attachment 2: Honeywell Cardinal Rules

No Employee/Contractor may:

1. Engage in horseplay or conduct that endangers or injures employees, risks damage or actually does damage to company and/or customer property or the environment.
2. Bring into any company and/or customer site: firearms, explosives, or weapons of any type.
3. Bypass or operate equipment without guards, safety devices, or control equipment without following company and/or customer established procedures and protocols.
4. Disassemble, enter or perform servicing, changeover or maintenance on equipment without properly de-energizing and safeguarding all power sources according to the applicable lock-out/tag-out policy.
5. Violate a life safety permit procedure (confined space, hot work, line breaking and fall protection).
6. Knowingly place her/himself or another person in physical danger, conceal a safety hazard or unlawful chemical release to the environment, or fail to promptly obtain attention for a personal injury or chemical spill.
7. Possess or be under the influence of illegal drugs (not prescribed by a Physician of for their own use) or alcohol while on a customer site, company-owned and/or company-operated facility.

The actions listed above have been found to have such great potential for serious injury or damage that any employee that engages in such actions may be subject to discipline, up to and including termination from the company or removal from the project site, regardless of previous performance. This policy is intended to protect the employee and his/her co-workers.

All employees are expected to understand and adhere to these Cardinal Rules and to request assistance in questionable situations. Further, all employees are encouraged to question the safety and environmental performance of all operations and become involved in improving them.

Project Manager Signature: _____

SMP Attachment 3: Site Employee Contractor List

Badge #	Employer	Name	Phone Number	Supervisor

SMP Attachment 4: Contractor Safety Declaration & Work Authorization Form

Contractor Safety Declaration

As a duly authorized and designated representative and agent of_____, hereafter called "Contractor/Subcontractor", I hereby certify and agree for myself and for and on behalf of Contractor /Subcontractor:

I have visited the project site_____and visually inspected the general and local conditions which could affect the Contractor /Subcontractor Work. Any failure of the Contractor /Subcontractor to reasonably ascertain from a visual inspection of the site, the general and local conditions which could affect the Contractor /Subcontractor Work, will not relieve the Contractor/Subcontractor from its responsibility to properly complete the Contractor /Subcontractor Work without additional expense to Honeywell. In addition, I have read and agree to comply with all the Terms and Conditions as specified in the written contract.

1. I have already instructed or will immediately instruct all such agents and employees with respect to such conditions and/or hazards and the proper safety precautions to be observed in regard thereto;

2. I certify that all necessary, adequate and operative protective clothing and equipment have been or will be immediately issued to all such agents and employees, together with full instructions and training for their use at Contractor's cost;

3. I certify that all Honeywell Safety and Work Specific procedures as specified in the Honeywell Contractors Safety Guide, including those addressing employee personal protective equipment (PPE), Life Critical Tasks and tool and equipment requirements will be put into effect; and that all such agents and employees will be properly supervised to insure compliance in the use of PPE, procedures and equipment and in the strict observance of safety rules and regulations;

4. I certify that all such agents and employees have completed the identified and required training and that proof of such training has been submitted to Honeywell representative. If such identified training has not been completed I agree to complete such training as identified and required to a standard equivalent or exceeding Honeywell standards.

5. I certify that I will participate in the Honeywell program to observe and monitor all such agents and employees for compliance to specified Safety Procedures and work practices as defined or required by any and all governmental regulations and laws.

6. At a minimum, I certify that Contractor /Subcontractor employees have been trained and/or briefed for the following applicable programs (identified with x), in accordance with local laws/regulations,

__ General safety rules and regulations	_General protective clothing and equipment requirements
__ Specific safety requirements	
__ Confined space entry	_Lockout and tagout
__ Eye and face protection	_Line breaking
__ Hearing protection	_Excavation
__ Burning, welding and cutting	_Respiratory protection
__ Utility line hazards/precautions	x Honeywell Contractor HSE Guide
__ Chemical line hazards/precautions	_____
__ Workplace chemical hazards	_____
__ other (specify)	_____

Date: _____ _____

Signature of Contractor's/Subcontractor's Representative

Date: _____ _____

Signature of Honeywell Representative

Honeywell Use Only: **HID #:**

PRELIMINARY SAFETY DETAILS		*Honeywell Use Only: Work Authorization Form Expiry : (Max 12 months) HSE Signed:*			
Site		Contractor		Phone	
Name (PM responsible for the work)		Job / PO / SR Number			
Names of other workers		Honeywell Project Manager			
Scope of Work		Project Duration			
Location of Work					

1. Will you be using sub-contractors?	Yes □	No □	*You must inform the Honeywell Works Supervisor of all sub-contractors you intend to use.*	
2. Are all workers inducted to site & aware of first aid & emergency procedures?		Yes □	No □→	*If **No**, Do Not Proceed. Contact The Honeywell Project Manager*
3. Are workers familiar with the work area and specific hazards in the work area(s)?		Yes □	No □→	
4. Are tools, plant and equipment in good order (plant maintained, electrical equip. tagged, etc)?	No Plant/Tools□	Yes □	No □→	
5. Are workers aware of the safety requirements for the job & licensed where required?		Yes □	No □→	

If the Scope of Works changes Honeywell must be contacted prior to undertaking the new works

HAZARD ID, RISK ASSESSMENT & CONTROLS

Identify the Hazards ✓ **applicable**	**Assess the Risk** ✓ **applicable**	When assessing risks use these risk levels: Minor Potential for minor injury / first aid treatment; Moderate Potential for lost time injury / medical treatment; Major Potential for death or serious injury	
		Detail Risk Control Measures to Be Used	**Responsible Person**
□ Exposure to live electrical circuit	**Major*** □	List controls to eliminate or minimize risks.	List who is responsible for ensuring the controls are in place and are
□ Fall > 1.8m	**Moderate*** □	Refer to relevant procedure or JSA.	
□ Line Breaking	**Minor** □		
□ Confined Space Entry			
□ Asbestos			
□ Traffic / Mobile Plant			
□ Chemicals / Fumes / Dusts			
□ Noise / Vibration			
□ Public exposure to hazards			
□ Spill to Environment			
OTHER			

* *Detail Risk Controls & Responsibilities. Direct Authorisation required from the Honeywell Work Supervisor prior to commencing works.*

MANDATORY SAFETY PERMITS & SYSTEM ISOLATIONS

Safety Permits must be obtained and approved before commencing the following works. If not listed below use "other" section. (✓ applicable):

Other (not listed) — List any Risk Control Safety permits not listed below here.

□ Hot Works	□ Live Electrical	□ Confined Space Access	□ Line Breaking	□ Roof/Ceiling Access	□ Equipment Isolation	□ Fire / EVAC Impairment	□ Penetration in fire rating material

6. Will the work cause interruption/isolation of site utilities (water, gas, electricity)?	No □	Yes □→	*If **Yes**, contact the Honeywell Works Supervisor*
7. Will you need to isolate systems or services (medical gas, UPS, security, comms, etc)?	No □	Yes □→	
If Yes to Q7 or Q8, what is the extent and impact of the isolation(s) / interruption?			

CONTRACTOR DECLARATION

I confirm that all necessary Health, Safety and Environment protection measures and precautions as detailed in this form will be taken to ensure the health and safety of workers and others who may be affected by the work. I also confirm the workers undertaking this work are competent, and where required, licensed to carry out the tasks.

Contractor Signature		**Date**	

SMP Attachment 5: Safety Permit Applications (Contractor & Honeywell Employee)

The permits listed below are required when called for by a risk assessment or contractor work authorization and must be documented and kept with the SMP. Permits not included or shown below may still be applicable, as determined by the Honeywell PM. Contractors may also use their own permits if approved and accepted by Honeywell PM.

Line Breaking, roof/ceiling access, Equipment Isolation, Fire/EVAC Impairment, Penetration in Fire Rated Material, Others

(Click on images below for PDF file attachment)

Hot Work Permit


HONEYWELL HOT WORK PERMIT

WARNING! HOT WORK IN PROGRESS WATCH FOR FIRE!

BEFORE INITIATING HOT WORK, ENSURE PRECAUTIONS ARE IN PLACE!
MAKE SURE SPRINKLERS ARE IN SERVICE AND FIRE EXTINGUISHERS ARE READILY AVAILABLE!

A Hot Work Permit is required for all operations involving open flame or producing heat and/or sparks, to include, Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch-Applied Roofing, and Welding.

Instructions

Who, When, and Where?

Hot Work Being Done By:
☐ Honeywell
☐ Contractor

Phone

Customer Name/Job Number

Location/Building Area

Nature of Job/Object

Name of Person Doing Hot Work

Name of Fire Watch

I verify the above location has been inspected, the precautions checked on the Hot Work Checklist have been taken, and I authorize the work to proceed this day and authorize it to continue for this work.

Work Authorization obtained electronically via phone or fax?
Yes ☐ No ☐

Time Started | Time Finished | ☐ AM ☐ PM

Expiration Date | Expiration Time | ☐ AM ☐ PM

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

Signature of Fire Watch | Time Started

Signature of Fire Watch | Time Ended

Work area was monitored for 60 minutes following Fire Watch time and found fire safe.

Signature of Permit Authorizer (below) | Time Ended

Type of fire protection | Quantity
Dry Chemical Extinguisher
CO2 Extinguisher
Water Extinguisher
Hose, on valve at location
Other

☐ There are no safer ways of effectively/efficiently doing this job.

☐ Available Sprinklers, hose streams, and extinguishers are in service/operable.
☐ Hot Work Equipment in good repair

Requirements within a 35 foot (11m) "sphere" of work:
☐ Flammable liquids, dust, lint, and oil deposits removed
☐ Explosive atmosphere in area eliminated
☐ Floors swept clean
☐ Fans and conveyors isolated or shut down
☐ Combustible floors wet down, covered with damp sand or fire-resistant shields
☐ Remove other combustibles where possible. Otherwise protect with fire-resistant tarpaulins or metal shields
☐ All wall and floor openings covered
☐ Fire-resistant tarpaulins suspended beneath work

Work on walls/ceilings or enclosed equipment:
☐ Construction is noncombustible and without combustible covering or insulation
☐ Combustibles on other side of walls moved away
☐ Enclosed equipment cleaned of all combustibles
☐ Containers purged of flammable liquids/vapors

Fire watch/hot work area monitoring requirements:
☐ Fire watch will be provided during and for 30 minutes after work, including all coffee or lunch breaks
☐ Fire watch is supplied with suitable extinguishers, charged small hose
☐ Fire watch is trained in the use of this equipment and in sound alarm
☐ Include additional watch for adjoining areas, above, or below
☐ Monitor Hot Work area for 60 minutes after Fire Watch is completed (Max control time: 60 minutes)
☐ Monitoring of Hot Work area is guaranteed through smoke detection system, security cameras, security rounds or the presence of workers

Other Precautions- If these actions are required, Contact HSE For Approval Before Proceeding With The Work!

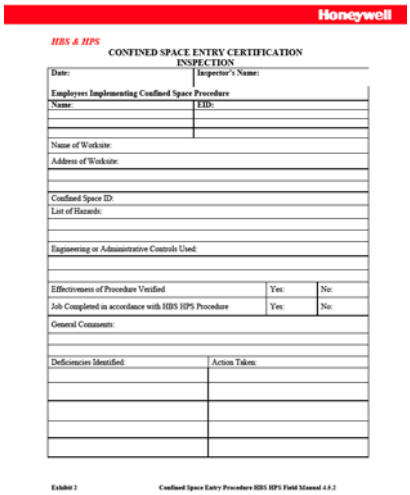
Initial/Time Actual Hot Work Initials

TIME | O2 (>21.5%) | FLAMM (<5%LEL) | INITIALS

☐ Breathing air provided at >19.5 % measured Oxygen
☐ Area smoke or heat detection has been disabled.
☐ Other

Return Completed Hot Work Permit to Honeywell HBS/HPS Office for Record Retention

Confined Space Permit & Cert.


Honeywell

HBS & HPS

CONFINED SPACE ENTRY CERTIFICATION INSPECTION

Date: | Inspector's Name:

Employees Implementing Confined Space Procedure

Name: | EID:

Name of Worksite:

Address of Worksite:

Confined Space ID:

List of Hazards:

Engineering or Administrative Controls Used:

Effectiveness of Procedure Verified | Yes: | No:

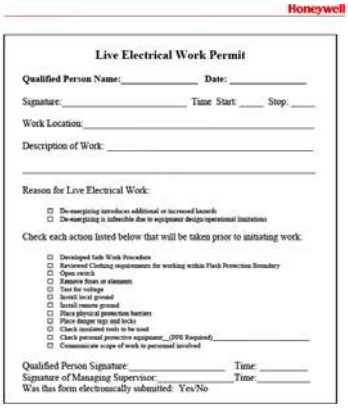
Job Completed in accordance with HBS HPS Procedure | Yes: | No:

General Comments:

Deficiencies Identified: | Action Taken:

Exhibit 1 Confined Space Entry Procedure HBS HPS Field Manual 4.0.2

Live Electrical Permit


Honeywell

Live Electrical Work Permit

Qualified Person Name:_____ Date: _____

Signature:_____ Time Start: ____ Stop: ____

Work Location:_____

Description of Work: _____

_____

Reason for Live Electrical Work:

☐ De-energizing introduces additional or increased hazards
☐ De-energizing is infeasible due to equipment design/operational limitations

Check each action listed below that will be taken prior to initiating work:

☐ Developed Safe Work Procedure
☐ Reviewed Clothing requirements for working within Flash Protection Boundary
☐ Open switch
☐ Remove fuses or elements
☐ Test for voltage
☐ Install local ground
☐ Install remote ground
☐ Place physical protection barriers
☐ Place danger tags and locks
☐ Check insulated tools to be used
☐ Check personal protective equipment (PPE Required)_____
☐ Communicate scope of work to personnel involved

Qualified Person Signature:_____ Time: _____

Signature of Managing Supervisor:_____ Time:_____

Was this form electronically submitted: Yes/No

Lockout/Tagout Permit


Honeywell

Multi Energy Source Equipment Specific Lockout/Tagout Procedure

LOCKOUT / TAGOUT

IDENTIFICATION

EMPLOYEE: | EQUIPMENT:

LOCATION: | ID NO:

DATE: | WORK ORDER OR IJOB #

ELECTRICAL

Isolation Measure | Location of Sources (include voltage and phase)

Unplug, lock/tag plug

Open circuit by disconnecting the power feed and lock/tag the feed

Disable circuit using breaker – lock & tag breaker in off position

Other (specify):

PRESSURE: (Identify source: air hydraulic)

Isolation Measure | Location (of supply valve, hose, etc.)

Disconnect supply hose, lock/tag, bleed

Close valve, lock/tag, bleed

Double block, lock/tag, and bleed supply line

Install blind, lock, tag, and bleed supply line

Other (specify):

STORED ENERGY (identify source: battery mechanical thermal other:_____)

Isolation Measure | Location and Description of Source

Cool, lock/tag

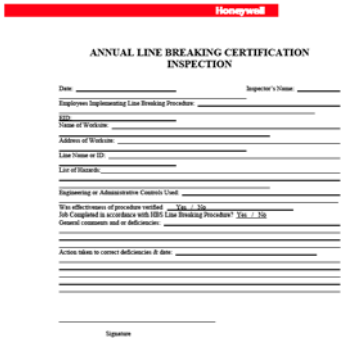
Insulate, lock/tag

Block and lock/tag

Disconnect battery, lock/tag

Supervisor Name _____

Line Breaking Permit & Cert.


Honeywell

ANNUAL LINE BREAKING CERTIFICATION INSPECTION

Date: _____ Inspector's Name: _____

Employees Implementing Line Breaking Procedure: _____

EID: _____

Name of Worksite: _____

Address of Worksite: _____

Line Name or ID: _____

List of Hazards: _____

Engineering or Administrative Controls Used: _____

Was effectiveness of procedure verified Yes / No

Job Completed in accordance with HBS Line Breaking Procedure? Yes / No

General comments and or deficiencies: _____

Action taken to correct deficiencies & date: _____

Signature

SMP Attachment 6: Incident Investigation Report – Filed per Occurrence

Part 1: BASIC INFORMATION (Complete and return to HBS HSE within 24 hours)		
Name of person reporting (if not the Supervisor)	Date of report	
Name and address of location	Region/Business Site Code (LID)	Supervisor's name Supervisor's telephone number

Claimant / Accident Information			
Full Name of injured party Employee ID #	Address of injured party Home phone: Work phone:		Is the injured party ☐ Male ☐ Female
	Employee's typical work schedule:		
Date of Hire Job title Employment status	Days worked ☐ Mon ☐ Tue ☐ Wed ☐ Thu ☐ Fri ☐ Sat ☐ Sun	Time begins/ends to work	Contractor? ☐ Yes ☐ No If YES, please complete: Name and address of Temporary Agency/ Contractor: Contact: Phone number:

Date of accident Time of Accident ☐ AM ☐ PM	Employer notified on what date	Name of place where incident occurred Address where incident occurred	Was there lost time? ☐ Yes ☐ No If yes, Last day worked
Briefly describe the incident			

Were authorities contacted? (police, fire, ambulance) ☐ Yes ☐ No If YES, who	Was a report number given? ☐ Yes ☐ No If YES, list number
Were any safeguards provided? ☐ Yes ☐ No Were they in use at the time of the incident? ☐ Yes ☐ No	
NATURE OF INCIDENT:	
TYPE OF INCIDENT:	
PART OF BODY:	

Medical Care Information	
Name and address of treating physician	Name and address of treating hospital/clinic
Phone number of treating physician	Phone number of treating hospital/clinic
Date employee first visited the doctor	What treatment was given (please check)
Describe diagnosis / medical treatment the doctor provided (List prescribed medications if any)	
Physical restrictions noted by the medical provider during the initial visit?	

Witness Information	
Name and address of a witness to the incident	Phone number where witness can be reached
Comments from witness Nº 1	
Name and address of a witness to the incident	Phone number where witness can be reached
Comments from witness Nº 2	
Anything related to the incident you would like to add	

Honeywell Internal

Part 2: INCIDENT INVESTIGATION (Complete & return to the HBS Regional HSE Leader within 5 days)	
Root Cause Analysis	
Why did the incident happen? (Direct Cause)	
Why did this occur? (Contributing Cause)	
Why did that occur? (Contributing Cause)	
ADDITIONAL COMMENTS:	
PRIMARY ROOT CAUSE:	
SECONDARY/CONTRIBUTING ROOT CAUSE(S)	
Please explain or if additional information is meaningful, please describe:	

List corrective and preventative actions:

Corrective Action	Responsible Person	Target Date	Completion Date

SMP Attachment 7: Safety Observation Form

SAFE OBSERVATION SYSTEM (SOS) REPORT FORM

A SOS is an unplanned event or condition that could have reasonably resulted in personal injury or illness, equipment or property damage, or an environmental excursion. Some examples include: Unsafe Conditions, Unsafe behavior, Events where injury could have occurred but did not, Events where property damage resulted or could have resulted, Events where a control measure was challenged or ignored.

1	SOS Title:						
2	Reporting Employee Name:			Employee EID:			
3	Name of Person responsible for closure:			Employee EID:			
4	Supervisor name:			Supervisor EID:			
5	Name of Contract	Contract Number		6	Address:		
7	Describe the SOS (what happened) / (Do *not use individual names if you have seen an unsafe practice)*:						
8	Honeywell HBS	9	Country: America	10	Region:	11	State:
12	Date SOS Observed:	DD/MM/YYYY					
13	Or select only one recommended time period for closing corrective action:	☐ One week ☐ Two weeks ☐ One month ☐ Three months ☐ Six months ☐ Twelve months					
14	Describe the corrective action:						
15	Date SOS to be closed (meet AOP goal):	DD/MM/YYYY					
16	Consequence of occurrence (select only one):	☐ Catastrophic (fatality) ☐ Major (hospitalisation) ☐ Serious (medical treatment/recordable) ☐ Minor (first aid) ☐ Negligible		17	Likelihood of Recurrence (select only one):	☐ Almost certain (>2 times/year) ☐ Highly likely (once per year ☐ Likely (once every three years) ☐ Unlikely (once every five years) ☐ Remote (once every ten years)	
18	Type of Hazard: (select only one):	☐ Contact in / between / under ☐ Contact with electricity ☐ Contact with sharp object ☐ Exposure to chemical (gas, dust, fume) ☐ Exposure to extreme temp. (hot/cold) ☐ Exposure to noise ☐ Exposure to low oxygen			☐ Fall from elevation ☐ Lifting / Repetitive Motion / Ergonomic exposure ☐ Liquid Splash / Contact struck against ☐ Slip / Trip / Fall (same level) ☐ Struck by ☐ Vehicle ☐ Another kind of hazard		
19	Type of SOS (select only one):	☐ Unsafe Behavior	☐ Unsafe Condition	☐ Incident with property damage		☐ Incident without property damage	
20	Location of Safety Observation (select only one):	☐ Manufacturing plant / Mill ☐ Honeywell Office ☐ Customer Office ☐ Hospital ☐ School ☐ Mechanical Room			☐ Laboratory ☐ Residence ☐ Warehouse ☐ Roof ☐ Computer Room / Control Room ☐ Vehicle ☐ Other		
21	Honeywell Risk Calculator (select only one):	☐ Major		☐ Moderate		☐ Minor	
22	Status:	☐ Open		☐ Closed			
23	Manager / Lead Signature:			Date:	DD/MM/YYYY		
	REMEMBER SAFETY IS EVERYONE'S RESPONSIBILITY						

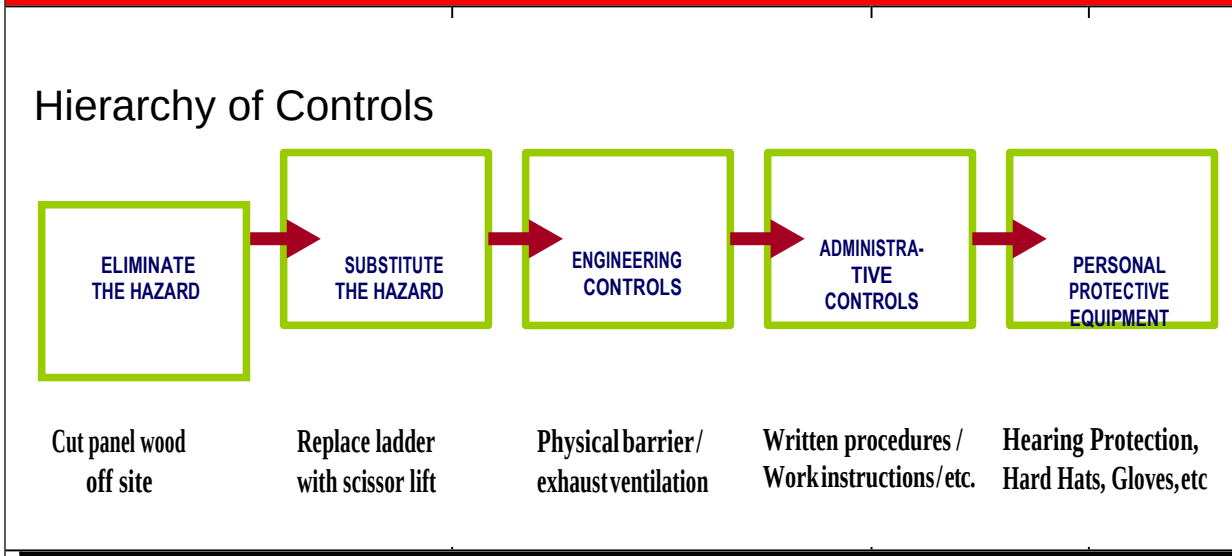
SMP Attachment 8: Hazard Assessment Site Inventory

The following table lists each of the completed contractor work authorization forms and risk assessments for the scope of work of this contract.

HID#	Description of Hazard, Location, Safety Permits Required	Original Date	Check which is applicable below		Review Date
			Contractor Authorization Form	Risk Assessment Form	
1	Vehicle Use	6/1/20	X	X	
2	Walking through a Construction Site	6/1/20	X	X	
3	Personal Protective Equipment (PPE)	6/1/20	X	X	
4	Crane Lift	6/1/20	X	X	
5	Hand and Power Tools	6/1/20	X	X	
6	Ladder Use	6/1/20	X	X	
7	Line Breaking	6/1/20	X	X	
8	Live Electrical Work	6/1/20	X	X	
9	Lockout Tagout	6/1/20	X	X	
10	Rigging	6/1/20	X	X	
11	Slips, Trips, Falls	6/1/20	X	X	
12	Storage of Materials Onsite	6/1/20	X	X	
13	Roofwork	6/1/20	X	X	
14	Installing/Replacing Luminaries				
15	Hot Work	6/1/20	X	X	
16	Mobile Working Platforms	6/1/20	X	X	
17	Lifting	6/1/20	X	X	
18	Non-permit Confined Space				
19	Industrial Vehicles	6/1/20	X	X	
20	Emergency Responses	6/1/20	X	X	
21					
22					
23					
24					
25					

SMP Attachment 9: Field Risk Assessment Form

FIELD RISK ASSESSMENT FORM CRITERIA / CALCULATOR



HONEYWELL RISK ASSESSMENT CALCULATOR

PROBABILITY / LIKELIHOOD	1. Negligible	2. Minor	3. Serious	4. Major	5. Catastrophic
5. Almost Certain	Medium	High	High	High	High
4. Highly Likely	Medium	Medium	Medium	High	High
3. Likely	Low	Low	Medium	Medium	High
2. Unlikely	Low	Low	Low	Medium	High
	Low	Low	Low		

Catastrophic
- ❑ Injury: Fatality of employees, contractors or the public. (Tier 1)
- ❑ Environment/Assets: Irreversible contamination of environment; Significant damage to building/equipment integrity.
- ❑ Public Relations: Significant public interest, national and/or international media involvement or significant impact on business reputation.
- ❑ Law and Permits: Federal regulatory intervention and/or regulatory fines greater then $5M to the company/unit; Government withdrawal of permits to operate the entire Honeywell unit or project.

Major
- ❑ Injury: Extensive injury or Hospitalization of employees, contractors or the public. (Tier 2)
- ❑ Environment/Assets: Reversible contamination of environment; Moderate damage to building/equipment integrity.
- ❑ Public Relations: Moderate public interest, regional media involvement or moderate impact on business reputation.
- ❑ Law and Permits: Regional/District/State regulatory intervention and or regulatory fines greater then $1M to the company/unit; Government suspension of permits to operate a project.

Serious
- ❑ Injury: Medical treatment of employees, contractors or the public. (Tier 2)
- ❑ Environment/Assets: Reversible small contamination of environment; Minor damage to building/equipment integrity.
- ❑ Public Relations: Some public interest, local media involvement or some impact on business reputation.
- ❑ Law and Permits: Local regulatory intervention and/or fines less then $1M to the company/unit; Customer suspension of some permits to a daily operation or written warning to Honeywell or project management.

Minor
- ❑ Injury: First-aid treatment or Safety Observation of an employee, contractor or a member of the public. (Tier 3)
- ❑ Environment/Assets: No contamination of environment, no breach of law and no damage to building/equipment integrity.
- ❑ Public Relations: Little public interest, local media involvement or little impact on business reputation.
- ❑ Law and Permits: No suspension of permits to operate, continue daily operations, verbal warning to Honeywell or project management.

Negligible
- ❑ Injury: No injury.
- ❑ Environment/Assets: No impact.
- ❑ Public Relations: No public interest, local media involvement or no impact on business reputation.
- ❑ Law and Permits: No impact.

Almost Certain
5. Occurred or likely to occur many times.

Highly Likely
4. Occurred or likely to occur several times.

Likely
3. Occurred or likely to occur once.

Unlikely
2. Might occur or likely to occur.

Remote
1. Rarely occurs.

RISK ASSESSMENT GUIDELINES

In most instances, moderate and major risks to health and safety can be adequately managed using site specific safe systems of work. For example, if a safety harness is specified as the control measure for working at height the risk assessment form should specify the pre-use inspections, selection of proper anchorage points, training of wearers, rescue of a suspended worker, etc.

For work with plant and substances consideration must be given to any safety recommendations of the manufacturer (e.g. the MSDS).

The actual workers performing the task should participate in all steps of the risk assessment process. It is crucial that the workers involved in the activity have input in the development and review of the safety measures.

Remember.
1. The risk assessment provides a written record of the process to be used to carry out a task safely. To demonstrate mutual understanding, it should be signed off by the parties who have responsibility for the tasks.
2. Management processes must be in place to ensure workers are competent and have the skills to complete the job and that there is a required level of supervision to ensure the tasks are completed as documented.
3. The risk assessment should be completed by all employees involved in the activity, not just the principal contractor or supervisor.

Describe the Site and the Scope of Work (Job Task)

The risk assessment should contain a brief description of the scope of work, location, supervisor, contractors, date & revision date where relevant.
Details of the specific area where the work is to be performed should also be included with the site details (e.g., building 1, phase 1 etc)

Document the Hazards that Make up the Scope of Work (Job Task)

In consultation with the persons performing the work, write down the hazards required to perform the scope of work/job task in the order to be carried out.
Details of the equipment and tools to be used should also be included. (e.g., fixing cabling to metal frame in roof space using an explosive powered ramset gun).

Identify Harm from Exposure to the Hazard

For each hazard, identify the harm/injury that may be caused from exposure to the hazard (s) to those engaged in the task or to others in the vicinity. For example, the main hazards from drilling concrete include exposure to hazardous silica dust, flying debris, high torque of tools and noise. The respective consequences would typically include respiratory damage, hearing damage, eye damage, sprains or cuts.
Pay particular attention to the use of plant and power tools to ensure that all safety hazards are identified.
For mobile plant check the general plant risk assessment record/Work instructions, as this will provide specific information on potential hazards associated with the plant.

Document all the Existing Risk Control Measures Associated with the Hazard to Eliminate / Reduce Risk

List all the control measures required to eliminate or minimise the risk of injury from the identified hazard (Refer to relevant Honeywell HSE Procedures). Control measures include training, instructions, information and supervision. For each hazard assess the foreseeable level of risk using the Honeywell risk assessment calculator.

Also include cross reference in the control measure column to any other risk assessments undertaken as part of the task, by referring to relevant hazard assessed (i.e. manual handling of ladders).

Risk Control Measures

Risk control measures should be selected in consultation with the relevant workers, making reference to the Honeywell HSE procedures where applicable. It may be necessary to seek advice from persons with safety training, working experience & the relevant Safety Advisor to identify the most appropriate control measure.
When selecting control measures consider:

- All persons that may be affected by the hazard, not just those involved in performing the task.
- The actual work practices on site.
- How often and for how long people are exposed to the hazard.
- The experience of workers doing the task.
- Safe work methods available and their effectiveness.
- The degree of safety training & instruction required (e.g. Safety inductions, safe work procedures, PPE use, use of MSDS's or the amount of supervision required).

Document Risk Level

Using the Risk Calculator, perform a risk assessment: evaluate the potential severity and probability (1, 2, 3, 4 or 5) of an incident for each hazard associated with the task.

Use the Risk Matrix to establish the risk ranking for each Task and Hazard; based on the Severity and Probability of an event, determine Low, Medium or High risk
Low Risk (green): Adhere to current hazard controls
Medium Risk (yellow): Control plan requires cell supervisor approval. Task should only proceed once the controls are in place
High Risk (red): Control plan must be reviewed and approved by the supervisor and site HSE. Work should not proceed until all the controls are in place and verified. High risk tasks must also be added to site Risk Assessment tool. Activities should take place to lower risk classification.

List in priority order any additional control measures required to eliminate or reduce the hazard to the lowest exposure level possible relevant to the Hierarchy of Control.

Hierarchy of Risk Control Measures

Select control measures from the highest level practicable in levels 1 to 5 below, e.g., first try to eliminate the hazard, as this gives the best result. The measures at the lower levels are less effective and require training of workers plus frequent review of the hazards and systems of work. In some situations a combination of control measures may need to be used.
1 - Eliminate the hazard
Discontinue the activity or stop using the plant, tool or substance where practicable.
2 - Substitute the hazard
Use something safer or change the system of work
3 - Engineering controls
Use guards, fencing, safety screens, etc to separate workers from the hazard, use dust extractors on tools or exhaust ventilation to reduce dust
4 - Administrative controls.
e.g. specific worker instructions or procedures.
5 - Personal protective equipment (PPE).
Only when level 1 - 4 control measures have been considered and applied to the highest extent practicable, any remaining risk may be reduced by using PPE such as safety harness, eye protection, hearing protection, etc.

Any specific training, permits and information needed to carry out the task safely should also be noted (e.g. work at height training).

Identify Who Is Responsible

Document the names of the person's responsible for implementing the control plan (additional controls/information) to lower the risk level.

Monitor and Review the Risk Assessment

Make sure the work is supervised to ensure that the work is carried out as documented in the risk assessment.
Review the risk assessment if conditions, location, etc of the work change or after an appropriate length of time. Consider also:

- Whether the control measures are suitable for the task.
- The degree of support it has amongst the employees concerned.
- The effectiveness of control measures.

Designated Major Risk Tasks

Major risk work includes, but is not limited to:

- Unprotected work at heights >1.8 meters / 6 feet, particularly on roofs.
- Working on ladders above 1.8 meters / 6 feet.
- Entering confined spaces.
- Live electrical works.
- Working with mobile plant and machinery.
- Working near power lines.
- Working with elevating work platforms and cranes.
- Trenching and excavation.
- Work on or near gas mains or electricity supplies.
- Working with/near asbestos or lead or their removal.
- Demolition.
- Using certain hazardous substances including carcinogens.

Assessing and Reviewing Subcontractor Risk Assessments

The team leader/project manager or their delegated representative should ensure that the adequacy of subcontractor risk assessments and any associated safety documents and instructions are assessed prior to commencing work. In assessing subcontractor risk assessments consider the following:

- Compliance with Honeywell's policies and procedures.
- Has the recommended process been followed to develop the risk assessment?
- Are foreseeable significant hazards and risks to health and safety identified in relation to the nature of the works, including plant, tools and equipment used?
- Are risk control measures adequate and in line with the hierarchy of controls?
- Are all legislative requirements satisfied?
- Has the subcontractors inducted their workers into their own risk assessment?
- Is there adequate provision for supervision to ensure control?

[CLICK HERE FOR LINK TO PRE-POPULATED RISK ASSESSMENTS/SAFE WORK PROCEDURES]

FIELD RISK ASSESSMENT FORM

ASSESSMENT NO:

SITE LOCATION:

SCOPE OF WORK (JOB TASK):

PERMIT TO WORK REQUIRED? Yes ☐ No ☐

PERSON POTENTIALLY EXPOSED:

	ALL STAFF		CONTRACTORS		
	STAFF MEMBER PERFORMING JOB ONLY		VISITORS		
	MEMBERS OF THE PUBLIC		OTHER (SPECIFY)		

DURATION OF EXPOSURE:

	UNDER 5 MINUTES		6-15 MINUTES
	16-30 MINUTES		31-45 MINUTES
	46 MINS -1 HOUR		1 HOUR OR MORE

FREQUENCY OF JOB:

	CONTINUOUS/ ONGOING
	NO OF TIMES PER WEEK
	NO OF TIMES PER MONTH

HONEYWELL RISK ASSESSMENT CALCULATOR

Severity / Consequence

Probability/ Likelihood	1. Negligible	2. Minor	3. Serious	4. Major
5. Almost Certain	Medium	High	High	High
4. Highly Likely	Medium	Medium	Medium	High
3. Likely	Low	Low	Medium	Medium
2. Unlikely	Low	Low	Low	Medium
1. Remote	Low	Low	Low	Medium

JOB HAZARD EXPOSURE OR DETAILED HAZARD AND HARM *List each of the hazards associated with the scope of work in the sequence they are encountered including possible harm and effects.*	**RISK** LOW / MEDIUM /HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	**RISK CONTROL MEASURES / SPECIAL PERMIT REQUIREMENTS** *List the control measures required to eliminate or minimise the risk of injury from the identified hazard (Refer to relevant Honeywell HSE Procedures)*	**RISK** LOW / MEDIUM /HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	**ASSIGN RESPONSIBILITY** *Write the name of the person responsible (supervisor or above): implement the control measures identified.*

I have read and understood the content of this RISK ASSESSMENT and agree to follow the requirements as outlined or alternatively contact the responsible Honeywell supervisor to revise the agreement

This risk assessment is written and approved at an administrative level. This approval does not imply that the risk assessment is a comprehensive and accurate document. Any subsequent use of the risk assessment makes it implicit upon the user to verify the accurate sequence of events, potential hazards, risks and controls.

RISK ASSESSMENT AUTHOR (PRINT NAME)	**AUTHOR'S SIGNATURE**	**ASSESSMENT DATE**
MANAGERS NAME (PRINT NAME)	**MANAGER'S SIGNATURE**	**ASSESSMENT REVIEW DATE**

EMPLOYEE SIGNATURES

FIELD RISK ASSESSMENT FORM

ASSESSMENT NO:	

SITE LOCATION:	SCOPE OF WORK (JOB TASK):	PERMIT TO WORK REQUIRED? Yes ☐ No ☐

PERSON POTENTIALLY EXPOSED:				DURATION OF EXPOSURE:				FREQUENCY OF JOB:	
	ALL STAFF		CONTRACTORS		UNDER 5 MINUTES		6-15 MINUTES		CONTINUOUS/ ONGOING
	STAFF MEMBER PERFORMING JOB ONLY		VISITORS		16-30 MINUTES		31-45 MINUTES		NO OF TIMES PER WEEK
	MEMBERS OF THE PUBLIC		OTHER (SPECIFY)		46 MINS -1 HOUR		1 HOUR OR MORE		NO OF TIMES PER MONTH

HONEYWELL RISK ASSESSMENT CALCULATOR

Severity / Consequence

Probability/ Likelihood	1. Negligible	2. Minor	3. Serious	4. Major
5. Almost Certain	Medium	High	High	High
4. Highly Likely	Medium	Medium	Medium	High
3. Likely	Low	Low	Medium	Medium
2. Unlikely	Low	Low	Low	Medium
1. Remote	Low	Low	Low	Medium

JOB HAZARD EXPOSURE OR DETAILED HAZARD AND HARM *List each of the hazards associated with the scope of work in the sequence they are encountered including possible harm and effects.*	RISK LOW / MEDIUM/HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	RISK CONTROL MEASURES / SPECIAL PERMIT REQUIREMENTS *List the control measures required to eliminate or minimise the risk of injury from the identified hazard (Refer to relevant Honeywell HSE Procedures)*	RISK LOW / MEDIUM/HIGH *Using the Honeywell Hazard & Risk Matrix list the risk level against each hazard*	ASSIGN RESPONSIBILITY *Write the name of the person responsible (supervisor or above): implement the control measures identified.*

EMPLOYEE NAME (PRINT NAME)	EMPLOYEE SIGNATURE	DATE	EMPLOYEE NAME (PRINT NAME)	EMPLOYEE SIGNATURE	DATE

SMP Attachment 10: Orientation Form (Completed at Project Construction Kick-off)

Employee/Contractor:…… Contract: …… Date……...

Honeywell Representative:…….

Please tick ✓	Yes	No	Comments
• Honeywell/Customer HSE Policy	☐	☐	
• Discuss (or provide copies) of relevant Honeywell and/or Customer HSE procedures	☐	☐	
• Discuss/provide copy of Contractor HSE guidelines	☐	☐	
• First Aid arrangements	☐	☐	
• Location of hazardous materials listed in Hazardous Materials Register	☐	☐	
• Emergency Procedures	☐	☐	
• Evacuation Procedures	☐	☐	
• HSE Risk Assessment Worksheet	☐	☐	
• Reviewed Health and Safety Plan	☐	☐	
• Site Entry/Access requirements	☐	☐	
• Specific Training for special Area/Tasks (list below)	☐	☐	
• Works Authorization Form requirements	☐	☐	
	☐	☐	
	☐	☐	

I have completed the Orientation & Training as required for this Contract and agree to follow the guidelines and procedures as outlined in these courses.

Name	Signature	Name	Signature

SMP Attachment 10: (Completed by ALL Contractor/HW Employees prior to construction start)

I have read and understand the Risk Assessments, completed Site Orientation & Safety training as required for this Contract at (enter project name) and agree to follow all guidelines to work safely			
Print Name	**Signature**	**Company**	**Date**

SMP Attachment 10: (Completed by ALL Contractor/HW Employees prior to construction start)

I have read and understand the Risk Assessments, completed Site Orientation & Safety training as required for this Contract at (enter project name) and agree to follow all guidelines to work safely			
Print Name	**Signature**	**Company**	**Date**

SMP Attachment 11: Training Register

The following table lists the Site Specific training requirements that must be completed prior to working on the project site. These training procedures were identified as a result of the completed hazard and risk assessments observed at the contract site. All employees and contractors must be familiar with the required training for this project and agree to follow these procedures for the entire duration of the project.

Training Register				
#	Training Requirement	Contract Required (yes or no)	Who is to Complete	Comments
1	Customer orientation	Yes	Honeywell Employees	
2	Honeywell Safety Awareness / Orientation	Yes	Honeywell Employees	
3	Asbestos Awareness	Yes	Honeywell Employees	
4	Bloodborne Pathogen Awareness			
5	Canine Awareness			
6	Cold Weather Safety			
7	Compressed Gas Awareness			
8	Confined Space Awareness	Yes	Honeywell Employees	
9	Confined Space Entry – advanced training required	Yes	Honeywell Employees	
10	Cranes & Slings	Yes	Honeywell Employees	
11	Driver Safety	Yes	Honeywell Employees	
12	Electrical Arc Flash Awareness	Yes	Honeywell Employees	
13	Electrical Safety General Awareness	Yes	Honeywell Employees	
14	Emergency Preparedness Plan (Customer)			
15	Environmental Hazard	Yes	Honeywell Employees	
16	Eye & Face Protection	Yes	Honeywell Employees	
17	Fall Protection	Yes	Honeywell Employees	
18	Fire Extinguisher Usage	Yes	Honeywell Employees	
19	Hand & Power Tool	Yes	Honeywell Employees	
20	Hazard Communication	Yes	Honeywell Employees	
21	Hearing Protection	Yes	Honeywell Employees	
22	Hot Work Permit	Yes	Honeywell Employees	
23	Ladder Safety	Yes	Honeywell Employees	
24	Laser Safety			
25	Lead Safety	Yes	Honeywell Employees	
26	Line Breaking	Yes	Honeywell Employees	
27	Lock Out/Tag Out	Yes	Honeywell Employees	
28	Machine Safeguarding			
29	Management of Change	Yes	Honeywell Employees	
30	Manual Material Handling / Back Safety	Yes	Honeywell Employees	
31	Office Ergonomics	Yes	Honeywell Employees	
32	Personal Protective Equipment	Yes	Honeywell Employees	
33	Powered Industrial Trucks	Yes	Honeywell Employees	
34	Process Safety Management			
35	Refrigerant Management	Yes	Honeywell Employees	
36	Respiratory Protection	Yes	Honeywell Employees	
37	Safety Observation System (SOS)	Yes	Honeywell Employees	
38	Safe Operations Management (SOM)Training	Yes	Honeywell Employees	
Below list other customer specific training requirements, if applicable.				
1				
2				

Honeywell Internal

SMP Attachment 12: Field Safety Checklist

Form completed by _____ Date_____

Honeywell requires a Field HSE Check List be maintained onsite for all current or new projects. It is to be performed prior to starting work during the initial site visit. Hazards identified are to be communicated to all personnel working at the site and referenced during future visits.

Original Date: _____ Revision Date: _____
Contractor(s): _____
Customer Name: _____ Customer Contact: Address:
Telephone No: _____ Customer HSE Rep: Phone:

1. Scope of work summary:

2. Personal protective equipment required on site?

	NO	YES (Honeywell)	YES (Contractor)	
Fall Protection?	☐	☒	☒	
Hard Hat?	☐	☒	☒	
Safety Glasses?	☐	☒	☒	
Hearing Protection?	☐	☒	☒	
Safety Shoes?	☐	☒	☒	
Protective Clothing? (specify)	☒	☐	☐	
Respiratory protection? Explain:	☐	☐	☒	

3. Safety hazards encountered at customer's facility (Check and explain plans for addressing the hazard).

Check for Yes	Safety Hazard	Name of Contractor / Personnel Performing Work	Plans to Address: Risk Assessment or Contractor Work Authorization
☒	Construction environment		Risk Assessment
☐	High or low temperature materials or equipment		
☒	Welding		Risk Assessment
☐	Laser equipment		
☐	Confined space or isolated work area		
☒	Overhead operations		Risk Assessment
☒	Work at heights requiring a ladder, lift platform or basket; who provides the equipment and has appropriate training been completed?		Risk Assessment
☐	Are there areas where the following conditions are present: Oxygen deficient atmosphere, toxic gases, vapors, fumes, mists, dusts, lead, mercury?		
☐	Known or suspected carcinogens including asbestos		
☐	Potential exposure to biohazards		
☐	Explosive or highly combustible materials		
☐	Excessive noise levels (signage identifies area)		
☐	High voltage (480 volts or greater) in the work area		
☐	Radiation sources		
☐	Ergonomics: excessive bending/stooping, cramped space		
☒	Slippery surfaces		Risk Assessment
☐	Open pits, vats, trenches		
☐	Material handling requiring hoists, cranes, rigging, forklifts?		
☐	Raw or partially treated sewage		
☐	High pressure equipment		
☐	Unguarded machinery		
☐	Hot work permits required		
☒	Lockout/tagout permits required		Risk Assessment
☒	Emergency evacuation		Risk Assessment
☒	Special parking or security requirements		Risk Assessment
☐	Customer hazard communication requirements		
☐	Process safety management requirements		
☐	Applicable MSDS's available; if no, who obtains them		
☐	Other hazards		

4. Specific safety considerations necessary to abide with customer's safety procedures. Building access

5. Have all employees been briefed on the customer's site emergency response and evacuation plans & how will employees be accounted for in the event of an emergency? Yes

6. Does the customer have a drug/alcohol policy for contractors and does it include drug testing? No

7. Have the employees assigned to this project received appropriate safety training to prepare them for safety issues identified? Yes

Complete, Sign and review on first visit or after work order changes. Revise annually. Review, sign & date:

Honeywell Manager	Employee\Contractor	Customer Representative (Optional)

SMP Attachment 13: Behavioral Observation Checklist (HW Employee Monitoring)

Utilize the Behavior Observation Checklist to identify both safe and at risk conditions in the work environment. After observation provide feedback to the employee for both safe and at risk observations. All at risk observations must have comments to identify corrective action or explanation. Only respond to questions that apply to the task

1. Observer

Report Observer Name

Observer EID

2. Observed

Observed Name

Observed EID

3. Task performed by Employee:_____

(4) Select SBU: HBS or HPS	(5) Select Pole (Americas or EMEA or AP):	(6) Region within Pole:	(7) State/District /Branch within Region:

(8) Location of Behavior Observation (select only one):

- ☐ Manufacturing plant / Mill
- ☐ Honeywell Office
- ☐ Customer Office
- ☐ Hospital
- ☐ School
- ☐ Mechanical Room
- ☐ Laboratory
- ☐ Residence
- ☐ Warehouse
- ☐ Roof
- ☐ Computer Room / Control Room
- ☐ Vehicle
- ☐ Other

(9) Date BOC Observed: DD/MM/YYYY

SAFE PATH OF TRAVEL			
Uses designated walkways to access work area	SAFE	AT RISK	N/A
Has clear view of path to travel	SAFE	AT RISK	N/A
PERSONAL PROTECTIVE EQUIPMENT (PPE)			
Head Protection	SAFE	AT RISK	N/A
Eye/Face Protection	SAFE	AT RISK	N/A
Hand Protection	SAFE	AT RISK	N/A
Foot Protection	SAFE	AT RISK	N/A
Respiratory Protection	SAFE	AT RISK	N/A
Electrical Protection	SAFE	AT RISK	N/A
Personal gas detector	SAFE	AT RISK	N/A
SAFE MOTOR VEHICLE OPERATION			
Does not use any mobile device while driving	SAFE	AT RISK	N/A
Secures equipment for safe transport	SAFE	AT RISK	N/A
Vehicle properly maintained	SAFE	AT RISK	N/A
Parking brake engaged when parked	SAFE	AT RISK	N/A
BODY POSITIONING DURING TASK			
Uses knees to lift not back	SAFE	AT RISK	N/A
Use knee pads when kneeling	SAFE	AT RISK	N/A
Watches hand placement / Keeps eyes on task	SAFE	AT RISK	N/A
Avoids pinch points or “line of fire” hazards	SAFE	AT RISK	N/A
Note: Line of fire: Struck by/against, caught in /between/under			
LADDERS			
Properly stores ladder on vehicle	SAFE	AT RISK	N/A
Ladders inspected prior to use	SAFE	AT RISK	N/A
Right ladder (step/extension) for the job	SAFE	AT RISK	N/A
Three points of contact at all times	SAFE	AT RISK	N/A
Does not use ladders in wet conditions	SAFE	AT RISK	N/A
Uses tool belt/back pack to carry tools	SAFE	AT RISK	N/A

PRE-JOB PLANNING			
Identifies all hazards in the work environment	SAFE	AT RISK	N/A
Conducts risk assessment using the risk calculator for	SAFE	AT RISK	N/A
Low / Medium or High Risks	SAFE	AT RISK	N/A
Obtains Work Permit where required	SAFE	AT RISK	N/A
Implements controls prior to starting work	SAFE	AT RISK	N/A
Communicates job activities with customer or team	SAFE	AT RISK	N/A
TOOLS			
Tools properly maintained	SAFE	AT RISK	N/A
Lock out, tag out properly applied	SAFE	AT RISK	N/A
Verifies zero energy after lock out	SAFE	AT RISK	N/A
Proper use of tools/ Uses right tool for the job	SAFE	AT RISK	N/A
Inspects tools before use	SAFE	AT RISK	N/A
INCLEMENT WEATHER			
Drinking plenty of fluids	SAFE	AT RISK	N/A
Taking rest breaks	SAFE	AT RISK	N/A
Uses ice cleats for icy conditions	SAFE	AT RISK	N/A
WORK ENVIRONMENT			
Keeps work area clean / free of trip hazards	SAFE	AT RISK	N/A
Checks work area for bees, wasps, snakes, etc	SAFE	AT RISK	N/A
HAZARD/INCIDENT REPORTING			
Reports Safety Observations	SAFE	AT RISK	N/A
Knows how to report injuries	SAFE	AT RISK	N/A
OTHER CRITICAL BEHAVIORS OBSERVED			
_____	SAFE	AT RISK	N/A
_____	SAFE	AT RISK	N/A

Describe At Risk Behavior:
Describe Safe Behavior:

Corrective action entered into SOS: Yes: **No:** **SOS Number:**

Manager / Lead Signature **Date** DD/MM/YYYY

SMP Attachment 14: Contractor Performance Safety Checklist (Contractor Audits)

Contractor Performance Safety Checklist

Site location:		**Location of work**		
Auditor:		**Date and time**	**Date**	**Time**
Details of work being undertaken				
Contract Number or Name				
Name of contractor				

Observed health and safety standards			**Comments**
(i) Have all contractor and sub contractor staff attended a site safety orientation course and received required HSE training?	Yes	No	
(ii) Have all contractor and sub contractor staff aware of the sites emergency procedures?	Yes	No	
(iii) Have all contractor and sub contractor staff been aware of what to do in the event of an accident and/or safety observation? (speak to contractor staff)	Yes	No	
(iv) Has the contractor made adequate first aid provision?	Yes	No	
(v) Have safety observations been submitted to Honeywell on a periodic basis?	Yes	No	
(vi) Are the contractor and sub contractor risk assessments, safe work procedures, method statements, HSE procedures, and permits to work being followed?	Yes	No	
(vii) Has required PPE, e.g. hard hats, safety boots, etc. been provided according to the risk assessment and is it being worn?	Yes	No	
(viii) Has the contractor implemented life critical control measures for fall protection, electrical safety, arc flash, and permit confined spaces?	Yes	No	
(ix) Where applicable are the contractor works securely fenced off or otherwise protected from the public, staff, etc?	Yes	No	
(x) Is the contractor maintaining a safe work area and implementing good housekeeping standards, including safe egress to roads, aisles, stairs, etc.?	Yes	No	
(xi) Is the contractor holding regular tool box talks with employees?	Yes	No	
(xii) Other observations			

Auditor: *I hereby declare that I have completed health and safety monitoring on the contractor named above*

Name (capitals)		Signature			
Job Title		Time		Date	
Contractors representatives name		Signature		Date	
Site managers name		Signature		Date	

SMP Attachment 15: Vehicle, Tool, & PPE Inspection Checklist (Honeywell Employees)

EMPLOYEE NAME:	VEHICLE #:
SUPERVISOR NAME:	VEHICLE MILEAGE:
LOCATION ID# VEHICLE ASSIGNED:	INSPECTION DATE (MM/DD/YY):

	Insp	Test	Items	OK	DEV	N/A	Deviations: Enter a brief description of deviation, action taken, and date corrected
VEHICLE SAFETY ITEMS	x		**Housekeeping -** vehicle, tools, and equipment are neat and orderly, items in driver compartment are adequately secured	X			
	x		**Ladder racks** - in good condition, hardware intact, operates easily, ladders secure			X	
	x		**Exterior/Body damage** - exterior clean and in good condition (note all damage including scratches, dents, etc.)	X			
	x	x	**Lights** visible and operational - headlights (low & high beam), tail lights, brake lights, emergency flashers, other lights	X			
	x	x	**Windshield washer system/wipers/fluid** - operating properly, good condition, appropriate fluid level	X			
	x	x	**Seatbelt** - available and in good condition	X			
	x		**Glass & mirrors** - clean, no cracks or pits in areas that obstruct driver's view, mirrors securely mounted, properly positioned	X			
	x	x	**Tire Condition and Pressure** - appropriate tire wear and pressure (including spare)	X			
	x	x	**Fluid levels -** verify that oil is full, no fluid leaks	X			
	x	x	**Tire Condition and Pressure** - adequate tread depth and appropriate tire wear, proper pressure (including spare)	X			
	x	x	**Brakes** - operating properly (per driver's verbal report), verify that emergency brake operates properly	X			
	x	x	**Doors & locks** - door catches and handles work properly, locks work properly and can be secured	X			
	x		**Fire extinguisher** - mounted within vehicle, gauge needle in "green" zone or otherwise indicates "full"	X			
	x		**First aid kit** - vehicle kit available and adequately stocked	X			
	x		**Chocks and cones -** available, as needed			X	
	x		**Vehicle registration, insurance card, driver's license, Honeywell driver's guide, fuel card** -present, current, available for appropriate vehicle	X			
LADDERS & FALL	x		**Ladders** - Rungs, rails, hardware, rope in good condition. Appropriate ladder size and type available (non-conductive ladder available when electricity could be encountered)			X	
	x		**Fall protection equipment** - harness, lanyard, anchoring equipment inspected and in good condition. Complete system from same manufacturer. Harness and lanyard stored properly (without twisting, bending, away from chemicals and direct sunlight). Replaced according to manufacturer guidance.			X	
PPE	x		**Eye protection** - readily available, clean, in good condition	X			
	x	x	**Hard hat** – in good condition, no cracks or dents. Cradle system intact and in good condition. Clean surface.	X			
	x		**Hand and foot protection** - available and in good condition	X			
	x		**Hearing protection** – appropriately selected, clean, in good condition, stored properly	X			

	x	x	**Respiratory protection** - appropriately selected, in good condition, stored properly	X			
TOOLS & EQUIPMENT	x		**Power tools** - in good condition; cords, plugs, prongs present and good condition; grounded or double insulated; no broken pads; guards in place; removed from service/replaced promptly if poor condition detected			X	
	x		**Pneumatic tools** - hose/whip secured to tool by positive means (to prevent tool from being accidentally disconnected); safety clips or retainers used on impact/percussion tools			X	
	x		**Hand tools** - Good condition, no mushroomed heads, no broken or cracked parts; removed from service/replaced promptly if poor condition			X	
	x		**Fuel-powered tools/equipment** - good condition; stored so as to prevent spilling of fuel during transport; when in use in enclosed spaces, measures are taken to prevent build-up of gases and fumes; stopped for refueling, service, and maintenance			X	
ELECTRICAL	x		**Extension cords** - cord and plugs in good condition (no cracks, cuts, or tape), prongs intact, cord is grounded or double-insulated (and/or GFI available)			X	
	x		**Lockout/Tagout** - appropriate devices available (locks, tags, hasps, etc.), appropriate variety available for job conditions			X	
	x	x	**Amp Meter** - clean, no damage, proper storage, good working order, test battery			X	
COMPRESSED	x		**Torches, hoses, regulators** - fittings in good condition, no leaks, auto shut-off tested, hoses & connections designed for pressure and service to which subjected; equipped with backflow prevention or flash arrestor			X	
	x		**Gas cylinders** - turned off, stored upright with caps in place, secured (to prevent tipping), properly labeled, used with appropriate PPE, regulators and torches removed and/or disconnected from cylinders when not used			X	
	x		**Personal Protective Equipment for Hot Work** (i.e. face shield, body protection, etc.) - protective equipment available and in good condition			X	
MISCELLANEOUS	x		**Outdoor/inclement weather supplies & equipment** - appropriate supplies available for hazards encountered (i.e. drinking water/fluids, snow/ice management equipment {sand, shovels, etc.], insect spray [di-electric spray required if working near electricity], sunscreen, etc.)			X	
	x		**Chemicals** - only "approved" chemicals used, all containers properly labeled, containers stored properly (secured). Material Safety Data Sheets (MSDS) on file at HON office. If refrigerant is distributed, logs are available and up-to-date.			X	
	x		**Hand lines and ropes** - no cuts, abrasions, decay, burns, signs of wear			X	
	x		**Portable blowers** - in good condition, proper ratings on blower, proper set-up and use (test)			X	
	x	x	**Air monitoring equipment (for confined space entry)** - appropriate for job conditions and hazards potentially encountered, in good condition and functioning properly, test/calibrate equipment according to requirements, appropriate calibration gases and test kit available			X	
	x	x	**Electrical insulating gloves (for electrical hot work) -** if used and available, ensure appropriate class/type for use, verify current inspection/test date stamp rubber protective layer (w/in past 9 mos.), stored in bag with fingers upright, stored away from direct sunlight in dedicated bag			X	
	x		**Electrical mats/barriers** - Mats and barriers in good condition, no tears, rips or holes. Appropriate for hazards encountered.			X	
	x		**Gasoline** - stored in approved flammable liquid container with self-closing lid, flame/flash arrestor. Stored to prevent tipping. Maximum capacity stored less than 5 gallons.			X	
	x		**Heaters** – equipped with proper shut-off (tip over protection), use only approved heaters in good condition.			X	
	x		**Permits** - verify adequate supply of required permits (Hot Work, Live Electrical, Permit-Required Confined Space Entry, etc.)			X	

Honeywell Internal

SMP Attachment 17: Emergency Response Plan

HBS Facilities Emergency Response Plan



Honeywell Business Unit:	Honeywell Energy Services Group
Street Address:	115 Tabor Road
City, State, Zip:	Morris Plains, NJ 07950
Date of ERP Review:	6/1/20

Emergency Response Preparedness (ERP) Checklist: ***(Click on PDF)***



SMP Attachment 17: Emergency Response Plan

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1. EMERGENCY PREPAREDNESS PLAN SCOPE:

Honeywell International Inc. (Honeywell) will provide a safe and healthy work environment. Consistent with policy, the following emergency action plan is developed for this site and will guide the actions taken by employees, management, and emergency coordinators. Emergency events addressed by this plan include building evacuation, fires, severe weather, medical emergencies, Bomb Threats or other facility-related emergencies that could endanger employees and/or visitors to this Honeywell location.

2. HSE HOTLINE REPORTING GUIDANCE:

Report all Injuries and Illnesses and Emergency Events addressed within this reporting procedure to the **Honeywell Hotline at (866-466-1765).** Early Post Injury Reporting with Immediate First Aid measures can reduce Injury Severity & Eliminate the need for Future Medical Care (Recordable Injuries).

3. DRILLS/TEST OF EMERGENCY PREPAREDNESS PLAN:

Familiarity with responsibilities and procedures must be thorough so that response to the plan is automatic. Each location is responsible for accomplishing at least one emergency situation drill every twelve (12) months. After accomplishing the emergency situations drill it must be documented on the Emergency Preparedness Drill Critique.

4. FACILITY IDENTIFICATION, DESCRIPTION, GENERAL INFORMATION:

Office Name/LID	**Board of Education Building**
Address	**22 Valley Rd, Montclair, NJ 07042**
Description of Bldg, Usage	**Administration Offices**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Montclair High School**
Address	**100 Chestnut St, Montclair, NJ 07042**
Description of Bldg, Usage	**High School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**George Inness Annex**
Address	**141 Park St, Montclair, NJ 07042**
Description of Bldg, Usage	**High School/Athletics**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Renaissance Middle School**
Address	**176 N. Fullerton Ave, Montclair, NJ 07042**
Description of Bldg, Usage	**Middle School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Glenfield Middle School**
Address	**25 Maple Ave, Montclair, NJ 07042**
Description of Bldg, Usage	**Middle School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Buzz Aldrin Middle School**
Address	**173 Bellevue Ave, Upper Montclair, NJ 07042**
Description of Bldg, Usage	**Middle School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Watchung Elementary School**
Address	**14 Garden St, Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Northeast Elementary School**
Address	**603 Grove St, Upper Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Hillside Elementary School**
Address	**54 Orange Rd, Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Edgemont Elementary School**
Address	**20 Edgemont Rd, Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Bullock Elementary School**
Address	**55 Washington St, Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Bradford Elementary School**
Address	**87 Mt. Hebron Rd, Upper Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Nishuane K-2 School**
Address	**32 Cedar Ave, Montclair, NJ 07042**
Description of Bldg, Usage	**Elementary School**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Pre-K/DLC**
Address	**49 Orange Rd, Montclair, NJ 07042**
Description of Bldg, Usage	**Pre-School Facility**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

Office Name/LID	**Woodman Field**
Address	**10 Essex Ave, Montclair, NJ 07042**
Description of Bldg, Usage	**Field House**
Location Description, Cross Streets, Directions	**Residential**
Facility Utilities, Nearby Buildings	**Residential**

5. EMERGENCY COORDINATOR INFORMATION

THE EMERGENCY COORDINATOR HAS PRIMARY RESPONSIBILITY FOR ASSURING THE IMPLEMENTATION OF THIS EMERGENCY PREPAREDNESS PLAN AND REQUIREMENTS STATED HEREIN. WHEN EMERGENCIES OCCUR, THE EMERGENCY COORDINATOR MAINTAINS PRIMARY RESPONSIBILITY FOR APPROPRIATE NOTIFICATIONS TO EMPLOYEES, HONEYWELL MANAGEMENT, MUNICIPAL EMERGENCY SERVICES (I.E. FIRE AND/OR POLICE DEPARTMENTS), AND OTHER AGENCIES OR SERVICES THAT MAY ASSIST IN MANAGEMENT OF THE EMERGENCY.

The alternate Emergency Coordinator serves in place of the Emergency Coordinator when the primary coordinator is unavailable. (It is recommended that these positions be filled with employees who are typically in the building for the majority of the workday.)

A. THE PRIMARY EMERGENCY COORDINATOR FOR THIS FACILITY IS:

Name	**John Eschmann**
Title	**Director of Buildings and Grounds – Montclair**
Office Phone	**973-509-4044**
Pager or Cell	
Alternate Phone	

B. THE ALTERNATE EMERGENCY COORDINATOR FOR THIS FACILITY IS:

Name	
Title	
Office Phone	
Pager or Cell	
Alternate Phone	

6. HONEYWELL CRISIS COMMUNICATION:

Major crisis situations often generate interest from the news media and require effective internal communications to address employee concerns. As soon as possible following a major crisis event, contact the Communications Leader to discuss the situation so appropriate internal and external communications plans and tools can be developed. Examples of such times where crisis reporting should be accomplished include the following:

a. Catastrophic facility damage caused by fires, storms, explosions, or earthquakes, tsunamis, accidents that may result in severe injury and threats or acts of violence or terrorism

b. Other unexpected events that have the potential to cause harm to Honeywell's employees, reputation, competitive positioning, or financial viability.

I. INTERNAL RESOURCE NUMBERS: It is always appropriate to contact the local site leader if they are not on-site at the time of the incident. Additionally, based on the nature of the event/injury it may also be necessary to contact other Honeywell personnel listed below:

	Name	Office Phone	Cell Phone
Local Site Leader(s)	Ian Hanley		973-222-0206
HSE Leader			
Facilities Manager			
HR Leader			
ACS Security Director			

- ❖ **Additional Links**
  - Corporate Communication Policy
  - Corporate Communication Contacts

II. EXTERNAL RESOURCES / EMERGENCY PHONE NUMBERS:

	Name	Phone
Police Department	Montclair Police Department	973-744-1234
Fire & Ambulance	Montclair Fire Department	973-744-5000
Building Landlord/Manager		
Other		

7. EMERGENCY EVACUATION SYSTEM:

A fire alarm will be used to alert employees within the building of fire or severe weather emergency or other need to evacuate the building or to seek shelter in place. In buildings that are not equipped with audible emergency alarms, employees will be alerted to other emergencies through direct verbal communication from the Emergency Coordinator(s) and/or designated alternate.

The Emergency Coordinator or designated alternate will make physical contact with employees who have sight or hearing disabilities to ensure that they are aware of the emergency.

a. BUILDING EVACUATION:

Evacuation of employees to a rally point outside of the building or to a refuge area within the building will be enacted whenever there is a threat to their safety or health because of an emergency condition. The refuge area shall be a safe area within the building away from windows where employees can gather, for example, in severe weather. The Emergency Coordinator is authorized to enact the evacuation of a particular room, floor, or the building.

- ✓ The designated rally point is:
  Specify: Outside front of the building near main road
  If the designated rally point is involved in the emergency, the alternate rally point will be:
  Specify: Outside rear of the building near main road
- ✓ The designated (indoor) refuge area is:
  Specify: TBD
- ✓ The Emergency Coordinator and Team will be responsible for accounting for all employees, visitors and contractors. If personnel are unaccounted for after conducting the headcount at the rally point, the Emergency Coordinator will be the designated person responsible for communicating with emergency services.
- ✓ Re-entry to the building will be coordinated through emergency services and the Emergency Coordinator. In the event of an incident preventing re-entry, the Emergency Coordinator will work with senior management, Facilities, and Health, Safety, Environmental (HSE) departments to assure the safety of the building and personnel.
- ✓ Injured personnel will receive medical care through the municipality's emergency response system.
- ✓ In the event an unplanned evacuation results from an actual site emergency, the Emergency Coordinator shall ensure appropriate notifications are made to site leadership.
- ✓ A diagram or description of the evacuation routes, exit doors, rally points and refuge areas are posted:
  Specify:
  The designated exit doors for this facility are (list exit doors).
- ✓ Know the locations of your building evacuation route, outdoor rally point, and indoor refuge area before an emergency occurs by reviewing the posted/attached instructions and/or evacuation map.

8. MEDICAL EMERGENCY:

Remember to report all injuries no matter how minor to your manager and HSE leader immediately and the **Honeywell Hotline at (866-466-1765).** *Never enter into a medical emergency area unless you are sure*

there are no hazards present. Scan the area visually, overhead as well, to ensure that there are no physical dangers present. We do not want to delay the initial medical emergency response nor do we want to provide additional responses to would-be rescuers. Never move or attempt to render any assistance that could impact greater injury to the already injured victim.

The following steps to be taken in the event of an on-site medical emergency:

a. *Immediately contact First Aid personnel and dial 9-911 for assistance, such as loss of consciousness, uncontrolled bleeding, potential heart attack or stroke and give exact location and nature of the emergency.*

b. *Remember, when First Aid arrives, they are in charge. Persons in the immediate area should be limited to only those identified by the First Aid Attendant. The First Aid Person will provide direction and course of action.*

c. *If further medical assistance is required, the First Aid Attendant or designate will contact dial 911 and request an ambulance be dispatched*

9. FIRE EMERGENCY (Evacuate and call 9-911):

To protect yourself, it is important to understand the basic characteristics of fire. Fire spreads quickly so there is no time to gather valuables or make a phone call. In just two minutes, a fire can become life-threatening. In five minutes, a residence can be engulfed in flames. Heat and smoke from fire can be more dangerous than the flames. Inhaling the super-hot air can sear your lungs. Fire produces poisonous gases that make you disoriented and drowsy. Asphyxiation is the leading cause of fire deaths, exceeding burns by a three-to-one ratio.

a. Protective Measures for Fires:

- ✓ Insure smoke alarms are installed, tested and cleaned in accordance with applicable instructions.
- ✓ Ensure Fire Suppression Systems are maintained and tested in accordance with applicable instructions.
- ✓ Ensure Fire extinguishers are in place and serviceable.
- ✓ Accomplish Annual Emergency Fire Drills to prepare employees.

b. Escaping the Fire:

- ✓ Review escape routes with personnel and practice escaping from each room.
- ✓ Ensure security doors and other antitheft mechanisms that could block outside window entry are easily opened from the inside.
- ✓ Remain low to the floor (where the air is safer in a fire) when escaping from a fire.
- ✓ Clean out storage areas. Never allow trash, old newspapers, boxes or magazines to accumulate.

c. Flammable Items:

- ✓ Never use gasoline, benzene, naphtha, or similar flammable liquids indoors.
- ✓ Store flammable liquids in approved containers in well-ventilated storage areas.

d. Fire sources and smoking:

- ✓ Never smoke near flammable liquids
- ✓ Smoke only in designated smoking areas as described below:

Specify: None

Provide deep sturdy ashtrays or outdoor approved cigarette/cigar disposal cans.

e. Heating Sources

- ✓ Be careful when using portable heating sources.
- ✓ Ensure space heaters are at least three feet (1 meter) away from combustible materials.
- ✓ Ensure Portable heating devices have a tilt shutoff as well as a timer shutoff.
- ✓ Always unplug Portable Heating Devices when not in use.

f. Electrical Wiring:

- ✓ Ensure electrical wiring is not exposed.
- ✓ Never Daisy Chain extension cords.

- ✓ Inspect extension cords for frayed or exposed wires or loose plugs.
- ✓ Make sure outlets have cover plates and no exposed wiring.
- ✓ Make sure wiring does not run under rugs, over nails, or across high-traffic areas.
- ✓ Do not overload extension cords or outlets. If you need to plug in two or three appliances, get a UL-approved unit with built-in circuit breakers to prevent sparks and short circuits.

g. During a Fire If your clothes catch on fire:

- ✓ Stop, drop, and roll until the fire is extinguished.

10. TERROIST / BOMB / BIOLOGICAL / CHEMICAL / RADIOLOGICALTHREAT EMERGENCY:

a. Remain calm, listen carefully and record the following details:

- ✓ *Time the call was received,*
- ✓ *Details of the threat (Where is the bomb or When it is expected to explode),*
- ✓ *Details of the caller (voice tone – angry, joking, sarcastic, quiet, business-like),*
- ✓ *Background noise (car noise, street noise, television, radio),*
- ✓ *Time the call ended*
- ✓

b. Notify Local Police Department, Honeywell Management and Security immediately.

Bomb, Chemical and/or Biological Threat Guideline

Detailed DESCRIPTION OF CALLER'S VOICE	***Ask the below EXACT WORDS upon BOMB THREAT***
Male_____Female_____ Young_____Middle Aged_____Older_____ _____ Calm _____Nasal _____ Angry _____Stutter _____ Excited _____Lisp _____ Slow _____Raspy _____ Rapid _____Deep _____ Soft _____Cleared Throat _____ Loud _____Deep Breathing _____ Laughter _____Cracked Voice _____ Crying _____Accent _____ Normal _____Familiar _____ Slurred _____Disguised BACKGROUND SOUNDS _____ Street _____Factory _____ Animal _____Clear _____ Voices _____PA System _____ House _____Traffic _____ Other *THREAT LANGUAGE* _____*Well spoken*_____*Incoherent* _____Foul/ Irrational_____Read Message?	*1. Where is the device right now?* *2. What does it look like?* *3. What kind of a device is it?* *4. Why are you doing this?* *5. What is your name?* 6. Are you part of an organization? *7. Why are you warning us?* 8. What will cause it to activate?
*Person receiving call*_____*Time Caller hung up*_____ *Phone number at which call was received*_____*Date*_____	

11. HAZARDOUS CHEMICALS:

If applicable, identify and list below all hazardous chemical quantities stored on site. Otherwise state "Not Applicable" to this location.

✓ **Inside and/or outside locations: Not Applicable**
✓ **Quantities of hazardous materials:**

- ✓ **Physical and/or chemical hazards, i.e., asphyxiation hazards**
- ✓ **Hazardous material properties, i.e. flammability, toxicity. Reference location of Safety Data Sheets**

12. INTERNAL HAZARD / CONTROL MEASURES:

Include in this section any process operations that may fail during an emergency event.

Possible Failures	Emergency Control Measure Description

The following are examples of process operations that are addressed in the procedure, but do not need to be part of this section if not applicable to your location: *(Truck/railcar deliveries, transfer of materials, utilities, pollution control devices, control rooms, pipelines, control valves, ventilation systems, boilers, pressure vessels, security access controls, fire protection systems, identify existing engineering control measures to avoid release of hazardous materials).* However, if applicable, prepare emergency control measures for each potential failed process that may apply to your location.

13. EMERGENCY DRILL REQUIREMENTS

a. *Annual Emergency Evacuation Drills*

- ✓ *Drills must be accomplished annually and include different types of Emergency Scenarios as outlined in this Emergency Preparedness Plan*
- ✓ *Upon completion of the Emergency Evacuation Drill use the Critique Form to Document Drill.*
- ✓ *In accordance with Corporate Policy,* once the Emergency Evacuation Drill is complete, forward the Critique Form to regional HSE Manager for entry into the Corporate Event Tracking System.

b. *Annual AED Emergency Drill*

- ✓ *If a location has more than 200 employees an AED is required.* Before making the determination to purchase an AED, contact your Regional Safety Manager.
- ✓ Locations with AEDs must conduct AED drills at least annually on all shifts where AED trained personnel are present. These drills must be documented and must measure the actual response time.
- ✓ When AED drill response times are greater than or equal to 5 minutes, the organization must create a corrective action plan to reduce the response time to less than 5 minutes. *This action plan must be documented in the Corporate Event Tracking System by the HSE Manager*. Corrective actions must include a mechanism for ensuring the response time of 5 minutes or less is met.

14. NATURAL DISASTERS:

a. TORNADO EMERGENCY:

I. Tornado Terms:

- ✓ **Tornado Watch:** Means Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- ✓ **Tornado Warning:** A tornado has been sighted or indicated by weather radar. Take shelter immediately.

II. Protective Measures before and during a Tornado:

- ✓ Listen to NOAA Weather Radio or to commercial radio or television newscasts for the latest information & remain alert.

- ✓ Look for approaching danger signs such as a dark greenish sky or dark low-lying cloud with rotation or evidence of large hail.
- ✓ Listen for a loud roar, similar to a freight train.
- ✓ If you see approaching storms or any of the danger signs, be prepared to take shelter immediately or if you're under a tornado WARNING, seek shelter immediately!
- ✓ If inside an enclosed structure such as a small building, school, nursing home, hospital, factory, shopping center or high-rise building, go to a pre-designated shelter area such as a safe room, basement, storm cellar, or the lowest building level. If there is no basement, go to the center of an interior room on the lowest level (closet, interior hallway) away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside. Get under a sturdy table and use your arms to protect your head and neck. Do not open windows.
- ✓ If outside with no shelter lie flat in a nearby ditch or depression and cover your head with your hands.
- ✓ Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.

b. HURRICANE/CYCLONE EMERGENCY:

I. Hurricanes Terms:

- ✓ **Hurricane/Cyclone and Tropical Storm Watch**: Hurricane/tropical storm conditions are possible in the specified area, usually within 36 hours. Tune in to NOAA Weather Radio, commercial radio, or television for information.
- ✓ **Hurricane/Cyclone and Tropical Storm Warning**: Hurricane/tropical storm conditions are expected in the specified area, usually within 24 hours.

II. Hurricane/Cyclone Protective Measures before and during a Hurricane:

- ✓ Make plans to secure property by closing all windows, doors and roof vents if possible.
- ✓ Determine a safe room / location for shelter.
- ✓ Listen to the radio or TV for information.
- ✓ Turn off utilities if instructed to do so.
- ✓ Evacuate building if directed by local authorities and be sure to follow their instructions.

c. EARTHQUAKE EMERGENCY:

I. Protective Measures before and during an Earthquake:

- ✓ *Keep your cool, avoid panic and confusion and ride out the motion.*
- ✓ *Take cover under a sturdy desk, table, or bench or against an inside wall, and hold on. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.*
- ✓ *Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.*
- ✓ *Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load bearing doorway.*
- ✓ *Remain inside until shaking stops and it is safe to go outside. Most injuries during earthquakes occur when people are hit by falling objects when entering into or exiting from buildings.*
- ✓ *Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.*
- ✓ *Do not use elevators during an Earthquake.*

II. Post Earthquake Protective Measures: *Being prepared for aftershocks are extremely important. Even though secondary shockwaves are usually less violent, they can be strong enough to cause additional damage to already weekend structures.*

- ✓ *Check for injuries amongst those around you. Notify First Aid of injured persons as soon as safe to do so. Do not move the seriously injured unless they are in immediate danger. Try and keep the injured warm.*
- ✓ *Contact local emergency resource centers such as the hospital or fire department as required for injuries or fire concerns or call 9-911.*
- ✓ *Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or relief organizations*
- ✓ *Listen for sounds or smell of leaking gas and exit building if the smell of gas apparent.*
- ✓ *Be aware of possible tsunamis if you live in coastal areas. These are also known as seismic sea waves (mistakenly called "tidal waves"). When local authorities issue a tsunami warning, assume that a series of dangerous waves is on the way. Stay away from the beach.*
- ✓ *Always open cabinets cautiously as objects may have shifted causing falling hazards.*
- ✓ *Never leave the worksite area unless you have advised your Site Manager. You may be jeopardizing your safety (bridge or road damage, et cetera) as well as create traffic congestion for emergency vehicles.*
- ✓ *If evacuation is ordered, leave by the nearest emergency exit and report directly to your designated assembly/rally point.*

d. VOLCANO EMERGENCY:

I. Protective Measures before and during a Volcanic Eruption:

- ✓ Monitor local radio stations and News Broadcasts
- ✓ Ensure the building / office ventilation system is turned off. This will keep ash particulates from entering building.
- ✓ Cover sensitive equipment with plastic sheets to keep ash particulates from entering parts.
- ✓ Evacuate immediately from the volcano area to avoid flying debris, hot gases, lateral blast and lava flow.
- ✓ Wear long-sleeved shirts and long pants.
- ✓ Use goggles and war eyeglasses instead of contact lenses.
- ✓ Use a dust mask or hold a damp cloth over your face to help with breathing.
- ✓ Stay away from areas downwind from the volcano to avoid volcanic ash.
- ✓ Stay indoors until the ash has settled unless there is a danger of the roof collapsing.
- ✓ Close doors, windows and turn off all ventilation systems.

e. TSUNAMI EMERGENCY:

I. Understanding Tsunamis Terms:

- ✓ Advisory: An earthquake has occurred in the Pacific basin, which might generate a tsunami.
- ✓ Watch: A tsunami was or may have been generated, but is at least two hours travel time to the area in Watch status.
- ✓ Warning: A tsunami was, or may have been generated, which could cause damage; therefore, people in the warned area are strongly advised to evacuate.

II. Tsunami Protective measures before and during a tsunami event:

- ✓ Turn on your radio to learn if there is a tsunami warning if an earthquake occurs and you are in a coastal area.
- ✓ Move inland to higher ground immediately and stay there.
- ✓ **Visual Indication of Imminent Tsunami** - Strong Earthquake lasting 20 seconds or more where it is difficult to stand or walk or the water level at the beach begins receding / being pulled back into the ocean.

15. Insert PDF of Building Evacuation Map and Location of Fire Extinguishers on Following Page

